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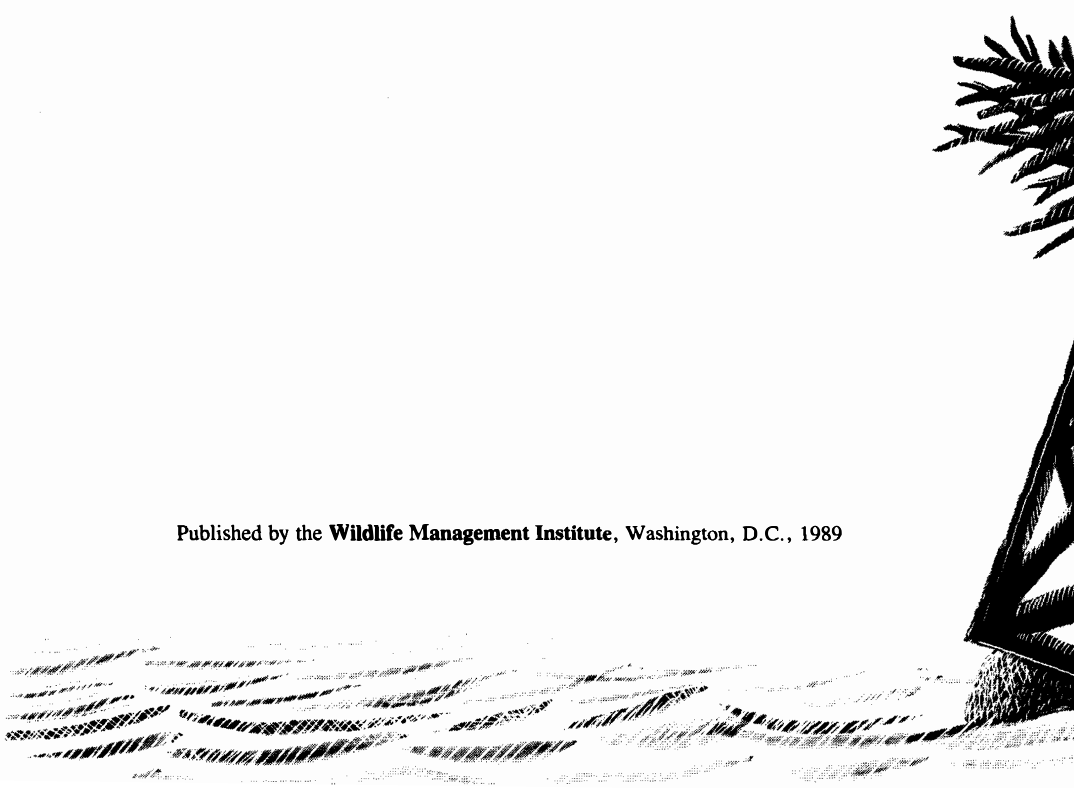

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Executive Vice-President
International Association of Fish and Wildlife Agencies
Washington, D.C.

Opening Remarks

Laurence R. Jahn
President
Wildlife Management Institute
Washington, D.C.

Good morning, ladies and gentlemen. Welcome to the 54th North American Wildlife and Natural Resources Conference. We gather here in the U.S. capital as President Bush's administration and the new (101st) Congress are getting their players in position, and as new strategies and initiatives are being molded to come to grips more effectively with natural resource, economic and other U.S. and worldwide problems.

As the human population expands in numbers and activities, concerns have magnified over the health of lands, waters, wild living resources and sustained yield of citizen benefits from the resource base. Emphasizing the need to realign how natural resources are viewed, used and managed is a continuing stream of reports on excessive soil erosion, degradation of surface waters and groundwaters, loss of wetlands, reduced growth rates of trees, single-purpose management of forests, abuse and irresponsible conversion of western rangelands, and other degradations of the quality of life.

Integrated management of natural resources designed to place uses of those resources on a firmer foundation is being advanced through realignment of a number of laws and management policies. As we celebrate the 20th anniversary of the National Environmental Policy Act this year, additional initiatives are being called for and supported by the public.

New emphasis on integrated management of natural resources is being advanced for two principal reasons: (1) to place uses of natural resources on a sustainable, rather than an exploitable basis; and (2) to curtail mounting taxpayer expenditures and prevent future costs of restoring natural resources following their degradation or destruction. Currently, taxpayers face increasing costs to clean-up contaminated sites, correct soil erosion, restore water quality, and rebuild populations of fish and wildlife, especially threatened and endangered species.

In all of these situations and more, it is imperative to recognize the dominate influence of people on natural resources. Management objectives and guidelines must be viewed as essential to husband and perpetuate the public values and services of the resource base as human actions are carried out. This approach requires sensitive, integrated management of natural resources and human activities. With such requirements, alternatives to prevent adverse impacts to resources can be identified and implemented.

Just as this Conference is focusing on "Strategies for Meeting Natural Resource Needs," so is the new Congress. Hearings have been scheduled on global issues, including:

- Ozone depletion in the Arctic and Antarctic due to man-generated chemicals, and its implications for health of organisms, including people;
- The "greenhouse effect" and global warming, with its potentially serious impacts by way of major climate changes, altered patterns of food production, projected rise in sea levels and accelerated coastal erosion; and
- An array of coastal issues involving degradation of some of the world's most productive aquatic areas resulting from increasing inflows of nutrients, sediments and hazardous materials.

Fish, wildlife, economic and quality of life losses have been substantial and, without new management strategies and procedures, will grow larger.

The U.S. Congress and legislative bodies in other countries are at the drawing boards to address these global problems and others. Their first step is to develop a framework of scientific facts within which new realistic management strategies and plans can be crafted to resolve the problems through adjustments of human impositions and activities.

Increasing recognition of the need for broad realignment of man/air/land/water/wild living resource relationships prompted new U.S. Federal agricultural programs in the Food Security (Farm) Act of 1985. For the first time in a half-century, a strong and practicable conservation dimension was integrated into federal food and fiber commodity programs to correct excessive soil erosion, degraded water quality and inadequate wildlife habitat, and place agricultural land use on a more sustainable basis. While progress is being made under the 1985 Farm Act, new strategies and procedures await identification in the 1989–1990 farm bill to make additional advances. Attention is especially needed to correct and prevent widespread water quality problems and bridge the transition in realigning landowner financial incentives or rewards.

One new strategy demonstrates clearly that a conservation dimension can be integrated into economic programs, domestically and internationally. The U.S. Farmers Home Administration is authorized to use conservation easements of 50 or more years to help farmers reduce their heavy and frequently delinquent debts on loans closed before Christmas 1985. The primary intent is to minimize government farm-loan losses, while allowing debt-overloaded farmers to continue living on the land. These new procedures hold much promise to benefit indebted farmers, taxpayers and natural resources. Easements that maintain wetlands, floodplains and other critical areas help build public assets rather than contribute to government deficits.

Landowners in the northcentral U.S., for example, combined efforts with appropriate federal and state agencies to help themselves, as well as conservation programs, through hundreds of conservation easements in the first year of the program. These debt-reduction, conservation-benefiting arrangements are stimulating new teamwork among government agencies. Similar swaps also are being advanced internationally in countries such as Brazil, to link debt relief to maintaining tropical forests. More such economic/conservation, private/public benefit strategies and procedures await imaginative and practical design by you and others.

A first-order challenge is to realign the proportion of the U.S. federal budget allocated to natural resources. Traditionally, it has been small—less than 10 percent. In recent years, it has been shrinking even smaller. And threats continue to divert the flow of federal aid dollars away from needed fish and wildlife programs. Despite deficits, a concerted effort must be made to enlarge investments in natural resources to ensure environmental and economic conditions that provide sustained quality life for people. Decision makers must be encouraged to satisfy that goal.

President Bush's pledge of no net loss of wetlands, combined with recently announced goals of the Environmental Protection Agency to implement that welcome commitment, provides hope that ways to maintain and restore wetlands will be strengthened. What remains to be defined is a more efficient procedure that perpetuates the tremendous public benefits and values of wetlands. Inefficiencies and frustrations with existing federal permit (section 404 dredge-and-fill) and disincentive (swampbuster) programs emphasize that something more is needed immediately. A reasonable process is required for landowners proposing developments involving wetlands.

The three-point legal presumption/rebuttal/appeal system used in Massachusetts, Florida's Southern Water Management District and Canada for fish habitats should be authorized and implemented in every state, territory and province to maintain wetlands. This system holds promise for developing an integrated national/state/local partnership to maintain wetlands more effectively. This and other new procedures need to be implemented promptly.

There are no substantial reasons to continue converting wetlands to agricultural commodity production—actions that claimed 87 percent of the U.S. wetlands lost in two recent decades (1950s–1970s). The U.S. Department of Agriculture reports that food and fiber needs well into the twenty-first century can be provided without sacrificing important aquatic areas. Recent estimates project removing 100 million acres or more from crop production. Obviously, there is no need to convert more wetlands and woodlands to commodity production. New procedures must replace outdated taxpayer-subsidized commodity production and market mechanisms that fail to perpetuate wetlands.

Both the U.S. and Canada are realigning their agricultural programs to place uses of land and water on a sustained basis. In the process, provisions should be and, in some cases, are being incorporated to help achieve objectives of the 1986 North American Waterfowl Management Plan. While the emphasis is on maintaining and restoring wetlands, continental drought continues to depress wildfowl population recovery—hopefully only temporarily. North America's duck populations are at the lowest ebb in history, and need effective teamwork assistance.

Part of that restoration effort will involve enlisting greater cooperation of citizens in curtailing the illegal take of waterfowl and other wildlife. Large-scale arrests, confiscations, fines and jail sentences for taking wildlife and fish illegally remind us that additional attention is needed to promote ethical restraint. New approaches are needed to enlist cooperation from more individuals to reject and report illegal activities. State and federal conservation law enforcement officers need such helpful assistance to identify, root out and prevent violations. A joint resolution in the U.S. Congress (H.J.Res. 100) seeks to halt the illegal taking of migratory waterfowl. Violations against wildlife and the habitat that supports them (and us) cannot be tolerated.

It is obvious that people's uses of and impacts on natural resources must be reexamined and realigned to ensure they perpetuate ecological processes and are economically sound. New ways are needed to eliminate inconsistencies in government programs. Technical assistance and financial rewards or incentives—using taxpayer dollars—must be rearranged to promote and achieve sustained-yield, multiple-benefit uses of natural resources. Our pressing task is to reorient institutional and administrative procedures and practices to do what is right and necessary to achieve that goal.

The fine cadre of speakers and discussions in the next three days will provide ideas for generating opportunities, strategies and procedures for integrated management to place human uses of the resource base on a sustainable basis. The needs are large. Sensitive responses must chart our course for the 1990s and the twenty-first century.

Stewardship: Our Conservation Agenda

The Honorable Manuel Lujan, Jr.
Secretary
U.S. Department of the Interior
Washington, D.C.

I am very happy to be with you today for the North American Wildlife and Natural Resources Conference. I know that many of my predecessors as Secretary of the Interior had the great opportunity to address previous North Americans here in Washington. It is indeed a great privilege to carry on that tradition. As you all know, I am fairly new at my job. From my years in Congress, I was sure that I had a thorough knowledge of the Department. And I did. But my knowledge and viewpoint was as a Representative. Now, as Secretary, I am learning things about the Department that one could never learn by being on the Hill.

As part of this educational process, I recently visited some parks and refuges in Florida. The staff at Everglades National Park graciously provided me an opportunity to go fishing. I asked them: "Can you guarantee me a 13-pound bonefish like the President caught?" The Superintendent hesitated a moment, and I could tell he was uncomfortable. And at last he said: "Mr. Secretary, a 13-pound bonefish is . . . well . . . it's the Presidential size. . . . For Cabinet members, however, we do have some 11 pounders."

Believe me, I am not criticizing the Park Service. After all, the Fish and Wildlife Service in Florida had a lot worse news about the high level of mercury found in bass near their refuges. Seriously, I was very pleased with the great professionalism I found among both agencies on my visit there last week.

I took this job because President Bush asked me. I hope all of you realize what strong supporters both President Bush and I are of fish and wildlife programs and projects that benefit our nation's sportsmen. His decision to remove the proposed cap on the Pittman-Robertson and Wallop-Breaux funds offers convincing proof of his interest and support. I am very excited about where we are going under President Bush's leadership. It is a time of new ideas and new faces at Interior.

What are some of my goals? What would I like to achieve? I will share a few of those with you today. First, I want to help in the international effort to promote the "no net loss of wetlands" on this continent. Recognizing that the North American Waterfowl Management Plan is a very promising long-term conservation initiative, I am especially encouraged to know the federal, state and local governments, private conservation clubs, and sportsmen groups are working together in a common cause. I believe these partnerships are crucial for effective conservation of our nation's natural resources.

I spoke recently with the new EPA administrator, Bill Reilly, and was able to convey to him how committed Interior has been and will continue to be in the cause of wetland conservation. Moreover, I told him that Interior stands ready to do its utmost in preserving and restoring these important habitats.

I am a great believer in stewardship. That's what this job is all about. I believe in wise use and conscientious care of our resources. But I believe the very best way to accomplish our conservation goals is through informed consensus and cooperation. I an very pleased that the Bureau of Land Management is working with groups such as Trout Unlimited to help restore degraded streams and riparian areas on our public lands.

The Bureau of Reclamation is, as you know, embarked on a new course. The major shift in its role announced in the past two years offers the Bureau an opportunity to expand its conservation role. It has a great opportunity to address a wide range of fish and wildlife needs as well as human needs. I encourage the Bureau's research endeavors and field applications in this area.

The National Park Service is one of this country's most recognized government agencies. But it has endured a very trying year. Natural disasters have led to some public misunderstanding and confusion about the Park Service's role. To help rectify that, I am requesting the National Park Service to aggressively expand and improve its resource management capabilities. As you know, the President and I both support continued acquisition of new parklands and wildlife refuges. The President's budget requests $206 million dollars from the Land and Water Conservation Fund for additional recreation and land acquisition in fiscal year 1990.

I am a great believer in harmony—in productive cooperation. That's why, as a Congressman, I supported the challenge cost-sharing concept. I know the Forest Service, Bureau of Land Management, and Fish and Wildlife Service have become quite active in seeking to utilize this method to maximize their efforts. I am glad you are taking a detailed look at this relatively new funding approach during this Conference and will be interested in reviewing your findings.

Finally, I want to assure that all of us on the new Interior team will seek to further the policy of good cooperation with all of you who are involved in natural resource management. I will advise each of my new bureau directors and assistant secretaries that productive cooperation among all interest groups will be the guiding principle in our management policies.

I thank you for the opportunity to meet with you here at the North American Conference. I know we are going to get to know each other a lot better over the coming weeks and months. My door will be open to you and I will always listen to your views. You are resource professionals and I value your comments on how we in the federal government are managing our lands and waters and wildlife. I look forward to working with you in the future.

Resolving Resource Problems in the Next Decade

The Honorable George J. Mitchell
Majority Leader
United States Senate
Washington, D.C.

Fifty-three years ago, President Franklin D. Roosevelt issued the call for a new North American Wildlife Conference to succeed the 21 prior meetings of the American Game Conference. In so doing, the President emphasized that problems in wildlife restoration and conservation were not merely local or even national, but international. "My hope," he wrote, "is that through this conference a new cooperation between public and private interests, and between Canada, Mexico, and this country will be developed."

These words were written at a time of great economic stress in this nation and crisis in natural resources. The two problems are inseparable.

As the great conservationist Ding Darling told that first North American Conference: "Wealth will continue to exist on this continent only so long as the natural resources of our soil and water continue to yield up their riches. When these are gone," he said, "prosperity, standards of living and happiness among our people will vanish with them."

Darling described our continent's natural resource problems in the 1930s this way:

"The Connecticut River," he said, "is foul with sludge and oily slime-waste.

"The Great Lakes, once the world's greatest fresh-water reservoirs of what might have been a perpetual source of food and employment, have been wantonly depleted.

"Four hundred million acres of public lands under Federal administration are with legalized custody of wildlife.

"Three States out of every four are without adequate technical staffs to administer the meager funds which are allocated for their use.

"There are not enough migratory waterfowl and songbirds and one of the chief reasons for the deficiency is the useless destruction of nesting grounds and native habitat."

And finally he noted that there were no schools or textbooks or enough teachers adequately prepared to furnish well-rounded courses in wildlife management. Darling painted a dismal picture.

It cannot be said that we have been unresponsive to these problems or that we have failed to heed the calls for action by President Roosevelt, Ding Darling and others. To the contrary, we have invested substantial resources during the past half-century and have made some progress in resolving our natural resource problems. The Clean Water Act, the Clean Air Act, the Endangered Species Act, the Emergency Wetlands Resources Act and many other laws enacted over the past five decades demonstrate the commitment by our society to conservation of natural resources.

That commitment has paid very real dividends. Atlantic salmon have returned to the Connecticut River. Our laws now require consideration of fish and wildlife resources in the management of federal lands. The federal excise taxes collected under the Pittman-Robertson, Dingell-Johnson and Wallop-Breaux programs, which this year will exceed $300 million, have provided a stable foundation for the development of state fish and wildlife agencies. More than a thousand students now graduate each year with wildlife degrees from nearly 100 colleges and universities.

Nor have we focused only on the problems within our own nation's political boundaries. Our actions have acknowledged that the international cooperation called for by President Roosevelt is essential to prevent one nation from frustrating the conservation objectives of other nations.

On the final day of the first North American Wildlife Conference, the United States and Mexico concluded a convention on the protection of game animals and migratory birds. In the decades that followed, we signed treaties with the other nations with which we share our migratory bird resources—our neighbors in Central and South America, and Japan and the Soviet Union. Through the Convention on Great Lakes Fisheries, the United States and Canada have worked to restore the biological productivity of these waters.

The United States was the first of 95 nations to ratify the Convention on International Trade in Endangered Species. This treaty, which most of the world knows as the Washington Convention, seeks to ensure that trade will never be a contributor to the extinction of any species. In 1986, the Senate ratified the Ramsar Convention on Wetlands of International Importance to stem the progressive encroachment on, and loss of, wetlands. More recently still, 34 nations, including the United States, agreed to curb the emissions of chlorofluorocarbons which are depleting the Earth's protective layer ozone.

Despite our efforts to heed the warnings of the natural resources crisis of the 1930s, there is increasing evidence that the progress we have made is being overtaken by events. In 1970, when the first comprehensive Clean Air Act was signed into law, Americans registered 108 million cars and drove 900 billion miles. In 1987, we registered 177 million cars and drove more than 1.7 trillion miles, with no decline in sight. The United States now consumes more energy, and thus produces more sulfur dioxide and oxides of nitrogen, per unit of Gross National Product than any other developed nation. Sulfur dioxide and oxides of nitrogen combine to form the acidic precipitation that has damaged forests, lakes and streams and the aquatic life that inhabit these waters.

More and more Americans are directly experiencing the consequences of our high energy consumption. In the Washington, D.C. metropolitan area last summer, 34 summer days exceeded the occupational standard for air quality. It would have been illegal to expose a factory worker to the kind of air Washington residents breathed, and children played in, for over a month last summer.

Recently released EPA data indicate that 15 million *more* people are exposed to unhealthy levels of ozone after last summer. This means 150 million Americans are living in areas where it is unhealthy just to breathe the air. These and other environmental problems are no longer confined to this continent or this hemisphere. They reach to the most remote corners of this Earth.

The fossil fuels that we burn add large quantities of carbon dioxide not just to our air but to the atmosphere surrounding all of our globe. Population growth and economic development go hand in hand and lead inevitably to an enormous worldwide rise in the combustion of these fuels. At the same time, this growth is reducing the Earth's ability to absorb that carbon dioxide.

Twenty-seven million acres of tropical forest are being cleared each year to accommodate the expansion of population development. The belt of vegetation at the tropics is the densest in the world. Its destruction leaves carbon dioxide unabsorbed in the atmosphere, where it stops the heat of the earth's surface from radiating back into space, just like the glass of a greenhouse traps the sun's warmth. The result has been that our over-loaded planet is sending distress signals.

This decade has seen the highest average temperatures recorded—in a century of rising temperatures. A NASA scientist testified before Congress last year that it is a 99-percent probability that last summer's extreme heat and drought marked the perceptible start of the greenhouse effect.

Tropical deforestation not only is changing the Earth's climate, it also is destroying the priceless genetic heritage of our world. The British conservationist Norman Myers has asserted that the loss of tropical forests during the next two decades could cause the extinction of several hundred thousand species of plants and animals.

Extinction is irrevocable. Nothing we can do, no computer, no mechanical ingenuity can ever duplicate even a single one of the simplest forms of life that are being wiped from the face of the earth. Professor Edmund Wilson, of Harvard, says that the one truly catastrophic event of these decades is the loss of genetic and species diversity. ''This,'' he testified, ''is the folly our descendants are least likely to forgive us.'' He is right.

But it is not merely folly. It is an unforgivable dereliction of our duty to the natural earth and to our descendants. ''[I]t is worth remembering that a butterfly is far more complicated than any machine ever constructed by man,'' the Professor said. And he was right.

Once diminished by the loss of a species, our Earth shrinks; its future is narrowed; and humanity itself is diminished. Many practical persons believe that our moral duty is only to our own species, not to others. They insist that human needs, human comfort and human development can and should take precedence. To those practical persons, I can only answer that mankind is part of the natural order of the world.

Chemical substances of plants heal the bodily ailments of human beings. It is estimated that the active ingredients of fully 40 percent of all medical prescriptions written in our nation are derived from plants. Who can measure the human pain eased and the human benefits gained from these plant derivatives? And who can predict, today, which of the obscure plants and insects being decimated yearly may hold the genetic key to the next medical miracle? The forests of the tropics contain volumes of such valuable genetic information.

Our closest counterparts to this library of nature in North America are our wetland ecosystems. They are our most biologically productive areas, and roughly a third of all endangered species of animals are dependent on them. And like the tropical forests, we have subjected our wetlands to much destruction.

From the mid-1950s to the mid-1970s, we drained, filled and cleared 9 million acres of wetlands in the 48 conterminous states. Less than half of the original 200 million acres remain, and the destruction continues today at a rate of half a million acres per year—an area 12 times the size of the District of Columbia. Total wetlands loss in the Canadian prairie provinces of Alberta, Saskatchewan and Manitoba is estimated to be 40 percent of the original wetlands acreage.

The destruction of wetlands in North America, where many migratory birds species breed, and the likely greenhouse-induced drought, spells disaster for these species just as surely as the destruction of forests in Central and tropical South America, where they winter. The average number of North American ducks in recent years has been lower than any comparable period on record. Thirteen of some of our most abundant and widespread songbirds, like the American goldfinch and the eastern meadowlark, have declined at an average rate of nearly 3 percent per year over the past 20 years.

Ding Darling bluntly told the participants at the 1936 meeting of this Conference that "whatever we may have been doing is not wildlife conservation, since we continue to have less instead of more." Unfortunately, the same could be said today with respect to the job we have been doing in conserving our migratory birds and many other natural resources. We have got to do better.

When the Senate reconvenes in April, I will introduce legislation to protect, enhance and restore North American wetland ecosystems and the migratory birds and other fish and wildlife that depend on these habitats. One of the principal goals of this legislation will be to begin a long-term commitment to work with Canada and Mexico in implementation of the North American Waterfowl Management Plan. According to the U.S. Secretary of the Interior and the Canadian Minister of the Environment, the Plan is "the best opportunity we will ever have" to halt the decline of many species of ducks, geese and other migratory birds. The goal, which we hope to achieve by the year 2000, is to restore the continent's waterfowl not to the numbers that existed in the 1950s, but only to the lower levels of a decade ago.

The extent of habitat destruction has been so great that even achieving this modest target will require an unprecedented cooperative strategy to conserve nearly 2 million acres of wetland ecosystems in the United States and almost 4 million acres of these habitats in Canada. The key to the success of this undertaking will be the participation not only of the national governments of our countries, but also the involvement of state, provincial, territorial and local governments, and private individuals, conservation organizations and businesses.

The North American Wetlands Conservation Act, which I intend to sponsor, will provide federal funding to encourage these public and private partnerships for wetlands conservation projects in Canada and Mexico as well as in the United States. This is a beginning.

The new effort I have described must go hand in hand with increased efforts to stem the rate of wetlands destruction through regulatory and other means. Added incentives and controls must be found for protection of the public benefits provided by the many privately owned wetlands. Next, we must look toward greater implementation of the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere. The framework provided by this accord for conservation efforts in the Caribbean and Central and South America is critical to the well-being of many of the world's migratory birds.

It is well past time to begin carrying out the habitat protection provisions of the migratory bird treaties with Japan and the Soviet Union, which were ratified by the Senate over a decade ago. The Supreme Court reminded us in 1983 that "the protection of migratory birds has long been recognized as a national interest of very nearly the first magnitude." Our efforts to care for this resource should better reflect the magnitude of that interest.

The solutions to the problems of air pollution and global climate change are no less straightforward or more overwhelming than the remedies available to conserve migratory birds. For we have found that just as neglect of pollution controls means dirtier air, emphasis on controls can mean cleaner air. We are suffering from a manmade phenomenon that can be controlled. We have developed the technologies of control. We have the resources to apply those technologies. Until now, we have lacked the political will to do so. We must now develop that will. Air pollution is not just a regional problem, not just an industry problem, not just something that affects people in the United States or in Canada. Air pollution is a worldwide problem. It affects all of us.

Within our own country, a solution that penalizes one region, or one segment of industry, would be unfair and unrealistic. We have an integrated national economy. None of our regions can thrive in isolation or in opposition to others. A policy that imposes huge job losses in West Virginia or Ohio or Kentucky is no more acceptable than a policy that imposes heavy pollution damage on Maine or Vermont or North Carolina.

A solution will impose costs on all of us, just as a failure to act imposes damage on all of us. The issue is no longer how each of us can best avoid our share of these costs. The issue is how to fairly apportion those costs and reduce that damage to our health and to our environment. We must confront this problem together. We must work together to solve it. And we will solve it.

We will have a vote on Clean Air Act legislation in this Congress. The crucial juncture in policy making is when it becomes clear that the risk of inaction is greater than the risk of action. We are now clearly past that point. We must acknowledge that we have been conducting an enormous chemical experiment with our world. And we still cannot predict how it will come out. But we have learned in this century that life on our planet, and the atmosphere which surrounds it, exists in a fragile balance that is all too easily disrupted.

It is time to use what knowledge we have on hand and act to halt the destruction, to reverse the damage where possible, and to recognize that our future rests on the survival of other living things and the continued existence of a livable earth. If we do not do these things, we run the risk that our world will become a lifeless desert, a silent proof of the last environmental prediction that came true. It is our obligation to see that this does not happen. Each of us is on this Earth for a relatively short time. In that time, we are stewards, holding the Earth's natural resources in trust for future generations. We can, and we must, convey to them the very basics of healthy human existence—clean air, pure water, unpoisoned land and a rich diversity of life.

Recommendations of the Commission on Research and Resource Management Policy in the National Park System

John C. Gordon
Dean
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New Haven, Connecticut

My great pleasure and honor this morning is to summarize for you the recommendations of the Commission on Research and Resource Management Policy in the National Park System.

Recently there has been an outpouring of focussed and well-researched reports addressing these topics—from organizations like NPCA, and from the National Park Service (NPS) itself. All these were valuable to us and we used them extensively, but there has been no independent, citizen report since the Leopold and Robbins reports over two decades ago, and no prior independent commission has attempted to address both the cultural and natural resources the system contains.

So, this report reflects the collective thought of 17 diverse people, aided by many more in the Park Service and outside it. We hope it is a catalyst for debate, but we particularly hope is is a spur to action, because a marvelous window of opportunity is open before us. It is open because much has changed since the last citizen commissions, whose work remains useful and valid. Indeed, we reaffirm much of what they contain. But consider these profound changes:

- Environmental change and resource management have become objects of general citizen concern—the ozone layer, global warming and tropical deforestation have catalyzed awareness and set the stage for action.
- The Park System itself is vastly larger and serves a larger more diverse set of publics. At the same time, Parks have become islands and are ever more influenced by the world around them. That they exist and function is a tribute to the dedication of the Park Service.
- The Yellowstone fires have focused public attention on resource management policy as never before.
- Ecosystem science has emerged and is beginning to transform resource management—focusing our attention on properties of the system rather than on pieces of it.

Thus, research and resource management were the natural focus of the Commission's work, and we have made recommendations in four areas: Ecosystem Management, Research, Professionalization, and Education.

First, ecosystem management needs to be further developed even as is is applied to all NPS units. The Service must eschew management by sound bite—naturalness is not a management strategy. Ecosystem management is the paradigm providing the soundest philosophical and technical basis for stewardship of the National Park System. It can provide the best foundation for the dual cultural and natural conservation missions, and also for the expanded educational mission of the National Park

Service. This strategy is defined by James Agee and Darryll Johnson in *Ecosystem Management for Parks and Wilderness* (1988):

> Ecosystem management includes, within a given geographic setting, the usual array of planning and management activities but conceptualized in a systems framework; identification of issues through public involvement and political analysis, goal setting, plan development, use allocation, activity development (resources management, interpretation), monitoring and analysis. Such coordinated management is a process by which goal-oriented management can effectively occur; it is not an end in itself. Success in ecosystem management is defined by achieving goals, not by the volume of coordination.

Thus ecosystem management requires goal-setting for an individual park, definition of boundaries, developing and maintaining inventories to monitor success, and establishment of the information base necessary to understand and predict the behavior of the system and its components. One explicit assumption of such management is that ecosystem boundaries will often differ from political or ownership boundaries; therefore, the park and its goals must be integrated with the surrounding region, as neighbors have a direct stake in setting and achieving these goals.

Implementing ecosystem management requires a quantum leap in both the quantity and the quality of research supported by the National Park Service. Much of the necessary information can only come from long-term studies, as opposed to the current short-term, ''brush fire'' approach to research funding and design. Holistic, ecosystem-level investigations are necessary. Experimentation and scholarly investigation must become a regular part of National Park Service programs, actively encouraged rather than grudgingly tolerated. A major component of research must have a degree of autonomy from park management, to ensure independent, credible scientific assessments.

Any program to improve research and resource management must consider upgrading the professional qualifications and abilities of all employees of the National Park Service. At the same time, such improvement may mean utilizing the services of professionals in new disciplines. Again, parks' invaluable resources must be managed by people who can analyze and understand them, if the resources are to be maintained.

Professionalization is the means to ensure that both internal and external factors keep managers accountable for protecting the resources and serving the public. These factors include systematic and continuing research, university curricula and education to ensure disciplined knowledge, peer review, and participation in professional organizations. For example, for both in-house and contractual research and management projects, the National Park Service should implement peer review mechanisms that draw on the best qualities of similar arrangements utilized by the National Academy of Sciences and the National Endowment for the Humanities.

Education is the great unifier of the National Park System. Public resources will not be preserved unless we are committed, as a nation, to their preservation. The resources and the values they represent are inextricably linked. Education is the chain that may bind disparate elements together over the next century, enabling the National Park Service to resist pressures for instant gratification. An enduring element for all areas of the National Park System is the role and responsibility of the Service to provide all people with the information and inspiration necessary to appreciate the resources of the system and the greater environment.

The adoption of a broader educational mission will have strong implications for research and resource management in the National Park System. Each park, and the system as a whole, must develop education goals in coordination with preservation and visitation goals. These should be ambitious and will often be difficult to achieve. For example, the full range of our cultural heritage should be presented and interpreted. The history of slavery and the oppression of Native Americans should receive as much research and honest interpretation as the more attractive elements of our nation's past. Only truth can make us free to achieve unity of purpose in America's pluralistic democracy. Similarly, management decisions for natural resources should allow opportunities to see a wide range of ecosystems. To portray the diversity and function of ecosystems will require vigorous management and restoration efforts, for example, the reintroduction of top predators. The goal of all management should be to provide as full a range of educational experiences as is compatible with the preservation of resources. The future of the National Park System, and of the world, depends on the understanding such education engenders.

In conclusion, let me emphasize again that the parks, in their combination of heritage and current vitality, present an unprecedented opportunity to:

- truly understand how to manage our landscape, to preserve both our heritage and our vitality;
- increase our sense of national unity by increasing our collective understanding of our cultural roots and the natural systems that contain and sustain our culture; and,
- exhibit international leadership in the care and betterment of the environment.

These global goals transcend the Park System but the parks themselves are the keys to achieving them. The parks should become irresistible forces for the propagation of a land ethic. They should be centers of beauty and rationality that expand functionally by virtue of their evident excellence. They should by example lead us all to a passionate desire to care sensitively for all our lands and waters.

1988 National 4-H Wildlife and Fisheries Recognition Awards

Myron D. Johnsrud
Administrator
Extension Service
U.S. Department of Agriculture
Washington, D.C.

Mr. Gary Chealde, a self-employed furniture and cabinetmaker from Suttons Bay, Michigan in Leelanau County, has been a 4-H volunteer leader for four years. He and his wife Beverly have three children. Gary has been very active in providing leadership for the 4-H Conservation Club and a 4-H Natural Resources Club in the county. These clubs have conducted many learning-by-doing activities under Gary's leadership such as: conducting an inventory of the flora and fauna on a 60-acre tract of land donated to the 4-H Conservation Club, mapping the area; constructing a map of the topography of the area and making a $3' \times 5'$ topo model with a flowing stream; designed a hiking trail and built a bridge on the property; released pheasants; and conducted three-day campouts and hikes surveying the nature of a stream.

Future plans that Gary and his clubs have made include: a wildflower nursery, improving habitat for pheasants by plantings of wildlife foods, raising and releasing pheasants, and improving the forest and wildlife management of the 4-H Conservation Club property. They also received a $2,500 matching grant for building a meeting pavilion on the club property, which the members will help construct. Gary says, "rewards are realized when during these activities, the 4-H members begin to understand the sense of wonder, appreciation for and stewardship necessary to maintain the wild places and wild living things we love in such environments."

Mr. George G. Larson, of Tomahawk, Wisconsin in Oneida County is a retired maintenance director from the Tomahawk school system, who has been a 4-H volunteer leader for 23 years. His Lucky Hills 4-H club, for which he is fish and wildlife leader, has placed top in the county for the past 12 years in the Conservation of Natural Resources category and placed first in the state during the past year. He and his wife Deloris, are both very active in a number of conservation and civic activities and organizations. They and their club have taken 45 acres of donated land and made a wildlife demonstration area in concert with state and local conservation agencies. On this land, they have developed nature trails, planted wildlife food plots, planted trees, constructed and erected nesting boxes, built brush piles and planted cover for small mammals, maintained old logging roads, and developed a lecture area. With the club working to develop this area for wildlife, they conduct workshops on wildlife management, forest ecology, nature hikes and other environmental experiences. The club also uses it often as an outdoor classroom, and as a place to relax, enjoy nature, and learn to appreciate the rewards of wise stewardship.

The club under George's leadership has developed a group of teen leaders who, along with George and Deloris, conduct outdoor learning experiences for about 700 youngsters and adults annually. These 4-H members study sharptail grouse, great blue herons, bald eagles, and conduct sandhill crane counts annually. They also have signed up over 300 acres in the Acres for Wildlife project, and have developed a course in ethical fishing and stream monitoring that the 4-H members participate in. George says that "through their work in 4-H, they have had many rewarding experiences," and that his faith in young people has never wavered. He stated that, "4-H is a big part of my life and I believe in it, because it is where young people may choose and control their interest and learning experiences. The leadership qualities and independence taught through 4-H learning-by-doing is of immeasurable importance when children grow in self-confidence, knowledge and feelings as they work together." Their future plans include developing a shooting sports/wildlife project, expanding a naturespace adventure program and developing a county-wide wildlife food plot program.

Mr. William J. Lauckner, of Nashua, Montana, in a partnership with his brother, farms and ranches 3,000 acres. He and his wife Myrna have been volunteer leaders for 12 years. They have two children, a son and daughter who have also been active in 4-H projects. William has conducted three successful 4-H wildlife camps and has presented numerous wildlife project workshops to 4-H clubs. He and his wife have also taught leader workshops in other counties. He is also active in many other organizations where his leadership is needed. He has received awards from the Montana fish and wildlife agency, from the U.S. Corps of Engineers and from the Trapping Association for his work in fish and wildlife conservation. They have attended and participated in Project Wild workshops and have conducted learning projects for 4-Hers in animal tracks, archery, black powder shooting, BB and .22 rifle shooting, trapping, compass orientation, mountain man history, and many fish and wildlife management related activities. Workshops on birds of prey, trapping, nature walks, scuba diving and fossil displays have also been conducted with the 4-H members participating.

Future goals include: working with other leaders to improve and expand wildlife projects, starting a wildlife club, and continuing the many activities at wildlife camps. William and Myrna state that "4-H has instilled in them the importance of teaching our young people about the values of wild living things while they are young, because they will be the leaders of tomorrow."

Mr. Gerald T. Martin, of Bell Buckle, Tennessee in Bedford Country, is a dentist who has been a 4-H volunteer leader for seven years. Gerald and his wife Pat and their two sons live on a 300-acre farm where Paul, one of the sons, got Dad interested in better managing spillways, lespedeza and diversion ditches on the farm, when they got involved in the 4-H wildlife judging activity. This review of conservation practices to benefit wildlife on their farm really caused him to get caught up in the 4-H wildlife program. Active members in many conservation organizations, Gerald and Pat over the last six years have helped 4-H members conduct many projects to benefit wildlife. Among these are: establishing seven FACE, (Food and Cover Establishment) food plots; erecting 14 bluebird boxes on bluebird trails; building and erecting three wood duck and six Canada goose nesting boxes; 35 feeding stations for birds; 14 brush piles for small animals; and establishing conservation practices on four farms, (300 acres total). He has coached 14 4-H wildlife judging teams, with these teams advancing to three state competitions. He and the 4-H club members have worked closely with the Tennessee Wildlife Resources Agency on many projects such as: Canada goose flock restoration, the FACE project, and wildlife judging.

Their future goals include establishing an annual award for the 4-Her showing the greatest achievement in the wildlife project, organizing a 4-H "bird count" group, helping deserving members make application and secure scholarships for higher education, and promoting the wildlife project as having something to offer everyone—the hunter, the hiker, the canoer, the observer and the collector.

Gerald says, "what we, as coaches and team members have learned through the 4-H wildlife judging activities, forms the basis for our other activities and influences others. And more important than learning specific practices and facts is the development of logic and reason as it relates to wildlife stewardship. My role as a leader is to motivate 4-H members to try to make a difference."

Mr. Roger K. Steinbach, from Suffolk, Virginia, is a Land Acquisition Specialist with the Virginia Department of Transportation and has been a 4-H volunteer leader for 11 years. He and his wife Ann have two daughters, who have also been active in 4-H. Roger started a 4-H natural resources club in the county and has watched it grow by involving the members in diverse natural resources projects and activities. These include forestry, wildlife, marine science, fish identification, water experiments and natural resources camps. Active in many leadership activities, they have been particularly involved in marine museum trips. He has participated in the Middle Management Leader Training for Marine Science and is currently on the District Planning Committee for the 4-H Marine/Aquatic, National Science Foundation Project.

Future activities include the development of a 4-H shooting sports activity, increased conservation and natural resources projects in the local club, training leaders for the district marine science program, and developing conservation education activities for the city 4-H program. Roger states, "to learn respect for the land and wildlife, the most effective way to accomplish this is to instill in young people the extreme importance of preserving the purity of our environment and the life forms it supports; of which ours is only one."

Mrs. Cheryl A. Youker, of Ventura, California, is a college student, wife and mother of two children, with the entire family active in 4-H. She has only been a volunteer leader for 4-H for two very active years, but is also involved in numerous other conservation organizations. She and her husband Phil, co-lead the 4-H wildlife project, which has concentrated on learning more about the wildlife in their county and how to appreciate what the needs of wildlife are. In these activities they have conducted nature hikes, workshops, service activities in nearby parks, studied stream life, animal tracks, bones and furs, and other natural resources related seminars.

Future activities Cheryl hopes to conduct include: learning more about the biology and geology of the area, the art of fly-tying and skills of fly-fishing. Cheryl says she has "learned how 4-H involvement can help make the best better. Each person has the ability to recognize the talents they can all share with children. The concept of 4-H has greatly influenced my life. The individual way each person can reach to achieve what he or she is best in, and give that back to the community is something not too many organizations have. I can not think of a better way to tell children about their future than to have them explore the beauty that only nature can provide them."

Presentation of the 1989 Guy Bradley Award

James D. Range
Chairman
National Fish and Wildlife Foundation
Washington, D.C.

The Guy Bradley Award was established in 1988 by the National Fish and Wildlife Foundation. The award is to be given annually to that person, or persons, whose dedication and service to the protection of the country's natural resources provide outstanding leadership, extended excellence and lifetime commitment to the field of wildlife law enforcement, and whose actions advance the cause of wildlife conservation.

The award is given in the spirit of Guy Bradley, an Audubon game warden killed in the line of duty in July 1905, while preserving a Florida rookery from plume hunters. Guy Bradley is believed to have been the first warden to give his life in the line of wildlife law enforcement.

The 1989 recipient more than meets these qualifications. Picked from a field of outstanding nominees, he received a top ranking from all of the nominating committee. The committee is comprised of seven volunteers representing federal and state wildlife agencies and conservation organizations.

The Foundation is honored to present the 1989 Guy Bradley Award to Terry Grosz, Assistant Regional Director for Law Enforcement in the Denver office of the U.S. Fish and Wildlife Service. Terry is a 1964 graduate of Humboldt State in Arcata, California where he earned both B.S. and M.S. degrees in wildlife management. He launched his law enforcement career in 1966 as a fish and game warden with the California Department of Fish and Game. He became a special agent with the U.S. Fish and Wildlife Service in California in 1970 and was named Senior Resident Agent in North Dakota four years later. Grosz's law enforcement career of more than 20 years has taken him to Canada, Mexico, England and the Orient on special anti-smuggling assignments for the Service. When he arrived in Denver in 1981 as Special Agent in Charge, he was the youngest in the nation to hold that position.

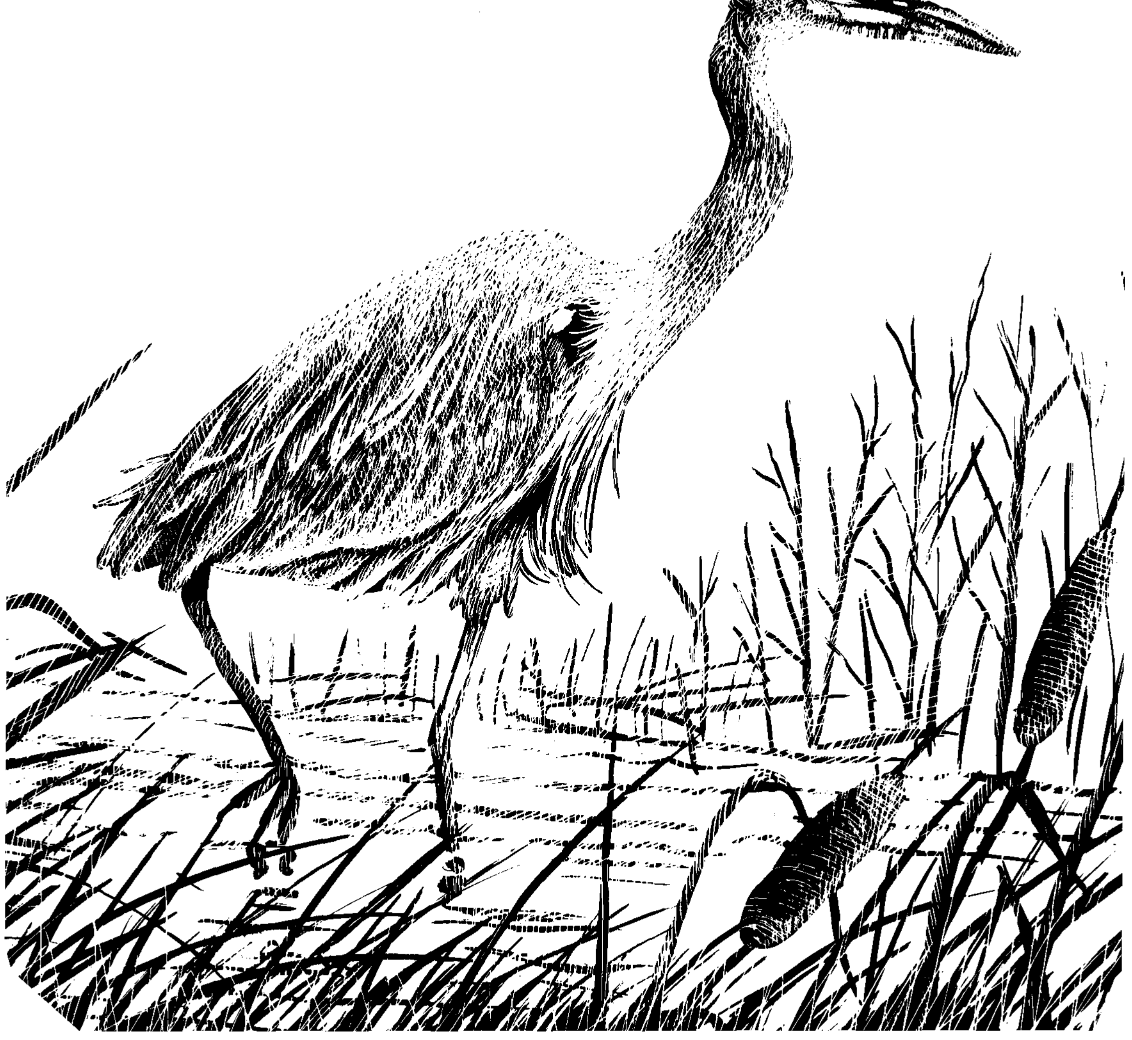
He has received numerous awards but the attribute most telling of Terry is that he still to this moment doesn't feel he deserves this award—he would rather see it go to one of his men in the field.

In recognition of his efforts on behalf of national and international wildlife conservation, we are pleased to present Terry with the Foundation's 1988 Conservation print with a commemorative plaque, together with a check for $1,000—the money will be donated in Terry's name to the wildlife project of his choice.

The Foundation would like to thank the Wildlife Management Institute for its help in this presentation. This award kicks off a special panel on the Status and Challenges facing Conservation Law Enforcement. I will leave a full description of the importance of law enforcement to folks like Dave Hall and John Gavitt, who will be among those presenting today.

However, in recognizing Terry today, I would like to emphasize the obvious. Wildlife violations occur 365 days a year, 24 hours a day. The poacher doesn't keep a 9–5 schedule, but more likely will work at night or on the holidays. The bad weather that grounds geese and helicopters is likely to bring the outlaw gunner out—so too must the law enforcement agent go into the field. Currently, there were some 6,700 state conservation officers and 210 federal special agents in the field. In other words, the law enforcement agent, state or federal, represents a 'thin green line' between those who would devastate our wildlife heritage for their own personal gain and those millions of hunters, fishermen and outdoor enthusiasts who are dedicated to conserving these fish, wildlife and plant resources for our children.

The Foundation applauds Terry and the dedicated hundreds who also deserve this recognition.



Special Session 1. *Water and Wetland Management: New Findings and Initiatives*

Chair
JAMES H. PATTERSON
Wildlife Habitat Canada
Ottawa, Ontario, Canada

Cochair
ROBERT J. BLOHM
U.S. Fish and Wildlife Service
Laurel, Maryland

Introductory Remarks

James H. Patterson
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Welcome to the Special Session 1, "Water and Wetland Management: New Findings and Initiatives." In order to assess the advancements in water and wetland management, some form of benchmark is required. Ten years ago this week the North American Wildlife and Natural Resources Conference met in Toronto, Canada. In many ways, that meeting proved to be a turning point for water and wetland conservation.

The conservation of water and wetlands was not high on any political agenda in 1979. Agricultural commodity prices and markets were strong, contributing to continuing agricultural expansion. This resulted in high rates of wetland loss and increasing degradation of soil and water resources. Discussions at the Toronto meeting revealed a high degree of frustration in the wildlife conservation community. It was readily apparent that the traditional wildlife programs were having little impact on protecting water and wetland habitats. Public and private habitat conservation efforts were not well coordinated, nor was there effective cooperation between the agricultural and wildlife sectors.

My purpose is not to paint a picture of gloom and doom, but rather set the stage to show how far we have come in water and wetland conservation. The 1979 North American Conference served to galvanize the forces of many in attendance to take a broader land-use approach to habitat conservation, recognizing that wildlife interests could not succeed in isolation. The frustration was redirected to a commitment to do things differently. The first tangible commitment to a new approach was the announcement by Secretary of the Interior Andrus and Minister of Environment Marchand that Canada and the United States would begin developing the North American Waterfowl Management Plan.

We are fortunate to have a number of excellent presentations on "Water and Wetland Management" this afternoon. I trust you will agree with me that the new findings and initiatives show substantial progress in the last decade.

Protection of Wildlife Habitat by State Wetland Regulations: The Massachusetts Initiative

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Introduction

Wetlands are among the most productive ecosystems in the world and provide crucial wildlife habitat. A wide diversity of taxa occur in wetlands, and depend on them for valuable feeding, reproductive and cover habitats. About one-third of all bird species (Kroodsma 1979), nearly all 190 species of amphibians, and many species of mammals (Fritzell 1988), reptiles and invertebrates (Clark 1979) in the United States occur in wetlands. Further, many endangered and threatened species are dependent on wetlands during all or parts of their life cycles (Williams and Dodd 1979). Depending on their type and location, wetlands also serve a variety of other ecological functions, such as improving water quality; facilitating flood and erosion control and groundwater recharge; and providing natural products and recreation (Tiner 1984).

A wide variety of federal and state laws protect wetlands in part due to their value as wildlife habitat and their other environmental and economic values. However, less than 46 percent of the original 215 million acres (87 million ha) of wetlands in the lower 48 states remained by 1975 (Tiner 1984). And in spite of growing awareness of the important values of wetlands, hundreds of thousands of acres of wetlands continue to be destroyed each year. Current regulatory and nonregulatory programs are considered inadequate for protecting the nation's wetlands resource base (The Conservation Foundation 1988). Thus, the objectives of this paper are to (1) examine why federal regulations, specifically Section 404 of the Clean Water Act of 1977, are ineffective for protecting wetlands; (2) review the status of states with state wetlands protection programs, and their preparedness to assume control over the protection and regulation of their wetland resources; and (3) examine how Massachusetts has recently expanded its wetlands protection regulations to protect wildlife habitat.

Limitations of Section 404

There are a number of federal laws and programs that provide protection for wetlands in the United States; however, Section 404 of the Clean Water Act is the principal federal regulatory authority controlling the destruction of wetlands (Barton 1986). The U.S. Army Corps of Engineers' (Corps) is the primary federal agency responsible for administering Section 404. Under this program, the Corps is authorized to issue or deny permits for the discharge of dredge or fill materials into U.S. waters, including most wetlands. While the 404 program has probably prevented the destruction of thousands of acres of wetlands (Office of Technology Assessment 1984), vast acreages of wetlands continue to be lost each year. These losses are in large part due to the lack of authority under Section 404 for the Corps to regulate many of the activities that destroy wetlands, and the limited way in which the Corps has implemented the 404 program (Barton 1986). A recent General Accounting Office (GAO) report to Congress on the administration of Section 404 by the Corps underscores some of the program's major limitations (U.S. General Accounting Office 1988).

Limitations on Jurisdiction of Section 404

Many activities resulting in substantial wetlands losses are not regulated by the Section 404 program. Conversions of wetlands for normal agricultural, silvicultural or ranching purposes may be exempted from permitting requirements (Section 404(f)(1)) as long as they are not intended to bring wetlands into a new use that would convert them to upland—as specified in Section 404 (f)(2). Further, the Corps' regulatory authority extends only to placement of dredge and fill material in U.S. waters. Activities such as clearcutting forests, ditching that drains wetlands, and certain plowing that does not deposit substantial dredge or fill materials have sometimes been interpreted by the Corps as not coming under its regulatory purview (U.S. General Accounting Office 1988). These deficiencies in the program take on enormous proportions considering that 87 percent of wetlands losses in the U.S. between the mid-1950s and mid-1970s were due to conversions of wetlands to agricultural use (Frayer et al. 1983).

Interpretations of Extent of Regulatory Jurisdiction

Another major limitation of the 404 program identified in the GAO report was the limited way in which the Corps implements the program. There has been much disagreement over whether the Corps is using the full range of its authority to protect wetlands. Environmental groups have pressed for and often have won expansion of the program through court decisions that have overturned the Corps' interpretation of the law (Barton 1986). Disagreements involve interpretations of several key provisions, including: (1) how wetlands boundaries are delineated, (2) assessment of cumulative impacts of individual permit decisions and (3) the extent of consideration given to practical alternatives to development in wetlands. Depending on whether these and other provisions are interpreted narrowly or broadly greatly affects the impact of Section 404 in protecting wetlands (U.S. General Accounting Office 1988).

Wetlands delineation. The Corps and resource agencies sometimes delineate wetland boundaries differently, which can greatly affect what areas are protected as wetlands under the 404 program. The Corps' wetland definition and subsequent delineation is often more narrow than that used by the U.S. Fish and Wildlife Service (USFWS) for its wetland inventory. The Corps generally requires an area to be wetter than does the USFWS wetland definition. The USFWS estimates that less than 99 million acres (40 million ha) of wetlands exist in the lower 48 states. The Corps estimates that only 64 million acres (26 million ha) are regulated under Section 404 (Office of Technology Assessment 1984). The largest disparities in wetlands boundary delineations between the Corps and other resource agencies typically occur in bottomland hardwood areas and in arid regions of the country where there is a lack of rain in the fall (U.S. General Accounting Office 1988). Hopefully, the recent interagency memorandum of understanding signed between the Corps and other federal agencies in January 1989 to adopt a single manual for identifying jurisdictional wetlands will help resolve some of these wetlands delineation limitations (Cohen 1989).

Cumulative impacts. According to Section 404(b)(1) guidelines, cumulative impacts are changes that take place in aquatic ecosystems that are attributable to the collective effect of a number of individual discharges of dredge or fill material. The cumulative impact of incremental wetlands losses can have detrimental effects on whole watersheds, such as increased flooding, turbid and eutrophic streams and lakes, and loss of plant and animal species. Under Corps guidelines, these effects are to be predicted to the extent reasonable and practical. However, the regulation of cumulative impacts are not addressed by the traditional site-specific permit evaluation, and no generally-accepted process for determining cumulative impacts exists. Thus, the Corps and resource agencies do not typically address cumulative impacts (U.S. General Accounting Office 1988). Much additional research is needed to develop cumulative impact assessment criteria. Gosselink and Lee (1987) proposed a methodology for cumulative impact assessment and management in bottomland hardwood wetlands.

Practical alternatives. Under the 404(b)(1) guidelines, no 404 permit may be issued if there are practical alternatives to the project that would be less environmentally damaging. The guidelines assume that if an activity is not water-dependent, then a less damaging alternative can be found, unless an applicant demonstrates otherwise. If the project does comply with these guidelines, the Corps then decides if the project is in the public interest balanced against its foreseeable detriments (Barton 1986).

The disputes between the Corps and other resource agencies most often concern projects that are not water-dependent. The Department of Interior believes the Corps should apply the guidelines as a threshold determination rather than a lesser component of the public interest determination. Further, the Corps often relies on permit applicants to determine whether practical alternatives to their proposals are available. The Department of Commerce believes the Corps' emphasis on economic impact often overlooks the long-term economic contributions of habitat to commercial and recreational fisheries (U.S. General Accounting Office 1988).

Implementation of Resource Agencies' Recommendations and Enforcement Activities

Agency recommendations. Federal and state resource agencies are also involved in 404 permit decisions. Under the Fish and Wildlife Coordination Act, the Corps is required to consult with the USFWS, National Marine Fisheries Service, and state fish and wildlife agencies. The Corps is to give full consideration to these agencies' recommendations for preventing or reducing fish and wildlife losses in issuing a permit (Barton 1986). While the Corps is generally receiving and considering resource agency views during the 404 permitting process, the Corps frequently does not concur with the suggestions offered by the resource agencies in making its final permitting judgements. Corps districts issued permits over the denial recommendations of resource agencies in 37 percent of 111 cases involving denials. Resource agencies rarely used procedures to get higher level review of district decisions, believing that current formal procedures for resolving disagreements with the districts are ineffective (U.S. General Accounting Office 1988).

Monitoring and enforcement activities. The last major limitation of the 404 program identified in the GAO report was the lack of surveillance to detect unauthorized activities or permit noncompliance. Neither the Corps nor the Environmental Protection Agency (EPA), which has independent enforcement authority under the Clean Water Act, routinely engage in monitoring or enforcement activities. Both agencies indicate a lack of resources and personnel to conduct such activities. However, the Corps rarely uses available civil or criminal remedies in pursuing violators of permit requirements, and few permits have been revoked or suspended because of noncompliance (U.S. General Accounting Office 1988). Hopefully, the recent interagency memorandum of understanding signed between the Corps and EPA in January 1989 to enforce the requirements of Section 404 will help resolve some of these monitoring and enforcement limitations (Page and Hanmer 1989).

The GAO report concludes that because of the many statutory exemptions and the jurisdictional limits to regulatory requirements, permitting and enforcement actions, Section 404 does not provide the basis for a comprehensive wetlands protection program (U.S. General Accounting Office 1988). This is most directly evidenced by the continuing rapid loss of wetlands in the United States, minimally estimated in 1980 at 275,000 acres (111,000 ha) per year (Office of Technology Assessment 1984). The final report of the National Wetlands Policy Forum also recognized the inadequacies of the 404 program. It recommended the vigorous promotion of state regulatory programs and the delegation of federal permitting responsibilities to state agencies. The Forum viewed these actions as providing the greatest promise for achieving improvements in the effectiveness and efficiency of the nation's wetlands regulatory efforts (The Conservation Foundation 1988). But how ready are states to assume this control over protection and regulation of their wetlands resources?

Status of State Wetlands Protection Programs

Nearly half of the 50 states regulate wetland uses to varying degrees; however, many of these states protect only coastal wetlands, with inland wetlands being largely unprotected except by federal regulations. Further, of the 99 million acres (40 million ha) of wetlands remaining in the lower 48 states, 94 percent are inland (Tiner 1984). Thus, the extent of state involvement in wetlands protection is best evaluated by examining the extent of states' inland wetland policies.

State involvement in inland wetlands protection is variable, with some states showing significant interest and others little at all. Glubiak et al. (1986) surveyed all 50 states and a number of territories, requesting information on each state's present or pending inland wetlands policies. As of early 1983, they determined that only 10 states and 2 territories had comprehensive wetlands laws. Since this time, at least 3 additional states (New Jersey, Oregon and Pennsylvania) have developed comprehensive inland wetlands regulations (R. W. Tiner, pers. comm., 1989) (Figure 1). However, simply because a state does not have a comprehensive wetlands law does not mean that they do not protect wetlands. For example, some states incorporate federal guidelines into state regulatory schemes. Other states protect wetlands as wildlife habitats and regulate their use through general habitat provisions. Still other

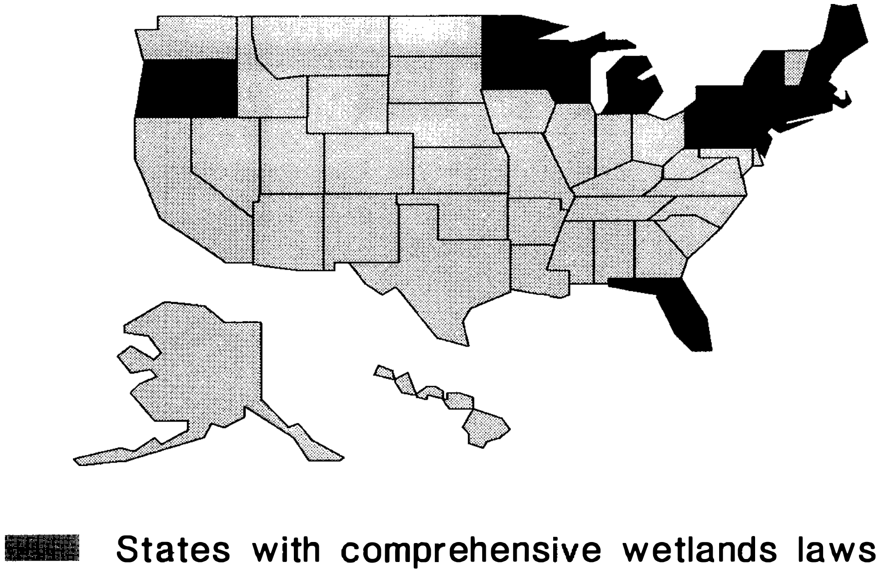

Figure 1. States with comprehensive wetlands protection laws (Glubiak et al. 1986, R. W. Tiner, Jr., pers. comm., 1989).

states regulate only specific wetland areas, while avoiding any statewide legislation. However, only the states with comprehensive laws possessed state mechanisms to assume greater control of their own wetlands policies (Glubiak et al. 1986). Although a congressional study in 1983 reported that almost a third of responding states indicated an interest in examining state assumption of control of inland wetlands regulation (Office of Technology Assessment 1984), only the state of Michigan has assumed such control (Glubiak et al. 1986). Thus, relatively few states are presently capable of assuming federal permitting responsibilities. Further, it is uncertain what priority state legislatures will give to protection of wetlands resources in future years.

The Massachusetts Initiative

Massachusetts, with passage of the Hatch and Jones acts in the 1960s, was the first state to provide comprehensive protection for wetlands. These two acts were repealed and consolidated in 1972, with passage of the Wetlands Protection Act (WPA) (Massachusetts General Laws Chapter 131, Section 40) (Dawson 1982). While there are several additional state laws that directly and indirectly protect wetlands, the WPA provides the primary regulatory and enforcement authority for protecting wetland resources in the state. This segment of the paper briefly summarizes the Act, and more specifically examines how the 1986 wetlands wildlife habitat amendment to the Act broadened the scope of wetlands protection.

The Regulations

The Massachusetts Wetlands Protection Act was enacted to protect public interests in both inland and coastal wetlands. These public interests are protected by prohibiting the removing, dredging, filling or altering of wetlands without a permit. The process of obtaining a permit is triggered by an application to do work in a regulated area. Each application is reviewed to determine its impact, if any, on the wetland resource area. This is followed by a public hearing and either issuance or denial of a permit. The regulations are administered initially by local conservation commissions. Each of the 351 cities and towns in the state appoints its own volunteer commission composed of local citizens. State agency involvement typically begins with appeal processes. The Department of Environmental Quality Engineering (DEQE) is the primary state agency with regulatory authority under the Act.

The Act identifies and provides varying levels of protection for 15 different wetland resource areas (Table 1). These include 4 categories of inland and 11 coastal wetland resource areas. Wetlands are defined broadly by the Act and, as a result, coastal beaches, dunes and banks, and barrier beaches are considered as wetland resource areas. These broad definitions are significant because they extend protection to habitats of wildlife that occur on beaches and dunes (Melvin 1989).

Prior to 1986, the Act protected seven resource interests associated with wetlands, including: (1) public and private water supply, (2) groundwater supply, (3) flood control, (4) storm damage prevention, (5) prevention of pollution, (6) protection of shellfish and (7) protection of fisheries. In 1986 the Act was amended to include wildlife habitat as an eighth interest to be protected. The amendment protects wildlife *habitat*, not wildlife populations or individual animals. It defines wildlife habitat as ''those areas subject to (the Act) which due to their plant community composition and structure, hydrologic regime, or other characteristics, provide food, shelter, migratory or overwintering areas, or breeding areas for wildlife.''

While the amendment did not change the geographical jurisdiction or the scope of regulated activities in wetland resource areas, it did broaden the scope of protection for wildlife habitat. Four key principles important to the amendment are summarized below, including: (1) importance of presumptions of significance, (2) establishment of performance standards, (3) special provisions for rare species' habitats and (4) added protection for vernal pool habitats.

Presumptions of significance. As under the pre-amendment framework, legal presumptions were created that most resource areas are significant to the protection of wildlife habitat (Table 1). The establishment of these legal presumptions places the burden of proof on the applicant seeking to alter a wetland to demonstrate either (1) that the area in question is not significant as wildlife habitat, or (2) the proposed work will actually contribute to the protection of wildlife habitat. It is often difficult to prove either of these conditions considering that a wetland, even a degraded one, usually provides at least some habitat for wildlife. It is also difficult to demonstrate that a development project in a wetland will actually improve its value as wildlife habitat.

Performance standards. The regulations also contain performance standards that projects must comply with when a proposed activity will alter a wetland area found to be significant to the protection of wildlife habitat. For non-water-dependent projects (activities that do not require direct access to or location in water bodies) in coastal resource areas, projects must have ''no adverse effect'' on specified wildlife habitat characteristics. However, non-water-dependent projects in inland resource areas face

Table 1. Wetland resource areas protected by the Massachusetts Wetlands Protection Act.

Inland Wetlands
Banks (of streams, rivers, ponds, or lakes)
Bordering vegetated wetlands (wet meadows, marshes, swamps, and bogs)
Land under water bodies (streams, rivers, ponds, or lakes)
Land subject to flooding (areas bordering streams, rivers, ponds, or lakes; also isolated areas flooded at least once per year)
Coastal Wetlands
Land under the ocean (includes land under estuaries)
Coastal beaches (includes tidal flats)
Coastal dunes
Barrier beaches
Coastal banks[a]
Rocky intertidal shore
Salt marsh
Land under salt ponds
Land containing shellfish[a]
Anadramous/catadramous fish runs[a]

[a]Resource area not presumed significant to protection of wildlife habitat.

different performance standards. For these projects, project size thresholds were established that allow a person to alter limited amounts of some inland resource areas without regard to protections for wildlife habitat. These threshold provisions were adopted to allow for small projects that will have relatively minor impacts on wildlife habitat. Only one threshold per lot is allowed, thereby reducing the effects of cumulative impacts on a single parcel. Further, permanent alterations above the permissible thresholds are permitted if offsite replication of the altered habitat is carried out under stringent conditions specified in the regulations.

Water-dependent projects in coastal and inland resource areas are typically granted limited project status and normal performance standards are suspended. However, special conditions may be required to minimize adverse effects. Activities relating to the maintenance, repair, or improvement of existing structures, public roads, and road drainage systems are typically granted limited project status in most resource areas.

Rare species habitat. The habitats of all rare vertebrate and invertebrate species listed as Endangered, Threatened, or Special Concern by the Massachusetts Division of Fisheries and Wildlife (MDFW) receive special protection. No activity, including a limited project, may have any adverse effects on the habitats of these state-listed rare species. Maps delineating the approximate boundaries of these habitats are continuously updated and periodically distributed to appropriate conservation commissions by MDFW. All applicants are required to check these maps prior to filing a permit to determine whether any portion of a proposed project falls within the mapped habitat. If it does, the applicant must notify the MDFW, which will either confirm or deny this preliminary determination. MDFW also determines whether a proposed project will have adverse effects on the habitat in question. The regulations create a rebuttable presumption that MDFW opinions are correct. Thus, the burden of proof is on the applicant to prove otherwise.

These new regulations protect the habitats of 105 species of rare wetlands wildlife. This is nearly two-thirds of the 162 species of wildlife that are so classified in the state, including 45 species of vertebrates and 60 species of invertebrates (Melvin 1989). Unfortunately, the Act does not specifically protect rare plant species.

Vernal pool habitats. Vernal pools are generally described as small, confined depressions that hold water at least during the spring and early summer. They occur throughout the state and they provide crucial habitat for several vertebrate and invertebrate wildlife species. Two-thirds of all amphibians in the state will breed in vernal pools, and 30 percent of these amphibians are vernal pool obligates (S. D. Jackson, pers. comm., 1989).

Vernal pools and a 100-foot (30 m) area around each pool are protected if they occur within a defined resource area, and if they have been certified and mapped by the MDFW. Under the regulations, vernal pools do not enjoy a presumption of significance as important wildlife habitat unless they have been mapped and certain biological criteria documented prior to permit filing. Specific certification criteria have been developed, and supporting evidence must be submitted to the MDFW for review and certification.

The Regulations at Work

Impacts. The complexity of the wildlife habitat regulations has created problems for applicants, conservation commissions, and state agencies. Each of the conservation commissions in the state are composed of local citizens who typically have no technical background, and for the most part are overwhelmed by the complexity of the regulations. So far this has resulted in the new regulations not being applied effectively and uniformly across the state. Further, both DEQE and the commissions are overwhelmed by the volume of filings under the Act. Over 11,000 filings were made from July 1988 through March 1989 (J. Felix, pers. comm., 1989). Neither DEQE or the conservation commissions have adequate staff or time to administer the program effectively.

The establishment of presumptions of significance in most resource areas places the burden on the applicant. However, the lack of a presumption for areas in floodplains beyond the line of the 10-year flood requires that all applications to alter wildlife habitat in these areas will have to be considered on a case-by-case basis. Considering most development pressure in wetlands is currently focused in floodplains, this will again add greatly to the burden of commissions to administer the regulations. Similarly, the large number of limited projects for which performance standards are suspended requires that commissions independently determine what protective conditions are appropriate to protect wildlife habitat. Again, this requires commissions to make complex decisions that they are unlikely to have the technical expertise to do so effectively.

For vernal pool habitats to receive full protection under the regulations, an intensive effort will be needed throughout the state to locate and map these important wetlands wildlife habitats. The extent to which vernal pools will be protected in the state depends solely on the interests and efforts of conservation commissions and concerned citizens to locate and map these wetland habitats. As of March 1989, only 16 vernal pools have been certified statewide.

Performance. It is difficult to evaluate objectively the performance of the wildlife habitat regulations since they went into effect on November 1, 1987. While the proportion of filings that result in an appeal averages 10 percent per year (Department of Environmental Quality and Engineering 1988), there are no data available on the number of wildlife habitat-related appeals that have been made to DEQE. However, there are data to evaluate the performance of the rare species habitat provision.

From November 1, 1987 through December 31, 1988, 436 rare species filings were submitted to MDFW (S. M. Roble, pers. comm., 1989). Subsequent determinations were made on 430. Of these 430 projects, 303 (70 percent) were determined by MDFW *not* to occur within the actual habitat of a rare species. Of the remaining 127 projects that did occur within the actual habitat of a rare species, 123 (97 percent) were determined unlikely to have any significant adverse effects on rare species habitat. This included 53 projects for which minor modifications or mitigating measures were requested during the review process. Finally, there were only 4 projects during this period that were determined would have adverse impacts on rare species habitat if allowed to proceed. This is significant because developers severely criticized the rare species habitat provision; however, less than one percent of rare species filings have resulted in permit denials.

Conclusion

The lack of an effective comprehensive wetlands protection program at the federal level makes it imperative that states begin assuming a larger role in development of programs to protect their wetlands resources. However, relatively few states currently have comprehensive wetlands protection programs. As state wetlands programs are developed and refined in the coming years, there is substantial opportunity to provide much needed additional protection for wetlands in general and for a wide variety of wildlife species and their habitats.

Acknowledgments

I thank the many individuals who contributed to development of strong wetlands wildlife habitat regulations in Massachusetts, including: D. Crook and S. M. Melvin, Massachusetts Division of Fisheries and Wildlife; A. O'Donnell, Massachusetts Audubon Society; G. I. McGregor, Boston, Massachusetts; S. Pearlman, G. Clayton, and C. Foote-Smith, Massachusetts Department of Environmental Quality and Engineering; and J. S. Larson, University of Massachusetts. S. M. Roble, Massachusetts Division of Fisheries and Wildlife, provided data on rare species habitat filings.

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Riparian Wildlife Information Needs in Western Oregon: Land Manager Concerns

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The combination of increasing demand for wood products, declining supply of mature timber, and current legislative regulations on riparian areas has stimulated a great deal of concern and skepticism over the value of existing riparian management guidelines in western Oregon. In response to these and other forest resource management concerns, the Coastal Oregon Productivity Enhancement (COPE) research and education program was initiated in 1987. COPE is a ten-year, $25-million, multi-agency, user-supported program designed to identify and evaluate existing and new opportunities to enhance long-term productivity and economic and social benefits derived from forest-associated resources of coastal Oregon. Formal problem identification began in 1986 with a series of meetings with coastal citizens and resource managers in which major issues were identified. Following subsequent workshops involving over 90 resource specialists, research on riparian zone management and reforestation-related practices were selected as foci for COPE research. Currently, COPE is in the second year of the program and consists of 23 separate research projects in multiple disciplines.

A nine-year study within COPE was initiated to help provide objective answers to questions on riparian-wildlife relationships in western Oregon, encompassing the Coast Range and Siskiyou Mountains. To assist in the development of a research program responsive to the information needs of western Oregon land and resource managers, we initiated an effort to identify and prioritize riparian management information needs. In this paper, we present our findings on perceptions of state and federal agency foresters and biologists and industry representatives on wildlife information needs to better manage riparian areas in western Oregon.

Methods

Problem Analysis Meetings

We met with 60 individuals from 11 state and federal land and resource management agencies and private timber companies between 14 April–28 July, 1988 to develop a comprehensive list of researchable riparian-wildlife topics. Meetings consisted of an introduction and overview of the COPE program, the wildlife project, an ongoing wildlife pilot study, and the wildlife problem analysis process. This was followed by an in-depth discussion of the organization's concerns and a listing of potential research topics. Topics were ones that the managers specifically felt that if information were provided, they would be able to manage more effectively lands under their jurisdiction. In general, we did not solicit concerns that were not already present within the organization; we merely elaborated on the organization's concerns and offered insight into how each concern might be considered from a research perspective.

Questionnaire

We developed a comprehensive questionnaire based on the issues and concerns raised during the problem analysis meetings (a copy of the questionnaire can be obtained from the senior author upon request). The questionnaire was divided into six groups of topics for organizational purposes: land use considerations, spatial scales, temporal scales, ecological relationships, management activities and vertebrate emphasis. The six groups differed in the nature and scope of the issues involved, and each group was subdivided into several topics. Each topic within a group pertained to a single concern and was stated in the context of riparian-wildlife relationships and potential impacts of management activities on those relationships. For example, in the group on ecological relationships, the topic of riparian areas as movement corridors was stated as follows: "Role and importance of streamside areas as migration or dispersal corridors, and the impacts of streamside and upslope habitat conditions and management activities on this role." The vertebrate emphasis group contained a list of vertebrate groups (e.g., cavity-dwelling species) and individual species (e.g., great blue heron, *Ardea herodias*) that were identified by the land managers. Vertebrate groups were not exclusive; they represented different, yet logical, species groupings based on specific ecological or management concerns. Individual species were combined into a single group to rank relative to other vertebrate groups; they were also ranked individually. Respondents weighted each topic relative to its importance in structuring the wildlife research program (scale 1–5). In this paper, we interpreted weights as the relative importance of information needed by land managers (Table 1). Within a group, the topics were rated relative to the other topics in that group, and several topics could receive the same weight. We encouraged each organization to involve as many appropriate personnel in as many administrative levels as possible to reach a consensus for the organization. Hence, each organization's response represented the opinions of more than one individual within the organization.

We mailed the questionnaire to 2 state and 4 federal land and resource management agencies, 9 county extension offices, and 22 private timber companies cooperating in the COPE program. We mailed a second identical questionnaire to all organizations that did not respond within 12 weeks. Further, because of insufficient response among county extension agents, we followed up the second mailing with a phone call.

Topic Prioritization

We considered each questionnaire response to represent the views of the organization represented, regardless of who or how many individuals within the organization provided input. Because of their size and extent of involvement in western Oregon land management, each Bureau of Land Management District and U.S. Forest Service National Forest was treated separately. To prioritize topics, we determined the overall mean response to each question and ranked topics accordingly. To determine overall mean response, we weighed each federal office (e.g., national forest) and state agency equally and weighted county extension offices and private timber companies proportionately such that the county and private sectors had the equivalent of one combined response each. Federal and state agencies were weighted more than county extension offices and private timber companies because they represented larger and more complex organizations with larger land bases. Federal and state responses also

Table 1. Rating system used to weight questions on appropriate spatial and temporal scales for riparian-wildlife studies, information needs on general ecological relationships and specific management activities, and vertebrate groups to emphasize in future riparian studies, COPE wildlife problem analysis questionnaire, 1988.

Weight	Meaning	Interpretation
5	Very important	This consideration should be given the highest priority in designing the wildlife research program.
4	Important	This consideration should be given moderate priority in designing the wildlife research program; an effort should be made to structure the research program in a manner that incorporates this consideration.
3	Moderate concern	This consideration should be given low priority in designing the wildlife research program; the research program should not be structured around this consideration, but information on this consideration should be obtained whenever practical.
2	Low concern	This consideration is of interest, but should receive no weight in designing the wildlife research program; no time or money should be devoted to this consideration; obtain information on this consideration only in conjunction with the needs of the study objectives.
1	No concern	This consideration is not of interest, and should not be considered in designing the wildlife research program; no time or money should be devoted to this consideration.

represented the combined opinions of many more individuals than the county and private responses. We recognized the potential for differences of opinion among land managers representing private versus public land management organizations, so we also compared responses among federal, state, county and private sectors; coefficient's of variation (cv) are reported to indicate the degree of variability within sectors. Rigorous statistical comparisons among sectors were not deemed appropriate or warranted for the purposes of this paper.

Results and Discussion

Response Rate

Thirty-one of 43 (72 percent) agencies/organizations responded to the questionnaire. Response rate was higher among federal and state agencies than among counties or private timber companies. Eight of 10 (80 percent) offices within 4 federal agencies responded. The U.S. Fish and Wildlife Service was the only federal agency that did not respond. Both state agencies responded. Only 2 of 9 (22 percent) extension offices responded to the questionnaire after two mailings. However, county extension response increased to 80 percent (8/9) after the follow-up phone call. Thirteen of 22 (59 percent) private timber companies responded. The low response rate among private companies is somewhat misleading, since most of the larger companies responded.

Land-use Considerations

Overall, land and resource management organizations (hereafter referred to as land managers) desired 81 percent (range 40–100, sd = 6) of COPE wildlife research to be devoted to riparian areas in forested settings, in comparison to riparian areas in nonforested (primarily agricultural) settings. Federal agencies desired the greatest emphasis on forested settings ($\bar{x}$ = 80 percent, sd = 18); however, private timber companies were more variable in their opinions. Both state agencies desired 75 percent of COPE resources to be devoted to forested settings. County extension agents placed the lowest emphasis on forested settings ($\bar{x}$ = 69 percent, sd = 14). These results coincide with the approximate distribution of riparian areas between forested and nonforested settings within the COPE study area, and suggest that information on the full range of land uses is desired. The emphasis on forested settings by federal agencies and private companies reflects the strong forest management emphasis within these organizations in western Oregon. However, we did not specifically survey agricultural organizations, so our results are biased towards forest managers.

Spatial and Temporal Scope

Evaluating cumulative effects of forest management activities over space and time was considered essential by most persons attending the problem analysis meetings. The importance of cumulative effects analysis was further evidenced in the questionnaire responses. Stand-level and particularly basin-level spatial scales were considered more important than microsite-level, patch-level or Coast Range-level scales for evaluating wildlife relationships and assessing relationships between forest management activities and wildlife; the pattern was similar among federal, state, county and private sectors (Figure 1a). Interestingly, private industry showed a slight preference for the large basin-level scale. These results support the need for basin-level approaches to riparian-wildlife studies.

Evaluating wildlife relationships and management impacts occurring over a 10- to 100-year period following an activity was considered more important than immediate (1-year post-activity) or very long-term (120+ years post-activity) impacts; federal agencies emphasized long rotation-length (80–100 years) time scales, while private industry, county extension, and to a lesser degree state agencies, emphasized shorter-term (10 years) time scales (Figure 1b). The overall support for long time scales (≥10 years) suggests that, from a land manager's perspective, information derived from short-term (1–5 years) experimental studies involving measured wildlife responses to vegetation manipulations may have less value than information derived from studies in which seral conditions spanning many years are evaluated simultaneously. Moreover, these results suggest that riparian-wildlife relationships should be viewed from a long-term perspective, in which potential short-lived, negative (or positive) effects of riparian management activities are evaluated relative to their long-

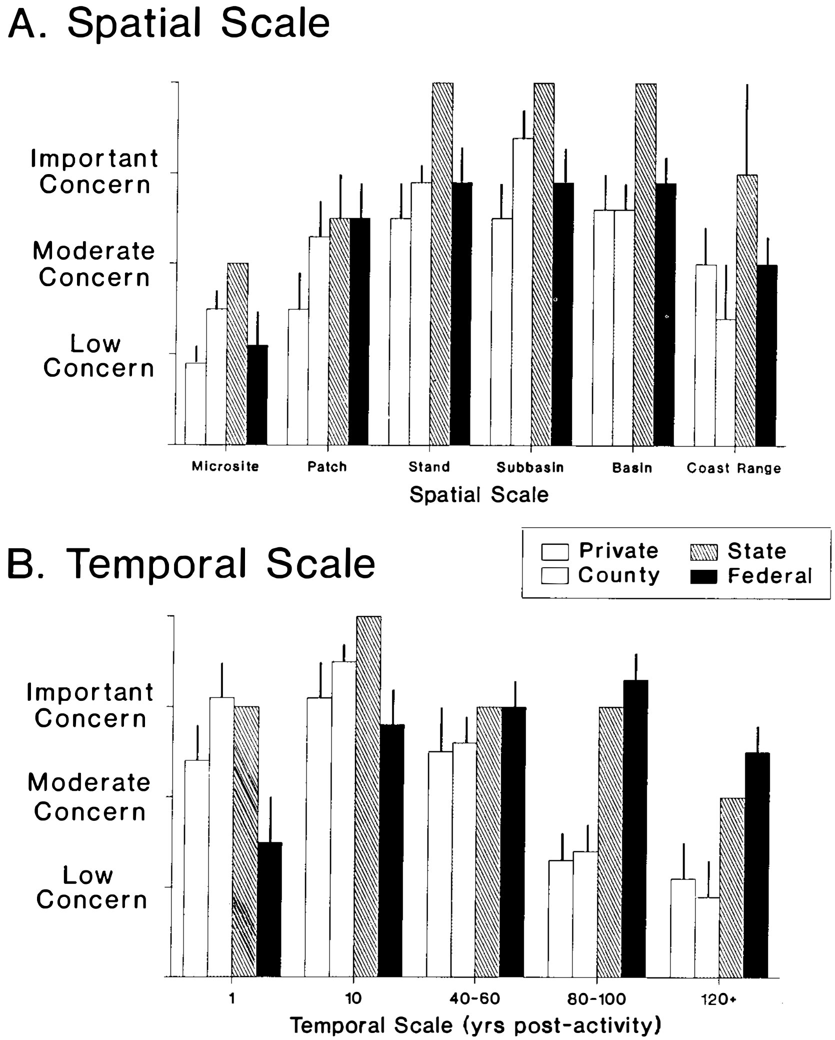

Figure 1. Mean (+1 SE) response by sector (private, N = 13; county, N = 8; state, N = 2; federal, N = 8) for questions on appropriate spatial (A) and temporal (B) scope of riparian-wildlife studies, COPE wildlife problem analysis questionnaire, 1988.

term impacts on riparian wildlife communities over the full rotation of a managed stand.

In today's heated bio-political environment there are growing legal and ecological mandates for cumulative effects analysis in which forest management impacts are assessed over broad spatial and temporal scales. Federal agencies, such as the U.S. Forest Service, are currently laden with environmental appeals over proposed land management actions. Many of these appeals focus on insufficient, or lack of, cumulative effects analysis by the responsible agencies, often with respect to cumulative impacts of forest management on wildlife populations. The ecological necessity for cumulative effects analysis in western Oregon is becoming increasingly obvious as the landscape becomes more intensively managed. Old-growth forests in the Coast Range of Oregon are nearly nonexistent. Private industry timberlands are mostly under intensive, short (40–60 year) rotation, even-aged management regimes. The remaining unmanaged, mature forest stands on federal lands that are available for timber utilization are rapidly being harvested and converted into young, intensively managed, even-aged monocultures. Our results suggest that land managers from both public and private sectors recognize the need for objective information to allow more accurate assessments of spatial and temporal cumulative impacts of forest management on wildlife.

Ecological Relationships

Land managers wanted more information on forest fragmentation-related topics, such as the relationship between wildlife communities and stand size (i.e., riparian stand size-width and upslope harvest unit size), stand isolation (i.e., distance between riparian buffer strips and stands of similar habitat condition), and habitat patchiness (i.e., patchiness of riparian habitat with respect to stand condition/age) (Figure 2a). Changes in riparian-wildlife associations in relation to stream order (i.e., size and location of stream within drainage network), and the role and importance of riparian areas as movement corridors for migration, dispersal or travel were also considered important landscape-level information needs by land managers (Figure 2a). Private timber companies were considerably less consistent (mean cv = 36.2 percent) than other organizations (county, mean cv = 21.0 percent; state, mean cv = 11.2 percent; federal, mean cv = 18.2 percent) in their concern for these issues and placed much less emphasis on the topic of riparian areas as movement corridors ($\bar{x}$ = 2.7, sd = 1.1) than did state ($\bar{x}$ = 3.5, sd = 0.7) and federal ($\bar{x}$ = 4.4, sd = 0.7) agencies. The high level of concern for all of these issues supports our previous interpretation regarding the need to approach riparian-wildlife problems from a broader, basin-level perspective. Clearly, land managers view the fragmentation of riparian vegetation (i.e., reduced stand size, increased edge, patchiness, and stand isolation) as an important issue, and recognize that insufficient information currently exists to assess the impacts of riparian habitat fragmentation on riparian-associated wildlife. The importance of movement corridors reflects the high interest in big game management (e.g., deer/elk) among state and federal agencies.

Land managers considered the relationship between wildlife communities and riparian buffer width the single most important information need (Figure 2a). This is not surprising, since riparian buffer width is the single most regulated riparian attribute and the subject of much of the riparian management controversy in western Oregon. Past buffer zone strategies were largely conceptualized and developed for the protection of instream resource values (e.g., fisheries, water quality); terrestrial wildlife resources were assumed to benefit by default, but they were not instrumental in structuring specific riparian management standards such as buffer width. This has been due in large part to a lack of objective information on riparian-wildlife relationships in moist coniferous forests of western Oregon. Our results clearly indicate that land managers place a high priority on developing a better empirical understand-

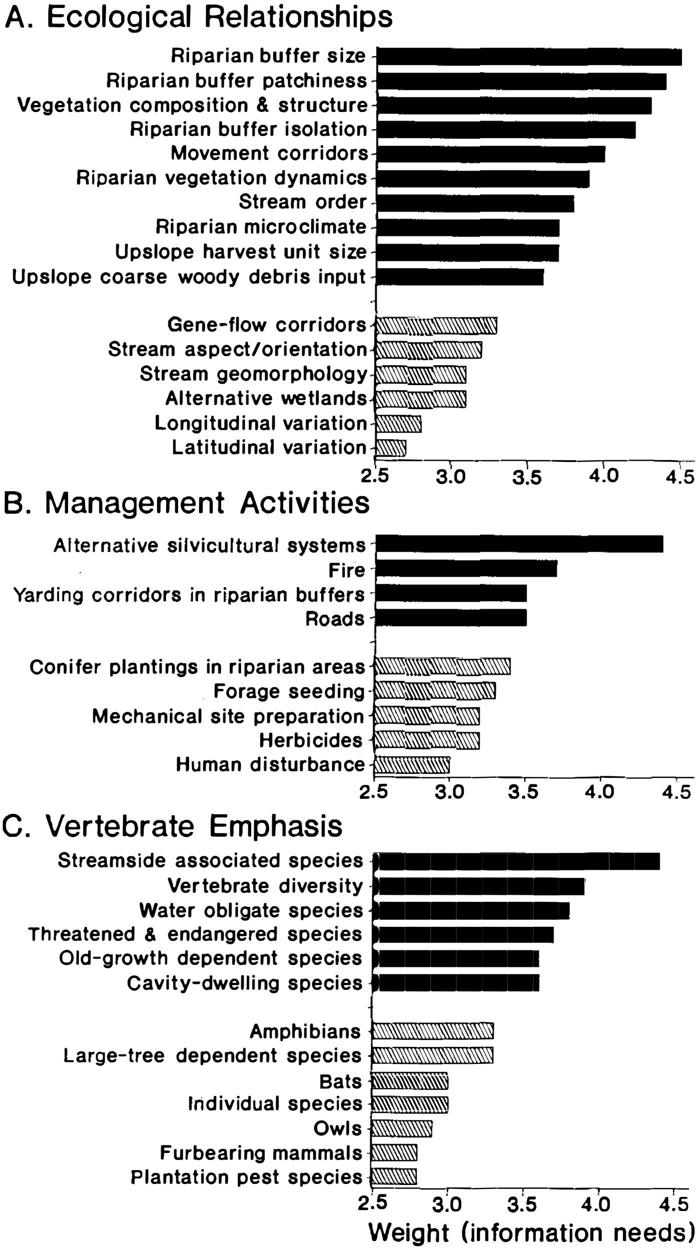

Figure 2. Weighted (see text) overall mean (N = 31) response for research topics on general ecological relationships (A), specific management activities (B), and vertebrate emphasis (C), COPE wildlife problem analysis questionnaire, 1988. Solid bars represent very important or important information needs; dashed bars represent topics of moderate concern. Standard errors range between 0.07–0.15.

ing of wildlife-buffer width relationships to help determine future riparian management guidelines.

Land managers were also concerned with stand-level topics, such as the relationship between riparian stand condition (i.e., vegetation composition and structure) and wildlife, the dynamics of riparian vegetation (particularly isolated buffer strips) over time, the role and importance of large woody debris to riparian wildlife, and the influence of microclimate on riparian-wildlife relationships (Figure 2a). Again, private timber companies were considerably less consistent (mean cv = 38.5 percent) than other organizations (county, mean cv = 19.0 percent; state, mean cv = 5.1 percent; federal, mean cv = 25.5 percent) in their concern for these issues and placed less emphasis on the topic of microclimate relationships ($\bar{x}$ = 2.9, sd = 1.3) than did state ($\bar{x}$ = 3.5, sd = 0.7) and federal ($\bar{x}$ = 3.9, sd = 1.0) agencies. Interest in these topics largely reflects concerns over the Oregon Forest Practices Act regulations, which specifies "leave" requirements for downed wood and large conifers and stresses the importance of protecting the stream microclimate (OAR 629-24). Currently, there is little information available on the value of large conifers and downed wood in riparian areas to terrestrial vertebrates or the influence of microclimate on riparian-associated vertebrates. In addition, there is a lack of understanding of riparian vegetation dynamics over time. In the problem analysis meetings, managers frequently questioned whether the riparian "leave strip" policy, evident in both state and federal management guidelines, is the most effective means of maintaining riparian habitat integrity over time. Many professionals believe that succession in riparian leave strips will proceed first to hardwood-dominated stands and then to brush-dominated sites, and that silvicultural intervention may be required if conifer trees are to be maintained in riparian areas in perpetuity.

All organizations placed low priority on the relationship between landscape geomorphology and riparian wildlife and geographic variation (latitudinal and longitudinal) in riparian-wildlife relationships (Figure 2a). The relatively low concern for geographic variation is surprising, since this topic was often brought up during the problem analysis meetings, and suggests that information provided from a relatively narrow geographic scope (i.e., single basin) may be acceptable to land managers. The relationship among various wetland habitats (e.g., streams, ponds, seeps) and wildlife was also of only moderate concern (Figure 2a), although state agencies believed this was an important topic ($\bar{x}$ = 4.0, sd = 0.0). The relatively low concern for nonstream wetlands reflects the preponderance of stream wetlands in the study area and the stream focus of most riparian management conflicts in western Oregon. The role of riparian areas as gene-flow corridors and the relationship between slope aspect/stream orientation and wildlife were considered of moderate concern overall (Figure 2a), although there was considerable disagreement among organizations. For example, federal agencies considered the topic of gene-flow corridors important ($\bar{x}$ = 3.6, sd = 0.9), while private companies had very little concern for this topic ($\bar{x}$ = 1.9, sd = 0.8). In fact, private industry gave gene-flow corridors the lowest relative score. This probably reflects the fact that most federal agency respondents were biologists with perhaps a greater appreciation of population genetics than most private respondents. In contrast, federal agencies considered the topic of slope aspect/stream orientation of relatively low concern ($\bar{x}$ = 2.9, sd = 1.3), rating only geographic variation lower, while private industry considered this an important topic

($\bar{x}$ = 3.4, sd = 1.0). State agencies considered this topic very important ($\bar{x}$ = 4.5, sd = 0.7).

Management Activities

The effects of alternative silvicultural strategies (e.g., no tree harvest, selective tree harvest, clearcutting) in riparian areas on wildlife was considered the most important information need of specific forest management activities (Figure 2b). The high level of concern for this topic is closely related to interest in riparian vegetation composition, structure, and dynamics (discussed previously) and further supports the need to provide information on management alternatives to the leave strip policy. The effects on wildlife of fire and roads in and adjacent to riparian areas and yarding logs through riparian buffers strips (i.e., creating yarding corridors) were also considered important topics (Figure 2b). The effects on wildlife of conifer reintroduction, mechanical site preparation, forage seeding, herbicide use, and human disturbance in and adjacent to riparian areas were considered of moderate concern. Not surprisingly, private industry ($\bar{x}$ = 3.7, sd = 1.7), county extension ($\bar{x}$ = 4.4, sd = 0.7), and state agencies ($\bar{x}$ = 4.0, sd = 0.0) considered herbicides an important topic, in contrast to federal agencies ($\bar{x}$ = 2.8, sd = 0.7), although this could change if federal agencies are again authorized to utilize herbicides.

Vertebrate Emphasis

Vertebrate species closely associated with streamside areas were considered the most important vertebrates to emphasize when evaluating ecological relationships and management impacts in riparian areas (Figure 2c). In other words, in order for land managers to formulate effective riparian management guidelines, information is needed most on those vertebrate species strongly associated with streamside areas. This emphasis was expected given the nature and scope of the COPE wildlife research program. Interestingly, diversity of all terrestrial vertebrates was considered the second most important vertebrate emphasis (Figure 2c). This largely reflects federal agency mandates to maintain populations of all native and desired non-native vertebrates; private ($\bar{x}$ = 3.3, sd = 1.3) and county ($\bar{x}$ = 2.5, sd = 1.3) organizations placed less emphasis on diversity than did state ($\bar{x}$ = 4.5, sd = 0.7) and federal ($\bar{x}$ = 4.0, sd = 0.8) agencies. Water obligate species (e.g., beaver, *Castor canadensis*), federal or state threatened or endangered species, old-growth associated species and cavity-dwelling species were also considered important vertebrates to emphasize in future riparian studies (Figure 2c). Not surprisingly, threatened and endangered species and old-growth species were considered important by state ($\bar{x}$ = 3.5, sd = 0.7, both issues) and federal agencies ($\bar{x}$ = 3.9, sd = 1.1, both issues), while private industry placed lower emphasis on these groups ($\bar{x}$ = 2.7, sd = 1.6 and $\bar{x}$ = 2.2, sd = 1.3, respectively).

Other vertebrate groups, including amphibians, large-tree obligates, individual species of special interest, bats, owls, furbearing mammals and plantation pests were considered of moderate concern overall (Figure 2c). However, there were notable differences among organizations. For example, federal agencies considered amphibians an important group to emphasize ($\bar{x}$ = 3.6, sd = 0.7), while private industry ($\bar{x}$ = 3.2, sd = 1.2) and county extension agents ($\bar{x}$ = 3.9, sd = 1.4) considered vertebrate plantation pests a relatively important group to emphasize. The relatively low concern for individual species in favor of species assemblages is interesting given the past emphasis on single species management within state and federal agencies. Discussions in the problem analysis meetings and questionnaire results indicate a change in management philosophy away from single species management and in the direction of community/ecosystem management, and suggest the need to provide information to land managers in a community-oriented context.

Summary and Conclusions

To summarize, land managers emphasized the need for information at basin- and stand-level spatial scales and 10- to 100-year temporal scales to allow them to more effectively manage riparian areas for wildlife. Landscape issues related to forest fragmentation were considered very important topics, reflecting the growing recognition of the potential significance of forest fragmentation effects on wildlife and the growing desire to manage wildlife populations at the landscape level. Stand-level information such as the relationship between riparian vegetation composition, structure, and dynamics and the wildlife community was also considered important and points to the need to investigate fully the biological ramifications of the Oregon Forest Practices Act riparian management regulations. Managers also expressed high interest in evaluating alternative silvicultural strategies in riparian areas designed to maintain riparian habitat integrity over time. In order to formulate more effective riparian management guidelines for terrestrial wildlife, managers expressed the greatest need for information on vertebrate species closely associated with streamside areas, followed by information on diversity of all terrestrial vertebrates and water obligate species. Finally, although not quantified, land managers expressed overwhelming support for multidisciplinary approaches to riparian studies that lead to the design and implementation of riparian management strategies for the benefit of multiple forest resources.

In general, private industry rated most issues much lower in importance than state or federal agencies. Hence, as a group, private industry seemed to exhibit less interest in riparian-wildlife issues than state or federal agencies. This probably reflects differences in land management objectives between private companies and public agencies and the interest-level of respondents within different organizations. In contrast to private timber companies, state and federal agencies employ wildlife biologists with a primary interest in and responsibility for forest-wildlife relationships, as evidenced by the relatively high level of concern for the riparian-wildlife topics in the questionnaire.

In general, private industry exhibited nearly twice the variation in response scores on most issues than state or federal agencies. Timber companies were extremely variable in their concern for the wildlife resource; some timber companies demonstrated a level of concern equal to or greater than state and federal agencies, while other companies demonstrated minimal interest in the issues. This wide variation in concern over issues undoubtedly reflects differences in company objectives and concern for the wildlife resource, but also may reflect a lack of understanding of the issues by persons employed by the companies. Individuals not fully understanding the nature and implications of an issue would be more likely to rate it lower than someone fully aware of an issue.

With notable exceptions, there was, nevertheless, remarkable concordance among private industry, county extension, state and federal agencies in the relative importance of various spatial and temporal scales, land management topics and vertebrate groups. Hence, the questionnaire proved useful in prioritizing information needs in western Oregon and providing direction for the COPE wildlife research program. Indeed, our findings have regional application and should be useful for similar research efforts in western Washington, such as the effort underway by the Center for Streamside Studies at the University of Washington. Perhaps more importantly, the personal meetings between researchers and land managers in conjunction with the questionnaire helped build awareness of the riparian-wildlife issues among all persons involved and served to bridge the critical gap between research and management. By improving communication and cooperation among researchers and managers, we have improved the likelihood that information generated through COPE research will be utilized by land managers to enhance the benefits derived from forest-associated resources of coastal Oregon.

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Agricultural Chemicals and Prairie Pothole Wetlands: Meeting the Needs of the Resource and the Farmer—U. S. Perspective

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Introduction

The prairie-pothole region of North America is the principal breeding ground for many species of North American waterfowl (Stewart and Kantrud 1973, 1974). Although the region comprises only 10 percent of the continent's waterfowl breeding area, it accounts for 50 percent or more of the annual waterfowl production (Smith et al. 1964). Unfortunately, drainage of wetlands for agriculture within the region has been severe. For example, in North Dakota, which contains about one-third of the prairie-pothole region in the United States (Figure 1), an estimated 20,000 acres (8,000 ha) of wetlands have been drained annually (McKenna et al. 1988). Although losses within the State have been reduced in recent years, less than 50 percent of the original wetland area remains (McKenna et al. 1988). In addition to losses from drainage, the number of wetlands available to adult and juvenile waterfowl has been restricted further by recent droughts. Concommitant with the reduction in available wetlands has been a decline in waterfowl populations. Numbers of several species reached their lowest levels on record in 1985 and 1988; estimates of the total number of breeding ducks in 1988 were 16 percent below the 1955–87 average (Anonymous

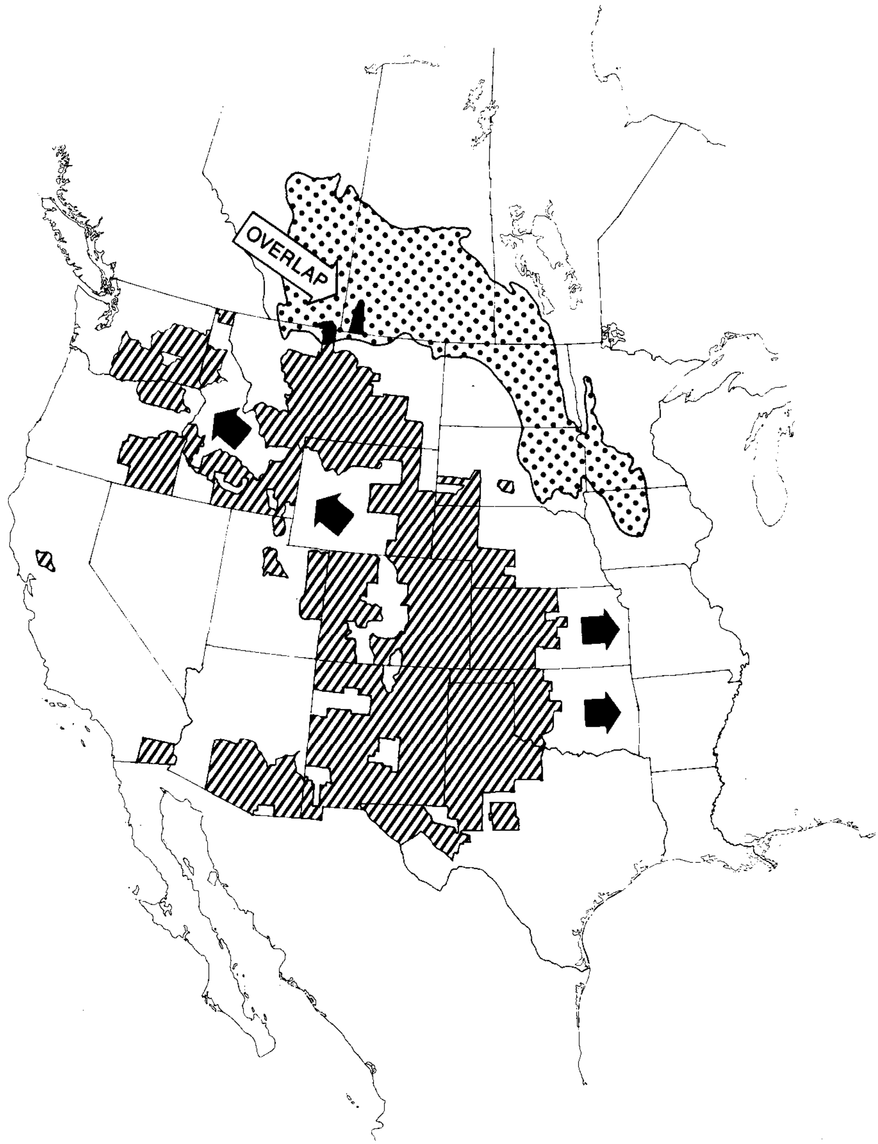

Figure 1. Location of the prairie-pothole region of North America (dotted area, after Stewart and Kantrud 1977) and the range of the Russian wheat aphid in 1988 (diagonal lines, Russian Wheat Aphid Investigative Committee, Great Plains Agricultural Council; unpublished data). Areas of overlap as of 1988 occurred in northern Montana and southern Alberta and Saskatchewan. Black arrows designate direction of range expansion of the aphid in 1988.

1988). In a joint effort to reverse this trend, the United States and Canada developed the North American Waterfowl Management Plan. It identifies specific population goals for individual waterfowl species to be achieved by the year 2000, primarily through the protection, restoration, and improved management of waterfowl habitat (Anonymous 1986).

Wetland loss, however, is only one of several possible factors contributing to the recent declines in North American waterfowl populations. Other factors include loss of upland nesting habitat, increased hunting pressure, increased predation related to reductions in the quantity of habitat, and reductions in habitat quality induced by agricultural chemicals (Sheehan et al. 1986, Sargeant and Raveling, in press). Herein, we discuss the reasons for concern over the effects of agrichemicals (pesticides and fertilizers) on prairie-pothole wetlands in the United States, summarize the results of studies conducted to date on this topic and identify the additional research needed to assess the impacts of agrichemicals on these wetlands. We conclude with a discussion of management strategies and initiatives which we believe may minimize inputs of these chemicals and their impacts on wetlands and waterfowl within this portion of the prairie-pothole region, while still meeting the needs of the agricultural community.

Reasons for Concern: Present and Future

There are several reasons for concern over the potential impacts of agrichemicals on wetlands within the United States' portion of the prairie-pothole region. First, the use of these chemicals within the region in the United States has increased. In North Dakota alone, the percentage of cropland treated with herbicides increased 53 percent between 1978 and 1984. During this same time period, the percentage of cropland treated with insecticides and fungicides increased 745 and 433 percent (McMullen et al. 1985, Grue et al. 1988). Also, the use of chemical fertilizers increased 38 percent between 1975 and 1984 (North Dakota Crop and Livestock Reporting Service 1985). Second, the application of these chemicals frequently coincides with the breeding season of waterfowl, and many of the insecticides applied are either acutely toxic to waterfowl, to the aquatic invertebrates on which adult and juvenile waterfowl depend for food, or both (Grue et al. 1986, 1988). For example, 13 of the 16 insecticides most commonly used in North Dakota (more than 10,000 acres, 4,000 ha) in 1984 have been classified as highly toxic to waterfowl or aquatic invertebrates (Grue et al. 1986, Johnson 1986). Twenty-three percent of the 2.9 million acres (1.2 million ha) to which insecticides were applied in 1984 were aerially sprayed with ethyl parathion and carbofuran, insecticides highly toxic to waterfowl. Insecticides considered highly toxic to freshwater invertebrates were aerially applied to 58 percent of the total acreage treated, with ethyl parathion and fenvalerate accounting for the majority of the acreage sprayed (McMullen et al. 1985, Grue et al. 1986). And third, the potential for agricultural chemicals to enter prairie-pothole wetlands and other nontarget habitats is great (e.g., *see* Grue et al. 1988, Figure 2). Cropland and rangeland frequently surround small wetlands. Most potholes are less than 1 acre (0.4 ha) in size (Smith and Stoudt 1968, Millar 1969), and may number as many as 100 per square mile (39 km^2) (Smith et al. 1964). Wetland margins are also frequently reduced during cultivation (Brace and Caswell 1985), and in dry years wetland basins may be cultivated and treated directly with fertilizers, herbicides and insecticides.

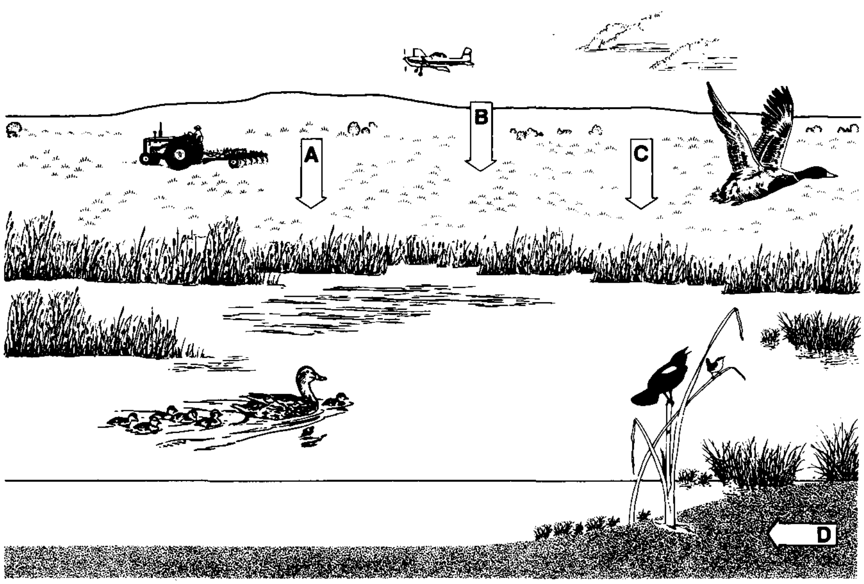

Figure 2. Primary routes by which agricultural chemicals may enter prairie-pothole wetlands: A = direct tillage of wetland basins, B = direct overspray during aerial application or drift following aerial or ground application, C = runoff from adjacent treated fields, and D = contaminated ground water. Drawing adapted from Pettingill (1970:237), Snyder and Synder (1984:cover), and Stuber (1988:cover).

The relatively short distance between wetlands, their small size, and the proximity of agricultural land to their boundaries, make direct inputs (overspray or drift) by aerial applicators unavoidable, if complete crop coverage is to be obtained. For example, studies indicate that 14 to 95 percent of insecticide formulations drift off-target when applied by aircraft, with an average actual deposit on target of only 46 percent (Ware et al. 1970). Fifty-nine percent of the 2.9 million acres treated with insecticides in North Dakota in 1984 were sprayed by aircraft; comparable statistics for 1978 were 21 percent and 366 thousand acres (146,000 ha) (McMullen et al. 1985).

Chemical Control for the Russian Wheat Aphid

A major change in pesticide use in the United States' portion of the prairie-pothole region may be an increase in the use of insecticides on cultivated small grains to control the Russian wheat aphid (*Diuraphis noxia*). The aphid invaded the United States from Mexico in 1986 and within three years has infested small grains within the majority of the western States (Stoetzel 1987, Figure 1). In 1987, about 28 percent of the 59.1 million acres (23.6 million ha) of small grains grown on the Great Plains were infested with the aphid (Table 1). Economic losses on the Great Plains in 1987 were estimated at 53 million dollars (Russian Wheat Aphid Investigative Committee 1988). In the past, insecticide use on small grains within the United States' portion of the prairie-pothole region has been low (e.g., less than 4 percent

Table 1. Production of small grains and Russian wheat aphid infestation within selected states in 1987.[a]

State	Acres (ha) planted × 1000				Total	% Acres (ha) infested
	Wheat[b]	Barley	Oats	Rye		
Colorado	2,550 (1,020)	220 (88)	100 (40)	10 (4)	2,880 (1,152)	100
Kansas	10,000 (4,000)	150 (60)	150 (60)	50 (20)	10,350 (4,140)	39
Montana	5,700 (2,280)	2,400 (960)	250 (100)	0	8,350 (3,340)	7
Nebraska	1,950 (780)	75 (30)	400 (160)	50 (20)	2,475 (990)	65
New Mexico	740 (296)	22 (9)	0	0	762 (305)	100
North Dakota	8,900 (3,560)	3,000 (1,200)	1,050 (420)	160 (64)	13,110 (5,244)	0
Oklahoma	5,200 (2,080)	35 (14)	100 (40)	40 (16)	5,375 (2,150)	19
South Dakota	3,512 (1,405)	930 (372)	1,500 (600)	130 (52)	6,072 (2,429)	3
Texas	8,100 (3,240)	70 (28)	1,000 (400)	6 (2)	9,176 (3,670)	56
Wyoming	310 (124)	170 (68)	95 (38)	0	575 (230)	48
Totals	46,962 (23,650)	7,072 (2,829)	4,645 (1,858)	446 (178)	59,125 (23,650)	28

[a]Data compiled from Russian Wheat Aphid Investigative Committee (1988).
[b]Spring and winter wheat combined.

of acreage planted with small grains in North Dakota, Grue et al. 1986) in comparison to that of other crops. Small grains are the predominant crops grown within the prairie-pothole region in North Dakota accounting for more than 50 percent of the acreage planted annually (McMullen et al. 1985, Grue et al. 1986). The arrival of the aphid in North Dakota, which appears to be imminent (Russian Wheat Aphid Investigative Committee 1988), could result in a significant increase in direct and indirect insecticide inputs to prairie wetlands and other non-target habitats.

In 1987, 2.4 million acres (1 million ha, includes multiple applications to the same acreage) were treated with insecticides to control the aphid in the western United States. Insecticides registered to control the aphid include dimethoate, disulfoton, and ethyl and methyl parathion (Table 2). In addition, several states have requested an emergency label exemption for chlorpyrifos from the Environmental Protection Agency to control the aphid (F. B. Peairs, pers. comm.). All of these chemicals are highly toxic to waterfowl and moderately to highly toxic to aquatic invertebrates. Recent studies (Peairs 1988) suggest that chlorpyrifos may be the most effective in controlling the aphid. Chlorpyrifos also appears to be the least toxic to waterfowl

Table 2. Insecticides used to control the Russian wheat aphid and their toxicity to aquatic invertebrates and juvenile waterfowl.

Chemical	Common trade name	Application rates[a]		Number of applications	Toxicity		Reported wildlife mortality[d]
		lbs	kg AI/ha		Aquatic invertebrabes[b]	Mallards[c]	
Chlorpyrifos[e]	Lorsban;® 4E	0.25–0.50	0.25–0.56	2	Very high	High[f]	Yes
Dimethoate	Cygon® 400	0.25–0.40	0.25–0.45	2	Moderate	High	Yes
Disulfoton	Di-Syston® 8	0.25–0.75	0.25–0.84	2	Moderate	Very high	Yes
Methyl parathion	Methyl parathion 4E	0.25–0.75	0.25–0.84	NLR[g]	High	Very high	Yes
Parathion[h]	Parathion 8-E	0.25	0.25	NLR	High	Very high	Yes

[a]AI = active ingredient.

[b]96h LC_{50} for various species of the amphipod *Gammarus*: Low = > 1.0, Moderate = 0.01–1.0, High = 0.001–0.01, Very high = < 0.001 ppm. Data compiled from Mayer an Ellersieck (1986).

[c]LD_{50} for 3–5 month old mallards (*Anas platyrhynchos*) expressed as mg chemical per kg of body weight: Low = > 1000, Moderate = 200–1000, High = 40–200, Very high = < 40. Data compiled from Hudson et al. (1984).

[d]Reports associated with control of insects other than the Russian wheat aphid: chlorpyrifos (Grue et al. 1983, Smith 1987), dimethoate (L. J. Blus, Patuxent Wildlife Research Center unpublished data), disulfoton (unconfirmed report, Smith 1987; Colorado Division of Wildlife, unpublished data), methyl parathion (parathion + methyl parathion, Grue et al. 1983) parathion (Grue et al. 1983, Smith 1987).

[e]Emergency (FIFRA Section 18) label exemption granted to some states in 1989 by the Environmental Protection Agency for controlling the aphid.

[f]Age unknown.

[g]NLR = no label restriction.

[h]6:3 mixture of parathion and methyl parathion also registered for controlling the Russian wheat aphid.

and other wildlife (Hudson et al. 1984, McEwen et al. 1986, Clements and Bale 1988), but the most toxic to aquatic invertebrates (Table 2).

Studies Conducted to Date

The potential for agrichemicals to enter prairie-pothole wetlands and directly or indirectly impact adult and juvenile waterfowl in the United States and Canada appears to be great (Grue et al. 1986, 1988; Sheehan et al. 1986, Mineau et al. 1988). However, few studies have evaluated, *in situ*, the effects of currently used chemicals on the quality of prairie-pothole wetlands (for a recent review of Canadian research, *see* Forsyth 1989 in this volume).

In the first published study of its kind within the United States' portion of the prairie-pothole region, Hanson (1952) assessed the impacts of aerial applications of the herbicide 2,4-D, and the insecticides chlordane, DDT, and toxaphene on aquatic plants and invertebrates, birds, and mammals within five North Dakota wetlands. All of the compounds tested had effects on the wetlands studied; however, only 2,4-D (amine and ester as emulsifiable concentrates) is currently registered for agricultural use in North Dakota. Hanson found that both of the 2,4-D formulations he studied (amine = 8 ounces active ingredient [AI]/acre, 0.6 kg/ha, emulsifiable concentrate; ester = 16 ounces AI/acre, 1.1 kg/ha, in No. 2 diesel oil) resulted in the death of 50 to 100 percent of nine species of dicotyledons (e.g., smartweed [*Polygonum* spp.] and watercrowfoot [*Ranunculus* spp.]) within the oversprayed wetland and its borders. Monocotyledons (e.g., bulrush [*Scirpus* spp.] and sedges [*Carex* spp.]) were also affected by the amine and ester formulations, but the latter was more toxic. Only a few invertebrates were killed by the ester, presumably because it was mixed with oil. No other species of animals were reported to have been affected by either herbicide treatment. No additional research was conducted on this topic in the United States until 1986.

In 1986, biologists from the Patuxent and Northern Prairie Wildlife Research Centers found that the aerial application of 2,4-D (4 ounces AI/acre, 0.3 kg/ha, emulsifiable concentrate) to North Dakota prairie-pothole wetlands adjacent to, or surrounded by, spring wheat had no apparent impact on the majority of aquatic plants, aquatic invertebrates, or three-week-old mallard (*Anas platyrhynchos*) ducklings (Borthwick 1988; C. E. Grue, L. R. DeWeese, G. A. Swanson, and S. M. Borthwick, unpublished data). In contrast, subsequent applications of the insecticides methyl (4 ounces AI/acre) and ethyl (8 ounces AI/acre) parathion as emulsifiable concentrates resulted in the mortality of most aquatic invertebrates with effects persisting for up to 18 days post-spray (Borthwick 1988); however, three-week-old blue-winged teal (*Anas discors*) appeared to be unaffected (C. E. Grue, L. R. DeWeese, G. A. Swanson, and S. M. Borthwick, unpublished data).

In 1987, this research group assessed the impacts of aerial applications of ethyl parathion (16 ounces AI/acre, emulsifiable concentrate) to sunflower fields adjacent to these same wetlands. In one study, the survival of mallards with broods (2 females with 10–12 ducklings each) and selected aquatic invertebrates was monitored on each of five fenced wetlands within the sunflower fields before and after an operational application of the insecticide. In this study, the pilot was instructed to follow normal procedures for sunflower fields in the area. Comparable data were collected on each of five fenced control wetlands surrounded by dense nesting cover (DNC) or native vegetation. By three days post-spray, 3.8 percent of the 104 ducklings released onto the wetlands within the treated sunflower fields were alive, whereas on the control wetlands, duckling survival ranged from 32 to 65 percent ($\overline{X}$ = 52 percent) of the 20 to 24 ducklings originally released per wetland. Brain cholinesterase (AChE) activity, a sensitive indicator of exposure to, and diagnostic of death from, organophosphorus insecticides (Hill and Fleming 1982) was severely depressed ($\geq$ 50 percent) in all but one of the ducklings found dead post-spray (n = 50) compared to controls collected during the same time period (n = 23). Effects on aquatic invertebrates within the wetlands were also severe. The survival of amphipods (*Hyalella azteca*) in 0.5 gallon enclosures within the contaminated wetlands was significantly reduced during the 25 days following the insecticide application compared to the controls. Wild juvenile waterfowl within unfenced wetlands in the sunflower fields and free-living aquatic invertebrates (except snails) within the fenced wetlands were also killed by the insecticide (Grue et al. 1988; C. E. Grue, M. W. Tome, S. M. Borthwick, and G. A. Swanson, unpublished data).

Also in 1987, the potential for drift and resultant wetland impacts following an aerial application of ethyl parathion (16 ounces AI/acres, emulsifiable concentrate) to sunflowers surrounding several unfenced wetlands was measured. In this study, the pilot was instructed to avoid contaminating the wetlands, but to still treat the entire crop. The insecticide was applied between 0650 and 0741 under environmental conditions ideal for aerial application (wind $\leq$ 4 mph, air temperature = 72°F). Although visual observations indicated that none of the study wetlands were oversprayed, wetland contamination was sufficient to cause the death of selected aquatic invertebrates that had been placed in enclosures in the wetlands. In addition, brain (AChE) activity was depressed an average of 23 percent in three-week-old blue-winged teal collected from the contaminated wetlands two days post-spray compared to teal of the same age collected from similar wetlands surrounded by native vegetation or DNC (Grue et al. 1988).

Research Needs

Additional studies are needed to quantify impacts of agrichemicals on the quality of prairie-pothole wetlands in the United States and to determine the effects of changes in habitat quality on waterfowl productivity. The objectives of this research should be to (1) determine the extent of wetland contamination within this portion of the prairie-potholes region, (2) determine the direct and indirect effects of these chemical inputs on waterfowl productivity, and (3) identify the chemicals and management strategies that minimize risks to waterfowl and other wildlife dependent on wetlands within the region. The specific research questions outlined below are interrelated, and answers to these questions should provide the information necessary to meet the needs of the farmer and protect wetlands within the region.

What Is the Extent of Contamination of Prairie-Pothole Wetlands by Normal Uses of Agrichemicals?

Recent studies (Grue et al. 1988, C.E. Grue, M.W. Tome, S.M. Borthwick and G.A Swanson unpublished data) suggest that normal uses of selected agrichemicals, particularly aerially-applied insecticides, can result in biologically significant contamination of prairie-pothole wetlands. However, these studies by design have been site specific. Additional studies are needed to develop or enhance methodologies that will facilitate the detection of wetland contamination within the entire region. Previous studies have relied heavily on chemical analyses to document contamination of study wetlands by agrichemicals. Unfortunately, these analyses are expensive, take a great deal of time, and interpretation of the results depends on the availability of corresponding data on biological effects. Furthermore, the detection limits of these analyses may not be as sensitive as *in situ* bioassays. For example, results of recent studies suggest that bioassays using selected aquatic invertebrates (amphipods: *Hyalella azteca*, snails: *Lymnaea stagnalis* and *Stagnicola elodes*) are indicative of wetland contamination following aerial application of some insecticides for a longer period of time post-spray than chemical analyses of water, sediment, aquatic plants and invertebrates, and juvenile waterfowl (Borthwick 1988; L. R. DeWeese, C. E. Grue, G. A. Swanson, and S. M. Borthwick, unpublished data). The efficacy of these and other bioassays (e.g., Microtox®, Microbics Corporation, Carlsbad, CA; Res-I-Mune®, ImmunoSystems, Inc., Biddeford, ME; mention of these trade names is for identification purposes only and does not constitute endorsement by the Federal government) for intensive and extensive surveys of wetland contamination needs to be evaluated. Extensive multi-year surveys of wetland contamination are needed to provide data suitable for inclusion in available models (e.g., *see* Cowardin et al. 1988) that incorporate information on habitat use, inputs of agrichemicals, and data on biological effects.

What Are the Seasonal and Cumulative Effects of Agrichemicals on the Productivity of Waterfowl Utilizing Wetland Habitats Within Intensively Farmed Areas?

Data collected to date suggest that adult and juvenile waterfowl utilizing wetlands within intensively farmed areas are likely to be exposed to aerially-applied insecticides, and that the direct and indirect effects on waterfowl productivity may be severe (Brewer et al. 1988, Fairbrother et al. 1988, Grue et al. 1988). These studies, however, have focused on only a small number of chemicals, crops, and agricultural practices, and a small portion of the waterfowl reproductive cycle. Of particular concern is the potential increase in the use of insecticides on small grains to control the Russian wheat aphid. Small grains are the predominant crops in the region and are also used as nesting habitat by some species of waterfowl (Duebbert 1987). The establishment of research areas (wetland complexes and watersheds enclosed with predator-proof fences) and the use of wing-clipped, pen-reared, wild strain female mallards and blue-winged teal equipped with radios would facilitate studying the effects of selected chemicals on waterfowl reproduction (egg laying through Class III ducklings). The proposed research would identify those agricultural chemicals and practices that pose the greatest and least risk to waterfowl, and provide data suitable for models and generating specific management recommendations.

Does Intermittent Tillage of Wetland Basins Affect the Quality of Seasonal Wetlands for Adult and Juvenile Waterfowl?

Seasonal wetlands appear to be those most important to adult dabbling ducks during the breeding season (Kantrud and Stewart 1977, Swanson and Duebbert 1989). During wet years, they also provide food and cover for broods and adult diving ducks

(Talent et al. 1982, Woodin and Swanson 1989). The high productivity of these wetlands provides the aquatic invertebrates that are an essential source of protein and calcium for laying females and growing ducklings (Krapu 1979; Swanson et al. 1979, 1985; Swanson and Duebbert 1989). In dry years, or late in the growing season, these wetlands are frequently tilled, planted, and directly treated with fertilizers, herbicides and insecticides (Kantrud and Steward 1977), only to be reflooded with subsequent rainfall. Seasonally flooded basins also function as groundwater recharge areas supplying water and the associated solutes, which may contain agrichemicals, to adjacent wetlands (LaBaugh et al. 1987). Currently, no data exist on the short- or long-term effects of these practices on the quality of these wetlands for waterfowl and others that may be indirectly affected. A multi-year comparison of agrichemical contamination, vegetation, aquatic invertebrates, and waterfowl use within tilled and untilled wetlands is needed.

How Does the Potential for Contamination Differ Between Wetlands Within or Adjacent to Fields Under Sustainable Agricultural Operations and Those Within Fields Under Conventional Tillage Practices?

Natural resource and conservation agencies are promoting the use of sustainable agriculture in an effort to minimize soil loss or deterioration, reduce agrichemical inputs, and increase habitat for waterfowl and other species of wildlife. Sustainable agricultural operations include the use of specific crop rotations (crop diversification), crop residues (conservation tillage), natural organic wastes (manure) instead of synthetically compounded fertilizers, and biological pest control (Kirschenmann 1988). Few data exist on the benefits of non-conventional agricultural systems to wildlife within the prairie-pothole region, and no data exist on how these systems compare with conventional practices in their effects on wetland quality. Higgins (1977) found the density of duck nests and the number of nests that produced young were 12 to 16 times greater on untilled uplands than within tilled croplands. Similarly, Cowan (1982) reported that waterfowl production on zero-tillage farms was nearly 4 times greater than that on conventional farms. More recently, Duebbert (1987) found no-till winter wheat provided acceptable nesting habitat for five species of waterfowl averaging nearly three nests per 100 acres (40 ha) with 27 percent of the nests producing young. Duebbert did not detect any adverse effects on nest success from the herbicides or fungicides that were used on the fields he studied. The advantages of sustainable versus conventional agriculture in reducing the potential for contamination of wetlands by agrichemicals need to be quantified.

How Effective Are Buffer Zones And Other Strategies In Minimizing Contamination of Prairie-Pothole Wetlands From Direct Overspray, Drift, or Runoff?

Buffer zones have been suggested as one means of reducing inputs of agrichemicals into non-target habitats within the prairie-pothole region. However, characteristics of these zones that will protect wetlands and meet the needs of the farmer have not been determined. Nor is there adequate information on the efficacy of other strategies for minimizing inputs. For example, differences in chemical formulations and methods of application may be important factors. Maintenance of grassed waterways may be an effective strategy to reduce wetland contamination through runoff. Research that evaluates the efficacy of buffer zones and other strategies using chemical and biological indicators of agrichemical inputs is needed.

Does Exposure to Agrichemicals Directly or Indirectly Contribute to Mortality of Waterfowl From Botulism and Other Diseases?

A recent investigation of waterfowl mortality related to botulism in North Dakota reported depressed brain AChE activity in one of the specimens collected alive (National Wildlife Health Research Center, unpublished data, R. Windingstad, pers. comm.). To our knowledge, this is the first case in which exposure to insecticides or other agrichemicals has been linked to a disease outbreak in waterfowl. In addition, recent studies conducted by biologists at the Northern Prairie Wildlife Research Center and the National Wildlife Health Research Center suggest that the toxin responsible for botulism can be generated by large die-offs of aquatic invertebrates (N.H. Euliss, Jr. and T.E. Rocke unpublished data). These die-offs could result from inputs of insecticides or other agrichemicals. Data on the direct or indirect contribution of inputs of these chemicals to the mortality of waterfowl from botulism and other diseases is lacking. Multi-year field and laboratory studies are needed to address this question.

Management Strategies and Initiatives: Now and in the Future

Resource agencies, conservation organizations and the agricultural community, however, cannot afford to wait five to ten years for the results of the studies outlined above before initiating a cooperative effort to minimize agrichemical contamination of prairie-pothole wetlands. Integrated interagency educational programs that promote strategies for reducing agrichemical inputs into nontarget habitats while benefiting the farmer are essential. Resource agencies and conservation organizations must be viewed as partners with the agricultural community in this endeavor, if the needs of the wetland resource and the farmer are to be met. To do this, resource agencies and conservation organizations will not only have to commit funds and personnel to evaluate the efficacy of management strategies, but will also have to help provide the information, training and incentives necessary for landowners and commercial pesticide applicators to modify their operations. Currently, the agrichemical industry invests millions of dollars in promoting their products, of which a significant amount goes to university extension and experiment station personnel. For resource agencies and conservation organizations to become true partners with agriculture in an effort to reduce wetland contamination, they must be willing to do the same.

We believe the following steps can be taken now to minimize inputs of agrichemicals to prairie-pothole wetlands and reduce impacts on the quality of these wetlands for waterfowl and other wildlife. First, landowners and commercial pesticide applicators must be made aware of the potential for agrichemicals, particularly aerially-applied pesticides, to enter and impact wetlands. Current pesticide applicator training and certification programs (for landowners and commercial applicators) stress proper handling, storage and disposal of chemicals. Little, if any, information on potential ecological impacts or alternatives to chemical use is included. A truly integrated training and certification program is needed. One way to do this would be to add resource agency representation to existing training teams. In addition, the relative toxicity of pesticides to aquatic invertebrates and wildlife, particularly waterfowl, their persistence in aquatic environments, and their efficacy against target pests need to be included in pesticide use recommendations prepared by university extension and experiment stations. The use of those chemicals that are efficacious, but are the least likely to contaminate ground water, or kill aquatic invertebrates, plants, and wildlife, needs to be encouraged. The use of "spot treatments" instead of whole-field applications also needs to be promoted, and landowners and commercial applicators trained to identify these situations. Increased emphasis on adherence to label instructions, economic thresholds, equipment calibration and maintenance, and use of application methodologies that minimize the potential for overspray of, or drift onto, nontarget habitats will help to reduce the potential for wetland contamination.

Second, but probably most important in the long term, is the need to promote agricultural systems that minimize, or offer alternatives to, agrichemical use (e.g., *see* Odum 1987, Leininger 1988). The conversion from conventional to sustainable agriculture will be a major step toward protecting the quality of wetlands and increasing available cover for wildlife. Conservation tillage, integrated pest management, grassed waterways and vegetative filter strips are all components of sustainable agriculture. Although this concept is not new, it is only now receiving attention, probably in response to soil erosion, decreased soil fertility, the increasing need and cost for agrichemicals and declines in farm profits. For example, only 20 percent of the 17.2 million acres (6.9 million ha) planted in North Dakota in 1988 were under some form of conservation tillage (Conservation Technology Information Center 1988).

A good example of the potential to reduce agrichemical use through the use of non-chemical alternatives is illustrated in Table 3. In fiscal year 1987, Region 6 of the United States Fish and Wildlife Service (which includes the majority of the prairie-pothole region in the United States) began a concerted effort to minimize the use of pesticides on national wildlife refuges and waterfowl production areas. The initiative was stimulated by a pesticide use survey within the Region which indicated a steady increase in pesticide use, primarily herbicides for noxious weed control, without a corresponding increase in land base. The primary strategies of the program were (1) to prevent the spread of noxious weeds, not eradicate them, (2) to incorporate weed control into all land management practices rather then consider it a separate issue, and (3) to seek and implement non-chemical control methods. Experimentation was encouraged. In North Dakota, the result was a reduction of 50 percent in the acres treated with pesticides, primarily herbicides, between fiscal years 1986 and 1988, and a 41 percent decrease in the amount of chemical applied (Table 3). The majority of the reduction was effected through an increase in haying, use of alternative crop rotations, and grazing by domestic goats and sheep. In fiscal year 1987, chemical control accounted for more than 50 percent of acreage treated for noxious weeds, whereas in fiscal year 1988 chemical control accounted for only 33 percent (S.B. Berlinger pers. comm.). Discussions are currently underway between the Service and the North Dakota Weed Control Association to establish collaborative teams to analyze local weed control problems, seek non-chemical solutions and establish demonstration and monitoring programs, all of which hopefully will lead to the type of long-lasting partnership previously discussed.

Table 3. Pesticide use on U.S. Fish and Wildlife Service national wildlife refuges (NWR) and wetland management districts (WMD) in North Dakota, 1986–88 (S.B. Berlinger pers. comm.).

NWR, WMD, or Complex[b]	1986[a]		1987		1988	
	Acres[c]	lbs AI[d]	Acres	lbs AI	Acres	lbs AI
Arrowwood Complex	2,317 (927)	1,830 (832)	2,329 (932)	2,721 (1237)	757 (303)	689 (313)
Audubon Complex	942 (377)	533 (242)	1,089 (436)	621 (282)	387 (155)	294 (134)
DesLacs NWR	713 (285)	780 (355)	207 (83)	418 (190)	88 (35)	107 (49)
Devils Lake WMD	798 (319)	887 (403)	236 (94)	917 (417)	261 (104)	307 (140)
J. Clark Salyer Complex	1,725 (690)	1,800 (818)	2,108 (843)	3,596 (1,635)	1,492 (597)	1,525 (693)
Kulm WMD	770 (308)	1,145 (520)	1,064 (426)	1,018 (463)	229 (92)	263 (120)
Tewaukon Complex	2,212 (885)	2,089 (950)	1,189 (476)	1,043 (474)	1,476 (590)	1,775 (807)
Upper Souris NWR	215 (86)	269 (122)	91 (36)	240 (109)	192 (77)	572 (260)
Totals	9,692 (3,877)	9,333 (4,242)	8,313 (3,326)	10,574 (4,807)	4,882 (1,953)	5,532 (2,515)
Percent change[e]	—	—	−14	+13	−50	−41

[a]Fiscal year beginning 1 October.
[b]Complex = Refuge + Wetland Management District
[c](hectares)
[d]AI = active ingredient (kilograms)
[e]Compared to 1986.

Conclusions

The potential for some agrichemicals to enter prairie-pothole wetlands and reduce the quality of these wetlands for waterfowl and other wildlife is great. Additional studies are needed to (1) determine the extent of wetland contamination by agrichemicals, (2) determine the direct and indirect effects of this contamination on waterfowl productivity and (3) identify the chemicals and management strategies that minimize chemical inputs and resultant ecological impacts. Educational programs that promote strategies for reducing wetland contamination, while benefiting the farmers' agricultural operation, are essential. Resource agencies, conservation organizations and the agricultural community will have to commit funds and personnel to evaluate the effectiveness of strategies to reduce wetland contamination and then provide the information, training and incentives necessary for landowners to modify their farming practices. Only through research, education and mutual cooperation will the potential for agrichemicals to impact the quality of prairie-pothole wetlands be reduced and the needs of the farmer and the wildlife resource be met.

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Agricultural Chemicals and Prairie Pothole Wetlands: Meeting the Needs of the Resource and the Farmer—Canadian Perspective

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Introduction

Approximately 64 percent of the total area of the prairie pothole region is located in Canada and provides breeding habitat for 16 million of the North American duck population of 62 million (Anonymous 1986, Sheehan et al. 1987). There are an estimated (Gollop 1964) 10 million depressions capable of holding water in the pothole region of Canada, with as many as 189 per square mile (73/km^2) and a mean of 46 per square mile (18/km^2). The pothole region lies entirely within the intensively cultivated farmland of Alberta, Manitoba and Saskatchewan, where wheat is the main crop. This overlap has resulted in the loss of 40 percent of original wetlands since settlement began (Anonymous 1986). Monitoring of over 10,000 potential wetlands across the Canadian prairies from 1981 to 1985 for degradation caused by haying, grazing, burning, draining, filling, cultivation and clearing showed that the percentage of degraded basins increased from 57 percent to 59 percent, and that degraded margins increased from 74 percent to 84 percent during the five-year period (Turner et al. 1987). In view of the increasing loss and degradation of habitat, emphasis will have to be placed on maximizing the quality of the habitat that remains (Sheehan et al. 1987). Agricultural chemicals have the potential to affect waterfowl directly through acute toxicity or indirectly through toxicity to food organisms or nesting cover. This paper presents an overview of the potential for adverse effects of pesticides and fertilizers on prairie wetlands and waterfowl, relevant research conducted in Canada, and needs for further research and cooperation with the agricultural community. An extensive analysis of potential effects of pesticides on ducks and wetlands in the Canadian prairies is available in Sheehan et al. (1987) and is summarized in Mineau et al. (1987).

Reasons for Concern

Prairie crops are sprayed extensively with herbicides: 80 percent of the wheat crop receives broadleaf herbicides and 91.5 percent of the rapeseed crop receives grass herbicides (Sheehan et al. 1987). Application of broadleaf and wild oat herbicides in the three prairie provinces increased by 40 and 55 percent, respectively, between 1978 and 1986, whereas the total area of cropland increased by 11.5 percent between 1976 and 1986 (calculated from data in Daciw 1979, Anonymous 1987 and provincial agricultural yearbooks, 1986 and 1987). Annual spraying for insect control in the Canadian prairies was estimated for the period 1971–81 to take place on 2.5–3.7 million acres (1–1.5 million ha), or 4–6 percent of land seeded to crops. This area increases to 7–8.6 million acres (3–3.5 million ha) or 14–16 percent of land seeded to crops, when bertha armyworm or diamondback moth are sprayed (Sheehan et al. 1987). Application of fertilizers in Manitoba and Saskatchewan increased by 82 percent between 1976 and 1986 while land seeded to crops increased by only 17 percent (calculated from data reported in the provincial agricultural yearbooks, 1976–1986). Use of nitrogen fertilizer is expected to increase by 300 percent during the 1980s to compensate for loss of organic content from prairie soils (Rennie et al. 1980).

The majority of spraying for control of weeds and grasshoppers takes place from mid-June through mid-July, which overlaps with the peak hatching period of mallard and pintail in June (Keith 1961, Dzubin and Gollop 1972) and later-nesting species of dabblers and divers. Hence, there is potential for direct effects of insecticides on ducklings and adults travelling through sprayed vegetation and for indirect effects on the aquatic food chain. Three of the six most commonly applied insecticides, carbofuran, dimethoate and chlorpyrifos, are highly toxic to waterfowl; the other three (carbaryl, malathion and deltamethrin) are relatively low in toxicity (Grue et al. 1986, Sheehan et al. 1987). Carbofuran is a proven hazard to waterfowl in alfalfa (Stickel 1975, Flickinger et al. 1980), whereas chlorpyrifos, malathion and deltamethrin are highly toxic to aquatic invertebrates. Aquatic plants and invertebrates may also be affected by some herbicides (Sheehan et al. 1987). Fortunately, no form of parathion is registered for use on field crops in Canada.

The effects of herbicides on upland nesting cover associated with prairie wetlands are not known. A recently registered, highly potent herbicide, metsulfuron-methyl, is effective in controlling western snowberry (*Symphoricarpos occidentalis*) when sprayed at the rate of 0.07 ounces of active ingredient (AI)/acre (5 g/ha) for brush control (Bowes 1987). It is likely that this herbicide will damage shrubby nesting cover adjacent to croplands, particularly if aerial application is permitted, since the rate of application to cereals is 0.06 ounces AI/acre (4.5 g/ha). Shelterbelt trees are frequently damaged or killed by drift of phenoxy herbicides, which suggests that nontarget woody vegetation important as nesting cover for waterfowl may be affected by some of the common herbicides used for decades.

Wetlands and their associated upland vegetation are islands of habitat in cropland that can be contaminated by pesticides as drift from aircraft or ground equipment, in runoff or as direct deposits from aerial application. Overspray of wetlands by aircraft cannot be avoided due to the large numbers and small size of the majority of wetlands (Millar 1969). Estimates of aerial application, as percentages of annual totals, are 9 percent for herbicides and 13 percent for grasshopper insecticides; control of diamondback moth is 100 percent aerial application (Sheehan et al. 1987).

Spraying Against Russian Wheat Aphid

The Russian wheat aphid was observed feeding on wheat and barley in southwestern Saskatchewan and southeastern Alberta for the first time in 1988 (Harris 1989, Johnston 1989). The extent to which this pest will become established in the pothole region of the Canadian prairies cannot be predicted, but it has the potential to become a very serious problem that would lead to extensive annual spraying of insecticides over waterfowl habitat. Wetlands would thereby be exposed to a more regular input of insecticide than has previously been the case. Three insecticides are registered in Canada for control of Russian wheat aphid: chlorpyrifos, dimethoate and malathion (Table 1). Chlorpyrifos is the most effective (Butts and Jones 1988), and is likely

Table 1. Insecticides registered in Canada for use against Russian wheat aphid and their toxicity to aquatic invertebrates and waterfowl.

Insecticide	Application rates: Pounds AI per acre (kg/ha)[a]	Application rates: Number of applications	Toxicity: Aquatic invertebrates[b]	Toxicity: Mallards[c]
Chlorpyrifos	0.43 (0.48)	NLR[d]	Very high	High
Dimethoate	0.19 (0.21)	NLR	Moderate	High
Malathion	0.62 (0.70)	NLR	Very high	Low

[a]AI = active ingredient.
[b]96 hr LC50 for species of amphipod (*Gammarus*): low = > 1.0, moderate = 0.01–1.0, high = 0.001–0.01, very high = < 0.001 mg/L. Data from Mayer and Ellersieck (1986).
[c]LD50 for 3–4 month old mallards (*Anas platyrhynchos*): low = > 1000, moderate = 200–1000, high = 40–200, very high = < 40 mg AI per kg body weight. Age of mallards is unknown for chlorpyrifos LD50. Data from Hudson et al. (1984).
[d]NLR = no label restriction.

to be the chemical of choice. If the aphids are not controlled by a spray application in mid-June, a second treatment, which would of necessity be applied by aircraft, would be required in early July (Butts, pers. comm.). The rate of application of chlorpyrifos, 7 ounces AI/acre (480 g/ha), would probably lead to significant losses of aquatic invertebrates in wetlands receiving direct aerial deposit. Spraying of ponds in Missouri with chlorpyrifos once in early June and a second time in early July at 0.05 pounds AI/acre (56 g/ha) resulted in 90–100 percent reductions in populations of larval caddisflies and mayflies; numbers of emerging adult midges were reduced by m ore than two-thirds, compared to untreated ponds (Macek et al. 1972). Malathion is also highly toxic to aquatic invertebrates; dimethoate is moderately toxic (Table 1). The potential for direct toxic effects of dimethoate and chlorpyrifos on waterfowl in the field cannot be ignored, despite the fact that broad-scale spraying of these insecticides for insect control has not resulted in reported cases of wildlife casualties in North America (Grue et al. 1983). Both insecticides have high acute toxicity ratings for mallard from laboratory data (Table 1), and Blus et al. (1987) have recently documented mortality of sage grouse in alfalfa fields sprayed with dimethoate.

Research Conducted to Date

A field study of the influence of 2,4-D on habitat quality and nesting behavior of ducks (Dwernychuk and Boag 1973) was the first field investigation of the effects of pesticides on waterfowl in the Canadian prairies. Although the study area was two islands in Miquelon Lake, Alberta, the effects demonstrated and the species of duck studied are relevant to prairie wetlands. When 2,4-D ester was sprayed on nesting habitat at 2 pounds AI/acre (2.2 kg/ha) once in mid-July, coverage of broad-leafed vegetation was reduced by 85 percent relative to unsprayed areas within one month. Cover of nettles, a favored nest plant of gadwalls, was eliminated, and thistles were reduced by 92 percent. Grasses, which were avoided as nest cover, increased by 219 percent within one year. Density of nests of lesser scaup, gadwall and white-winged scoter was reduced by 92 percent in the sprayed areas the year following treatment. The authors concluded that lack of nesting in sprayed areas was due to the loss of preferred cover plants.

Deltamethrin, a synthetic pyrethroid insecticide used for insect control on cereals (grasshoppers and cutworms), rapeseed and sunflowers (diamondback moths, flea-beetles and sunflower beetles) and alfalfa (alfalfa weevils and lygus bugs) was applied by aircraft in June 1986 to two ponds in Saskatchewan at the rate (0.1 ounce AI/ac, 7.5 g/ha) registered for insect control (Morrill 1987). Maximum concentrations of 0.20 μg/L deltamethrin in the water column were detected 1 hour after spraying; at 24 hours, they were 0.05–0.08 μg/L in the two ponds. Within 11 days of spraying, populations of chironomid larvae in the sediments of deep and shallow sites decreased to approximately one percent of pre-spray densities in both ponds. Populations on the two control ponds did not undergo similar declines during the same time period. Treated populations recovered to densities equivalent to those of untreated ponds by mid-August in one pond and late October in the other. In a preliminary study, the growth of mallard ducklings raised on one of the treated ponds was impeded after spraying and some mortality occurred, whereas control ducklings grew steadily (Neal 1987).

Carbofuran was applied to two ponds in Alberta by backpack sprayer at the rate registered for grasshopper control (2 ounces AI/ac, 140 g/ha) to simulate deposit by aircraft in July 1986 (Wayland 1989). Resulting concentrations in the water of the two alkaline ponds (pH 8.4–9.0) were 14 μg/L and 32 μg/L 16 hours after spraying. Freeliving populations of amphipods (*Hyalella azteca*) declined by 61 percent and 91 percent at deep and shallow sites, respectively, and numbers of trichopteran larvae declined by 92 percent, relative to pretreatment densities, at all depths two days after treatment. In a second experiment, carbofuran was added to the water of enclosures in a pond to produce two concentrations that could be expected from direct aerial deposit: 5 μg/L and 25 μg/L. The 5 μg/L concentration had no apparent effect on freeliving invertebrates. The 25 μg/L concentration resulted in declines in biomass of 95 percent in *H. azteca* and 88 percent in larval Chironominae, relative to populations in untreated enclosures, five days after treatment.

The herbicide bromoxynil ester was applied by hand sprayer to 12 manmade ponds at the Delta Waterfowl and Wetlands Research Station in Manitoba in June 1987 (R. D. Robinson, McGill University, unpublished data). Nominal concentrations in the water were 2.5, 50, 100 and 500 μg/L in three ponds per concentration. Bromoxynil ester was found to be highly concentrated in the surface film; phenolic bromoxynil was dispersed through the water column at near-target concentrations. A 24-hour LC50 of 50–100 μg/L was measured in amphipods (*H. azteca*) caged near the surface of the water, but no mortality was evident among freeliving aquatic invertebrates in any of the treated ponds, relative to the untreated ponds.

The effects of the herbicides 2,4-D amine and clopyralid on the submerged aquatic plants, *Myriophyllum exalbescens* and *Potamogeton pectinatus*, were assessed in plastic enclosures in a Saskatchewan pond (D. J. Forsyth, unpublished data). The herbicides were added directly to the water of the enclosures to produce two concentrations that could result from aerial application of up to 12 ounces AI/acre (850 g/ha) of 2,4-D or 4.3 ounces AI/acre (300 g/ha) of clopyralid: 0.01 mg/L and 0.1 mg/L. The 0.01 mg/L concentration of either herbicide did not adversely affect growth, but clopyralid caused a 65 percent increase in biomass of *M. exalbescens* relative to controls in 30 days. The 0.1 mg/L concentration of 2,4-D suppressed growth of *P. pectinatus* by 49 percent and *M. exalbescens* by 78 percent at 60 days after treatment, and caused 52 percent mortality of *M. exalbescens*. Clopyralid at 0.1 mg/L did not affect growth.

Research Needs

The studies conducted to date in Canada and the United States (Grue et al. 1989) have demonstrated the potential for some pesticides to adversely affect wetland ecosystems and waterfowl. These studies also demonstrate the need to determine the extent of wetland contamination, the effects of major-use chemicals on wetlands and waterfowl and ways to minimize the frequency of occurrence of such effects.

Extent of Contamination of Waterfowl Habitat

The extent to which pesticides and fertilizers are contaminating wetlands and associated upland habitat must be determined in order to predict potential effects on the productivity of waterfowl at the population level. Research is needed to develop appropriate techniques to quantify input of chemicals to wetlands. Bioassay techniques using aquatic invertebrates in cages or luminescent bacteria (Microtox®), as outlined by Grue et al. (1989), are worthy of testing for their usefulness as indicators of contamination. Bioassay techniques should be used in conjunction with chemical analysis of water or sediment to identify the toxic agent. Methods are under study to utilize solvent-filled dialysis membranes as samplers of pesticide molecules in water. Chlorinated organic compounds have been shown to accumulate in the solvent in patterns similar to those of aquatic invertebrates (Sodergren 1987), and are not subject to microbial degradation. Further testing of solvents is required to adapt the technique for use with nonpolar organophosphate or carbamate insecticides (J. N. Huckins, United States Fish and Wildlife Service, pers. comm.). This method would allow identification of pesticides in water for much longer intervals after spray events than is possible in the case of analysis of water, which is limited by rapid disappearance of chemicals through microbial degradation, hydrolysis and photodegradation. A program of long-term monitoring should be designed to determine the typical annual input of pesticides to wetlands, comparing ground application to aerial, and to assess the quality of habitat in the aquatic systems and associated upland vegetation. The sites monitored should be selected to reflect the varied conditions of soil moisture, crop types and insect problems found in different areas of the pothole region. Typical annual input of fertilizer nutrients to wetlands should also be monitored. Once the input of chemicals has been quantified, potential effects can be evaluated; however, evaluation of effects will require further field research on chemicals of concern.

Effects of Contamination on Productivity of Waterfowl

The indirect effects of insecticides and herbicides on the productivity of waterfowl require further study. Recommendations made by Sheehan et al. (1987) include research that will (1) determine the variability of primary and secondary productivity in wetlands, capacity to support ducklings and effects of variable food supplies on behavior and survival of ducklings; (2) standardize protocols for laboratory toxicity tests for aquatic invertebrates important to waterfowl; (3) standardize protocols for field studies to address the fate and short-term and long-term effects of insecticides and herbicides on aquatic organisms in wetlands; (4) determine the effects of herbicides on nesting cover and aquatic vegetation; (5) study the chronic effects of the more toxic and persistent herbicides on aquatic invertebrates; and (6) determine the effectiveness of buffer zones in protecting wetlands from contamination. Monitoring efforts recommended by the same authors include (1) comparison of duckling recruitment during years of average spraying and heavy spraying that would quantify clutch size and survival of ducklings and (2) modification of the collection of the annual waterfowl transect data to include contacting of farmers for information on pesticide use within the transects. Direct effects, on survival of adult and young waterfowl, of insecticides sprayed in major control programs require study. Field studies should be carried out at selected research areas that include complexes of wetlands and nesting habitat and should be multidisciplinary in approach, involving ornithologists, limnologists, toxicologists, hydrologists, chemists and agronomists. Research should be designed to provide data for simulation models of waterfowl productivity in relation to agricultural practices.

Alternative Agriculture

Alternative methods of farming that are designed to minimize erosion and conserve soil moisture (conservation tillage) or decrease dependency upon pesticides and synthetic fertilizers (sustainable agriculture or organic farming) are potentially beneficial to waterfowl. A survey of grain producers in Alberta indicated that 44 percent of producers in the province were practicing conservation tillage to some degree in 1987 and that the practice is growing in popularity (Jensen 1988). The benefit of increased nesting cover in the form of crop residue reported by Duebbert and Kantrud (1987) should be balanced against the possibility of adverse effects of herbicides that are used in conservation tillage. Sustainable agriculture should be beneficial to waterfowl through reduction or elimination of pesticide use (Chorney 1988); however, the benefits require documentation. A study was initiated by the Canadian Wildlife Service in Saskatchewan in 1989 to compare the quality of upland nesting habitat and productivity of waterfowl on organic farms to that of conventional farms.

Cooperation with the Agricultural Community

It is essential for farmers and pesticide applicators to be provided with information about the potential adverse effects of pesticides on wetlands and waterfowl. This information could be transferred through pamphlets, inclusions in provincial guides to farm practice, presentations to farm organizations, displays at agricultural events and the news media. Emphasis on minimizing pesticide use, spot-treating pests when possible, following label directions carefully, calibrating and maintaining equipment, reducing drift, observing economic thresholds (Grue et al. 1989), proper disposal of containers and observance of maximum wind conditions for spraying should be included in such communications. The fact that wetlands and waterfowl can be protected while meeting the crop goals of the farmer should also be emphasized. Involvement of wildlife toxicologists in training programs for pesticide applicators (Grue et al. 1989) would be a very positive innovation. Promotion of alternative methods of agriculture that reduce or eliminate input of pesticides to wetlands and nesting habitat, use of nonchemical insecticides, biological control methods and integrated pest management would help farmers to move away from chemical dependency. The North American Waterfowl Management plan provides an important means of interacting with the agricultural community to demonstrate methods of managing for crops and waterfowl simultaneously.

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New Approaches to Wetland Management Through the North American Waterfowl Management Plan: The U.S. Experience

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Like a catalyst that accelerates a chemical reaction, the North American Waterfowl Management Plan is accelerating wetland conservation. The Plan addresses the problems of declining waterfowl populations on the North American continent. Objectives of the Plan are to preserve and enhance habitat in areas that are critical to waterfowl in all seasons. The Plan works not only with existing wetland programs, but encourages bold new approaches to protect, restore or develop wetland habitat for waterfowl, other wildlife and society as a whole.

For more than 30 years, the states and the U.S. Fish and Wildlife Service have been preserving waterfowl habitat throughout the nation. On the northern breeding grounds, this effort is concentrated on a wide array of wetlands and nearby uplands with good quality cover for nesting waterfowl. Migration needs have been dealt with largely through protection and management of important staging areas. On the wintering grounds, the emphasis has been on wetlands and associated food resources. In the past, long-term habitat protection has been achieved largely through fee-title acquisition and perpetual easements. We need to continue to develop new tools to address wetland conservation needs.

Recently, waterfowl managers have begun to restore drained wetlands on private lands. Through the U.S. Department of Agriculture's Conservation Reserve Program, American farmers have retired 28 million acres of highly erodible cropland. The current goal is to retire 45 million acres. Many Conservation Reserve Program lands contain drained wetlands that could be restored. Landowners usually are reluctant to restore drained wetlands without an acceptable economic incentive. The Conservation Reserve Program fills this need for many landowners. Working with the agricultural agencies, the states and private conservation groups, the U.S. Fish and Wildlife Service has taken the lead to restore wetlands on Conservation Reserve Program acres. Through this cooperative venture, participating farmers can have their wetlands restored without cost to them.

In Minnesota, a State program called "Reinvest in Minnesota," makes payments to farmers for the use of land for wetland restoration and other conservation purposes. Other pilot efforts have also been undertaken to provide financial incentives for farmers to restore drained wetlands. Nearly all of the North American Waterfowl Management Plan projects now include restoration of wetlands using local opportunities and resources.

Once a drainage facility is interrupted by a dam across an open ditch or a tile break, run-off waters quickly fill the drained basins. Wetland vegetation and wildlife values return soon after refilling. Other wetland functions quickly resume, because soil conditions and topography are not changed appreciably by drainage actions. To date, more than 3,200 (1295 ha) acres of drained wetlands have been restored in the north central states. Other regions of the country also are restoring wetlands. Although wetland restoration efforts were begun before implementation of the North American Waterfowl Management Plan, the Plan places new emphasis on restoration and development of wetlands.

There are other opportunities to improve the quality and quantity of wetlands for waterfowl. For example, along the south shore of Lake Erie where vast marshes once existed, only remnants of these marshes remain. Most have been destroyed by agriculture activities, urban and industrial development and fluctuating water levels of Lake Erie. To protect these wetlands from high water levels and wave action, extensive breakwater structures have been built in the past. More are planned as part of the North American Waterfowl Management Plan. With this protection, the Erie marshes can be effectively managed for aquatic plants valuable to waterfowl and other wildlife.

Also underway in the north central states, most notably in Minnesota, is an effort to restore shallow lakes. The quality of many waterfowl lakes has deteriorated as a result of poor water quality and the influx of rough fish. The restoration process removes the rough fish and prevents them from re-entering the lakes. It also requires conservation measures on adjacent watersheds to help protect water quality of the lakes. The North American Waterfowl Management Plan provides new emphasis and accelerated action to restore these lakes in Minnesota and other states.

In the southern states and the Central Valley of California, many wetlands that were important to wintering waterfowl have been converted to intensive agriculture. Most of these former wetlands are now farmed for rice, soybeans, corn, cotton and other crops. Residues from most of these crops are staples in the diets of wintering waterfowl, but extensive fall tillage has reduced this resource as well. By curtailing fall tillage and reflooding rice stubble after harvest, and keeping fields flooded until the ducks leave in the spring, substantial acres of habitat can be provided. These areas are rich in food resources valuable to wintering ducks and geese. These lands can be drained and returned to agricultural production after the spring migration. In pilot projects underway in Louisiana, Texas and California, payments to farmers for reflooding these lands are being borne by the U.S. Fish and Wildlife Service, the cooperating states and private organizations. Some landowners in Louisiana and Texas have donated their lands for this purpose without charge.

Another form of restoration being carried out in the Lower Mississippi Valley is the reforestation of bottomland hardwoods that were once drained and cleared for agricultural production. Some of these lands have proven unsuitable for long-term, intensive farming and are now of questionable value for continued agricultural production. Through several land retirement programs, drainage ditches are being closed and lowlands reflooded. These lands are being reforested with oaks and other hardwood trees that will produce mast for winter food and habitat for waterfowl and other wildlife.

Improvement of public lands is a key element of the North American Waterfowl Management Plan. These lands include national wildlife refuges and state game management areas, places where waterfowl management facilities have been extensively developed. Many of these facilities have aged and need to be repaired and modernized. Actions now planned and underway will revitalize aging facilities on impoundment sites, will restore structures to keep saltwater out of freshwater coastal marshes and will improve tidal flows into certain salt marshes to bring about better production of waterfowl food, plants and invertebrate populations. Waterfowl managers across the country are finding new opportunities to bring about needed changes in existing lands managed for waterfowl.

Opportunities for better waterfowl management also exist on other public lands. The Department of Defense initiated a new effort to develop waterfowl habitat on military lands to contribute to the North American Waterfowl Management Plan. The Forest Service has instituted a new program called "Taking Wing." Through this program, the Forest Service is improving waterfowl habitat on national forests across the country. The Bureau of Land Management has proposed a program called "Autumn Wings" to maintain and enhance waterfowl habitat on their land holdings. Indian tribes in Minnesota and Wisconsin propose to improve wetlands on their reservation lands. These projects will produce waterfowl and enhance other related wetland values important to the tribes, such as wild rice and furbearer production.

Watershed management is also being revisited by managers working on the North American Waterfowl Management Plan as a means to improve water quality and to restore desirable water levels for ducks and other wildlife. In South Dakota, water levels on Lake Thompson have risen dramatically in recent years, the result of heavy rains and extensive wetland drainage. The resulting flooding of farmlands has disrupted the lives of watershed residents. An element of the project is to restore wetlands in the watershed to hold back run-off waters. Other actions will re-establish prairie grasses valuable to nesting waterfowl. Both actions will help to stabilize water levels and reduce sedimentation in downstream wetlands and lakes, making the entire watershed better for duck production and better for farming.

On a larger scale, there are areas of the country that need extensive watershed protection to improve water quality in order to restore wetland ecosystems important to ducks and other fish and wildlife. A good example is Chesapeake Bay and its associated watersheds. The participants in the Chesapeake Bay Program have made substantial progress in recent years and are now working with action committees of the North American Waterfowl Management Plan to address problems of mutual concern.

New interests are developing to encourage open marsh water management systems to restore tidal exchanges in many coastal wetlands to give access to marine organisms and other food items valuable to the wildlife that depend on these salt marshes. The goals are to control mosquitoes, improve the marshes for marine organisms and also for waterfowl and other migratory birds that winter on the Atlantic Coast.

A similar challenge with a different twist exists on the Gulf Coast marshes. Here, under different climatic conditions, freshwater and brackish marshes have been threatened by developments that allow saltwater to move inland. These developments include the intracoastal waterway and other canals that were dug for shipping and barge access to oil drilling sites. The intrusion of saltwater into the freshwater marshes upsets the balanced system that existed for many years and decreases the quality of habitat for wintering waterfowl. Management efforts to control saltwater intrusion range from small structures to major projects for correcting some of the undesirable movements of saltwater that have occurred in the past.

These efforts are not without problems. Proposals that involve dredging, deposit of fill materials in wetland systems or changing water flows must comply with the Clean Water Act and its implementing provisions, as well as mitigation policies of the federal and state agencies.

In the Central Valley of California, partners in the Plan seek to protect all of the remaining wetlands in the valley, some 80,000 acres (32,375 ha). They will do this by purchasing certain areas in fee-title and by acquiring long-term easements on others to protect their wetland characteristics. They also seek to obtain commitments for water supply to manage refuges and other waterfowl areas throughout the Central Valley, where competition for water is very intense. A dependable supply of water during fall and winter months is necessary for proper management on these marshes. Partners in the Plan in California are also working to reclaim wetlands from present agricultural uses. Recent actions by the State of California to acquire use rights either by fee-title acquisition or by easement be used to restore the wetlands. These restored wetlands will have values to waterfowl greater than their values for agricultural production under existing economic conditions.

An encouraging facet of the Plan is the enthusiasm displayed in team efforts by diverse groups to develop innovative strategies to protect and enhance wetlands. One of the best examples is taking place in the Ashepoo, Combahee and South Edista Basin of coastal South Carolina. Here, in a large natural, forested river basin and adjacent estuarine environment, conservation groups and public agencies have joined forces to protect this valuable wildlife haven. Groups interested in waterfowl have teamed up with natural area preservationists, marine fisheries interests and state and federal agencies to protect and manage the basin. This region is not only vital to waterfowl, but is also home to other migratory birds, endangered species and unique plant communities. It is a valuable spawning and nursery area for marine organisms. Similar teams are also at work in other joint venture areas across the United States and Canada.

The strategies being employed today to develop, restore and enhance wetlands emphasize the importance of obtaining long-term protection for those wetlands that remain. Now is the time to strengthen these measures that will protect the wetlands that have not been destroyed by agriculture, industry or urban development. There are undoubtedly many new and innovative ideas yet to be conceived to assist in this work. Our collective efforts will help guarantee the future of waterfowl. The North American Waterfowl Management Plan will build lasting coalitions that will benefit us all.

New Approaches to Waterfowl Habitat Management: The Canadian Experience

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As we, in Canada, look forward to the 1989 waterfowl breeding season, we're more optimistic than we have been for years. Generally speaking, the prairies are still under a heavy snow cap. That's good news. It means run-off to replenish the wetlands, sloughs and potholes that are the major factor in determining how well North America's waterfowl populations will bounce back from the record lows of the past seven years. But, as we all know too well, it takes a good political climate as well as good weather to create waterfowl habitat. And I'm happy to report that the political climate forecast for 1989 is just as encouraging as the weather promises to be.

The recent drought was a stark reminder of the prairies' dependence on water. We should have learned this during the 1930s. But those lessons were forgotten in the "fence row-to-fence row" cropping euphoria that swept Prairie Canada during the boom years of the 1970s. During the past decade, we've paid the price of that shortsightedness. Low yields, low prices, low demand for cereal grains on international markets and rising input costs have reminded us of Henry Ford's observation that those who don't learn from history are bound to repeat it.

The results have been devastating. Many farmers have simply been squeezed out of business; others have consolidated and down-sized their operations; yet others have concentrated their efforts on the higher quality soils. Marginal lands have either been put to alternate uses, such as pasture or forage production, or allowed to lie unused. The bright side of this tarnished coin—if there can be a bright side—is an increased level of conservation awareness.

The public understands and is concerned about soil and water conservation. Farm policy planners have been forced to look beyond merely increasing farm productivity. They've had to include soil and water conservation as integral parts of program developments.

In 1988, Agriculture Canada announced a new National Soil Conservation Program. Over the next three years, about $50 million will flow from this program into Prairie Canada. It will be matched by provincial governments to encourage farmers to retire marginal lands from intensive agricultural use.

Simultaneously, Soil Conservation Canada, a foundation established in 1987 on the recommendation of the Canadian Senate, is carrying out an extensive review of agricultural policies affecting land use. One of their primary considerations in determining ways to stem soil degradation focuses on wildlife habitat conservation.

The willingness of the farming community to examine how its actions impact on soil and water conservation is also reflected by wildlife managers. This spirit of introspection and commitment is the driving force behind The Prairie Habitat Joint Venture. We know the nature and magnitude of the habitat problems facing waterfowl managers in Prairie Canada requires new types of habitat preservation and enhancement programs and new ways to finance and deliver them. The Joint Venture is developing programs to address these issues at a time when public support for conservation action is strong. Both agricultural and wildlife interests have demonstrated they have the *will* to tackle these critical land use issues. The Prairie Habitat Joint Venture is one of the *ways* to achieve these goals.

First, let's examine some of the types of habitat preservation and enhancement programs that are needed to reverse present declines in waterfowl numbers. The Prairie Joint Venture's specific goal is to directly affect waterfowl production on about 3.6 million acres of public and private land across Canada's three prairie provinces. We also hope to improve waterfowl productivity on many more acres by encouraging farmers to adopt land use practices that will benefit waterfowl. It's a major undertaking requiring almost $1 billion in funding and the cooperation of many public and private agencies in Canada and the United States.

Many of our projects involve improving nesting cover on private land surrounding pothole complexes with high waterfowl production capability. Because these uplands are often areas with good cropping potential, landowners are often reluctant to dedicate them to wildlife habitat. As a result, we've established a continuum of program options—a type of Richter scale that allows us to determine the degree of agricultural versus wildlife benefit individual projects offer.

At the *intensive management* end of the scale are those projects that offer only waterfowl-related benefits. These will depend entirely on wildlife agencies for funding and development since the offer few opportunities for program integration with other resource sectors. They're costly, usually site-specific and limited to areas with extremely high waterfowl production potential. These intensively managed projects are expected to comprise the bulk of the Venture's efforts at the outset of the program.

At the opposite end of the scale are *extensive management programs*, those in which the agricultural benefits outweigh habitat values. These are likely to be integrated with other soil and water conservation initiatives, particularly those undertaken by agriculture. Habitat managed under these programs will likely be on private land and remain in private ownership. Landowners will be encouraged to adopt land-use practices that benefit waterfowl. They would also be given financial incentives based on the costs they incur—in terms of reduced income and increased management—by using these practices.

Most Venture projects will fall somewhere between the two poles depending on the degree of wildlife versus agricultural benefits they offer. This ratio would also determine the amount of input wildlife and agricultural agencies would invest in individual projects.

Obviously, pulling this all together is a complex coordinating task. Traditionally, conservation projects have involved single agencies operating independently with their own funding. Projects promising farming benefits were undertaken by agricultural agencies without reference to wildlife implications. By the same token, wildlife agencies launched habitat development programs without considering their effects on local farmers. Under the Prairie Habitat Joint Venture, these various agencies can contribute towards a common conservation objective, comply with their unique policy constraints and meet their individual mandates. Some may provide financial support only. Others may limit their involvement to program delivery. Yet others may limit their involvement to program delivery. Some may combine both but limit themselves to specific programs within their mandates.

In effect, the Prairie Habitat Joint Venture performs two major roles:

1. It provides an administrative structure under which the various private and public agencies can work to attain common goals
2. It provides a mechanism for joint funding of approved projects.

Administrative Structure

Right from the outset, the Joint Venture members insisted that, wherever possible, programs would be delivered by existing agencies. As a result, the Venture operates under a management agreement between various established Canadian private and public resource groups. The agreement defines how the joint venture will work, outlines the terms under which members can participate and establishes implementation procedures, role definitions, program funding and delivery processes. It also describes how agencies not directly involved in program delivery can provide financial support.

In practice, the Joint Venture's activities are coordinated by a regional body, *The Prairie Habitat Joint Venture Advisory Board*, and three *Provincial Implementation Groups* who ensure efficient program planning, delivery and evaluation at the provincial level.

The Advisory Board

The Advisory Board will initially be comprised of representatives from each of the organizations operating across the prairies—the Government of Canada, Ducks Unlimited Canada, the North American Wildlife Foundation and Wildlife Habitat Canada—as well as representatives from each of the there prairie provinces. There is provision for additional members in the future.

The Advisory Board has two main functions: It acts in a regional planning and coordinating role to ensure PHJV projects effectively achieve objectives; and it provides liaison between the North American Waterfowl Management Plan Committee and the implementing agencies. A small staff complement may be required to fulfill these duties. Responsibility for staffing will rest with the Advisory Board members.

Provincial Implementation Groups

Coordinating and implementing projects and programs at the provincial level requires a more formal organization. These implementation groups will consist of representatives from each of the public and private implementing agencies operating in the respective provinces. They will be responsible for approving program proposals, carrying out subsequent evaluations and recommending adjustments where necessary.

If legally constituted, the Provincial Implementation Groups may also contract for services on behalf of the Joint Venture, hold title to land or manage trust accounts on behalf of the implementing agencies. A small Secretariat will be provided by members of the Provincial Implementation Groups.

Joint Funding Mechanism

In addition to identifying and developing program proposals, the Joint Venture participants expect Canadian implementing agencies to underwrite portions of development costs. Additional funding would be obtained from other sources.

The Joint Venture has made provision for a banking function that could provide short-term financial management and accountability to any party contributing towards project development. Any legally constituted organization meeting the Joint Venture's conditions could function as a "banker." It can accept contributions from donors and hold them in trust until the Advisory Board assures the "banker" the funded project meets the Joint Venture's criteria and the donors' conditions.

If sufficient funds are not available for a specific program, the Venture will consult with the North American Waterfowl Management Plan Committee to arrange for additional financing. Once the Advisory Board has reasonable assurance of adequate financing for the program, it will endorse the program and notify the "banker" to release the funds.

The Prairie Habitat Joint Venture is an initiative that capitalizes on the new spirit of cooperation in conservation that has emerged as an aftermath of the recent drought. It draws upon the experience and resources of both private and public wildlife and agricultural agencies. It borrows from Ducks Unlimited Canada's well-developed agricultural extension programs, from the experiences of existing habitat programs between governments and private agencies, including the Alberta "Wetlands for Tomorrow" program and the Heritage Marsh programs in Saskatchewan and Manitoba.

The climate is right for a major new habitat initiative, a partnership between agriculture and wildlife agencies, both private and public. We have the administrative capabilities to guide such a program to its successful conclusion—the restoration of prairie waterfowl and their habitat for future generations. We have always had the will. Now the Prairie Habitat Joint Venture offers us the way.

Recent Successes in International Wetland Conservation

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Introduction

In North America, there is currently cautious optimism over the future conservation of wetlands. Against a background of a more than halving of the wetlands resource in the United States and a concommitant decline of the North American waterfowl populations, such optimism results not from a dramatic improvement in the status of wetlands, but from a broadening awareness of the *true functions and values* that are provided by wetlands. It is only when these functions and values are perceived to be real, in economic and sometimes cultural and heritage terms, that sustainable conservation of wetlands can be expected. In this paper, I wish to examine the achievements of wetlands conservation in other parts of the world and to consider whether such optimism is justified outside North America.

The primary goal for wetland conservation at international level must be to stem the global rate of loss of this diminishing habitat. This target can be addressed in three ways only: (1) by protecting existing wetlands against further loss, (2) by restoring damaged wetlands to their former status and (3) by creating new wetland habitats to replace those that have been lost. In a compelling summary of a conference entitled "Increasing our Wetland Resources," Feierabend (in press) concludes that the primary emphasis for wetlands should be placed on the protection and conservation of existing systems, rather than on the restoration and creation of new ones. This conclusion was based on three observations: firstly, that there is increasing public resistance to the alteration and loss of wetlands; secondly, that the scientific base for wetlands creation and restoration is not adequate to guarantee the success of such projects; and third, that the restoration and creation of wetlands is extremely expensive. For example, estimates of the cost of restoring L. Hornborga (Sweden) have ranged from (U.S.) \$6–\$18 million (T. Larrson pers. comm.). This latter point makes wetland creation or restoration irrelevant to situations in most developing countries (Dugan 1988). I shall therefore devote this paper to examining the international political and technological successes of recent years, particularly outside North America, that have contributed to the conservation of the world's remaining wetlands.

International Wetland Conservation: Political Achievements

Ramsar Convention

At least in the more developed world, the political future for wetland conservation appears bright. At the national level, many governments have implemented legal or regulatory systems to control developments that impact wetlands, while at international level the development assistance community is increasingly promoting environmentally sound policies within its funding program. Perhaps the most striking indicator of governmental interest has been the rapid growth of participation in the "Convention on Wetlands of International Importance especially as waterfowl habitat," otherwise known as the "Ramsar Convention." By the start of 1989, the 52 contracting parties to this Convention had listed 421 wetlands covering almost 30 million hectares. The USA became a party to the Convention on 18 December 1986 and has so far listed seven sites, including most recently Cheyenne Bottoms (Kansas).

The Ramsar Convention was the first modern global conservation treaty, and remains the only one to deal with a particular type of ecosystem. It was adopted in 1971 at one of a series of intergovernmental conferences organized by the International Waterfowl and Wetlands Research Bureau (IWRB). A contracting party makes two undertakings when joining this Convention. The first is to designate at least one wetland of their territory to the "List of Wetlands of International Importance" and, thereafter, to maintain the ecological character of that wetland. The second undertaking is to make "wise use" of wetlands in their territory, whether or not they are on the list. This "wise-use" provision has made the Convention particularly appropriate for developing countries, and the secretariat of the Convention are now giving high priority to promoting this concept, particularly to aid agencies involved in the support of development projects.

The Ramsar Convention uses a broad definition of "wetlands," and it promotes broad concepts such as "wise use" and "maintaining the ecological character" of sites. These terms have contributed to Ramsar's success, since governments are normally unwilling to join agreements that place detailed and constricting obligations upon them. However, such flexibility has also led to the criticism that the Ramsar Convention "lacks teeth." Many of the original sites to be listed lay within national parks or reserves and were therefore already protected. There are also numerous cases of piecemeal developments occurring within listed Ramsar sites. While there can be no doubt that the Ramsar Convention has been successful in raising awareness of wetland conservation issues, its success in significantly stemming the rate of wetland loss remains to be proven. The responsibility for achieving this goal through the Convention lies firmly in the hands of the contracting parties, although Ramsar can also be an invaluable tool for nongovernmental conservation agencies to urge contracting parties to make wise use of their wetlands and to list additional sites which meet the Ramsar criteria.

International Wetland Conservation: Technological Achievements

Wetland Inventories

In the development of an effective conservation program for wetlands, one of the first steps is to make an inventory of the important sites. Such inventories provide a basis for future monitoring, help to identify priority actions, provide baseline information for researchers and managers and stimulate interest in wetland conservation generally.

The development of international wetland inventories began with the compilation of simple lists of sites. However, with the development of the Ramsar Convention, there arose a need for widely accepted criteria for the identification of internationally important sites. Provisional criteria were drawn up at wetland conferences in 1974 at Heiligenhafen (Federal Republic of Germany), and refined at Cagliari (Italy) in 1980 and Regina (Canada) in 1987. These provide an objective means for drawing up "shadow lists" of sites for potential listing under the Ramsar Convention, and have been the stimulus for developing a number of regional wetland inventories. IWRB has been actively involved in most of these, and those that have been completed to date cover the Western Palearctic (Carp 1980), western Europe and north-west Africa (Scott 1980), the Neotropics (Scott and Carbonell 1986), Asia (Scott, in press) and Africa (Burgis and Symoens 1987). In addition, IWRB and the Asian Wetland Bureau, working in support of the Ramsar Convention, aim to start an inventory of the wetlands of the Oceanian realm in 1989.

Wetland inventories of this type are cost-effective to produce, since much of the information at the national level can be collected voluntarily through collaborating institutions. The Asian Wetland Inventory demonstrates vividly the value of such projects. In addition to locating and describing some 970 wetlands of international importance in 24 countries, it has also led to the formation of a network of 1,000 wetland conservation experts and more than 100 institutes for future collaborative projects in Asia. Such regional inventories provide excellent starting points for compiling more detailed national wetland inventories and are a valuable basis for national wetland strategies.

These regional inventories have suffered two major drawbacks. First, they concentrate only on the large and "internationally important" wetlands. This approach has meant that little international attention has been focused on the plight of the smaller wetlands. Second, these inventories have so far covered mainly the wildlife values of the wetlands, largely ignoring the other social and economic functions and values that are now recognized as being so important for wetland conservation (Adamus and Stockwell 1983).

Wetland Management

Wetland management and environmental impact assessment are important tools for integrating conservation with sustainable development. The importance of careful management planning is most clearly seen in arid and semi-arid regions where, because of the scarcity of water, wetlands are not only of critical importance for wildlife but are also under increasing pressure from human developments. Two examples from Africa illustrate the challenges that face wetland managers and planners.

The National Park of Lake Ichkeul in Tunisia (12,000 ha) is on the lists of the Ramsar Convention, the World Heritage Convention and UNESCO's Biosphere Reserve network. For waterfowl, it is one of the most important sites in the Mediterranean Basin (Scott 1980), with over 150,000 ducks, geese and coots present in most winters. The plan to construct irrigation dams on the main inflow rivers will cause major changes to the ecology of the lake, largely through an increase in salinity that will negatively impact the food chains which support the waterfowl and an important commercial fishery. Detailed management recommendations have therefore been proposed (Hollis 1986) which recognize the importance of maintaining the functions and values of the wetland. The most urgent management recommendation, which is currently being implemented, is the construction of a sluice on the outflow river. This will allow freshwater to be held in the lake during dry periods to compensate for the effects of the dams, with normal outflow during wetter periods.

However, even this measure will compensate only for the construction of three of the six proposed dams, and freshwater will have to be released from the dams in exceptionally dry periods, unless major ecological changes are to be suffered.

Floodplains pose particular problems for traditional conservation measures, since the area and extent of the wetland is usually unpredictable, dynamic and very much affected by upstream "developments" which change the level or the timing of the flood. This is particularly so in arid regions, such as Mali in the Sahelian region of West Africa. Here, each fall, precipitation on the upstream catchments of the River Niger bring a remarkable flood to the otherwise arid "Inner Delta of the Niger." The flood attracts some 2 million waterfowl, in addition to 0.5 million people who depend on this inundation for fish, rice cultivation and the grazing of their 1.5 million sheep and 0.5 million cattle. Recent studies conducted by IUCN, and stimulated by the persistent droughts of recent years, have concluded that the traditional approach in wetland conservation of defining protected areas is unlikely to be effective in the long-term conservation of such wetlands. Rather, emphasis must lie on ensuring that any upstream developments include the provision of a seasonal flood to maintain the present economic and ecological activities.

Training and Education

Training courses have been used in many parts of the world as a powerful tool for stimulating awareness and activity in wetland conservation. In Tunisia, Ghana, Cameroun and Malaysia IWRB has used training courses to communicate the methodologies of wetland conservation to wetland managers and planners. These courses have been very successful in bringing together participants from neighboring countries to share common problems, but a long-term investment in this approach is clearly needed, involving participants in collaborative projects, with appropriate equipment and support to carry out their activities.

Public education in developed countries through school curricula, the media and reserve facilities, such as those developed by the Wildfowl Trust in Great Britain, have done much to improve public support for wetland conservation. Such programs are still rare in developing countries, although the training of education officers by international conservation agencies is making an important contribution. In 1989, IWRB completed a collaborative project with the Tunisian government to build and equip an "eco-museum" (visitor center) within the National Park at Lake Ichkeul. This is the first project of its type in North Africa, and has great potential for attracting very considerable local and tourist interest to the National Park, through its imaginative displays which emphasize the functions and values of this important wetland.

International Wetland Conservation: The Waterfowl Approach

Waterfowl have historically played a disproportionately important role in the development of wetlands conservation. This is exemplified in North America by the status of organizations such as Ducks Unlimited and the level of resources that are being devoted to the North American Waterfowl Management Plan. Similarly, the name of the "Convention on Wetlands of International Importance *especially as waterfowl habitat*," reflects the role that waterfowl have played in this important initiative and, today, the majority of listed Ramsar sites have been designated on account of their importance for waterfowl.

In the developed world, where recreation and heritage values provide a strong argument for wetland conservation, waterfowl will continue to be an important currency for the conservation of wetlands. However, in countries facing pressures to develop their wetlands to meet increasing demands for food to combat famine, waterfowl conservation *per se* is understandably a very low priority for governments. Clearly, the emphasis in such countries must be to integrate development with conservation, building the case for conservation on the more relevant social and economic values that wetlands provide as described for the two examples in Africa, above. Even so, waterfowl will continue to play an important role as biological indicators for rapid assessment and regular monitoring of wetlands, and as a powerful vehicle for international collaboration, for public education and for channeling funds for wetland conservation from developed to developing nations.

During the last 30 years there has been much progress throughout the world in advancing knowledge on the status of waterfowl (e.g., *see* Boyd in press). The International Waterfowl Census, organized by IWRB, today receives data from more than 60 countries throughout the Western Palearctic and from Asia. These midwinter surveys provide the raw data for assessing the importance of individual sites, for monitoring trends in waterfowl population levels and for developing management plans for populations and recovery plans for threatened species. This program now requires to be extended to eastern and southern Africa and the neotropical region, where little is known of the status, distribution and threats to waterfowl. In contrast to North America, where the Waterfowl Management Plan has developed through a long-standing collaboration between Canada and the United States, the prospects of achieving such goals for migratory waterfowl flyways elsewhere in the world are less certain. The majority of waterfowl using the Western Palearctic and Asian flyways breed in the Soviet Union, and only since very recently can the possibility of cooperative research and conservation programs be viewed with optimism. Furthermore, these flyways pass through numerous countries, each with different languages, attitudes and legal frameworks for nature conservation. The opportunities for managing migratory waterfowl populations under such conditions are uncertain, and are still many years from being implemented.

Conclusions

At the international level there is cause for some optimism over the future conservation of large and internationally important wetlands due to the attention afforded to them through the Ramsar Convention. Less attention is being given to the smaller wetlands, and their successful conservation lies almost entirely in the hands of national governments and nongovernmental organizations.

A major international priority for wetland conservation in the 1990s must be an increase in international collaboration. This should include an improved transfer of expertise and technical methodologies between the eastern and western hemispheres, and increased support from developed to developing nations through the provision of funds, expertise and training for wetland conservation. Wetland scientists in North America have played a leading role in the development of methodologies for assessing the functions and values of wetlands; these methodologies need to be applied to other parts of the world through national wetland strategies covering all wetlands, not just the large and "important" ones. Such strategies must set targets for stemming the rate of wetland losses, and include the preparation of integrated management plans for individual wetlands, as well as the training of staff and planners. For the future management of waterfowl populations, a priority should be to develop strategies, modelled on the North American Waterfowl Management Plan, which will provide a framework for international cooperation. For many regions this will require that the quality of information available for the management of populations (population levels, bag statistics etc.) be geographically extended and improved.

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Summary Remarks

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The theme of this session was "water and wetland management: new findings and initiatives," and our speakers this afternoon highlighted new and innovative approaches to protecting and preserving wetland habitat. They also warned us of some of the dangers that now pervade key wetland areas and underscored the value to wildlife of water quality as well as quantity.

During the afternoon, Curtice Griffin discussed state initiatives to protect inland wetland habitat, such as regulations in Massachusetts that specifically include wildlife habitat as a basic tenet in wetland protection. Kevin McGarigal described efforts in the West that focus on the importance of riparian habitat to wildlife, while at the same time build an awareness of the key issues at stake among multiagency user-groups. By stressing communication and cooperation, the natural gap between research and management is bridged, thus enhancing the likelihood of effective management of these riparian areas. Papers by Grue et al. and Forsyth emphasized the potential for wetland contamination when agrichemicals enter the wetland ecosystem and destroy wildlife habitat as effectively as removal of the wetland itself. They also identified the challenge of the future—that is, providing alternative strategies to reduce these harmful inputs to non-target habitats, such as wetlands, while still meeting the needs of the farmer.

Carl Madsen and Sandy Macaulay talked about new approaches to wetland management under the auspices of the North American Waterfowl Management Plan. Carl described numerous initiatives designed to protect, restore and enhance remaining wetlands to compliment other existing programs, all offering long-term habitat protection. Sandy focused on the Prairie-Pothole Region and the ongoing cooperative efforts, enlisting private and public wildlife and agricultural agencies, to form a working partnership that addresses the major habitat problems in this important region. Finally, Mike Moser broadened our perspective in wetland management considerably by outlining for us successes in the conservation of wetlands outside the boundaries of this continent.

In summary, we are seeing wetland habitat disappear at an alarming rate, not only here at home in North America but in other parts of the world as well. However, we are also seeing the development of new and innovative approaches to wetland conservation and management that involve the cooperation and assistance of many different user groups. Public awareness of this dwindling resource is high, and interest in wetland programs has again reached the highest levels of government. Our success in the future will likely be measured not only by our ability to forge lasting partnerships of agencies and organizations but also by our willingness to develop and consider alternative, innovative approaches to wetland conservation and management.

Special Session 2. *Wildlife and Habitat in Managed Landscapes*

Chair
JON RODIEK
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Cochair
RICHARD M. DEGRAFF
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An Overview

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Progress in resource management is related closely to the continuous development of its separate disciplines. Virtually no improvements in resource management could be made without the constant renovation of the various disciplines' knowledge bases, values and belief systems. Imagine wildlife biologists limiting their interest and knowledge in wildlife to the increasing abstraction of the species or the individual. What progress in land-use planning would there be if the landscape architect's involvement in the landscape stopped with the visual and spatial attributes of the masterplan or the commercial logging company's interest for the forest stopped with the completion of the harvest?

During this 54th North American and Natural Resources Conference we will be exploring various strategies for meeting natural resource needs. In the session, ''Wildlife and Habitats in Managed Landscapes,'' one strategy emerges. This strategy suggests meeting resource needs by redefining habitats to include the concept of landscape. The concept, not landscape as phenomena but as environments, has a significant meaning for the way we plan for people, habitats and wildlife.

This strategy of resource management suggests applying the tools of planning, management and design not to discrete entities in the environment but to the entire landscape itself. This concept of landscape involves resource managers in two kinds of spatial manipulation where wildlife, habitats and human aspirations are blended together. One kind of space requires all the managers to see the landscape as one continuous entity. The other requires the managers to organize its form and function for all parties concerned.

In times past these two kinds of space were not successfully mixed together. There was an almost aristocratic concept of landscape that gave the managers all-powerful control over it. This way of viewing the landscape led to singlemindedness of purpose. Landscapes were therefore planned for the few who controlled it.

Today we see our landscapes as fields of conflict. Land-use decisions are based on legal and political decisions where compromise between authority and special interests are made. In such arenas it becomes difficult to remember that the ultimate strategy of resource use must be to perpetuate the landscape, not to destroy it.

Resource management improvements can be measured by how well we reconcile the differences between the pressures of human expansion and the limitations of our landscapes to produce natural resources. Three issues are central to this effect. First, resource managers must resolve the conflicts created in the spatial relationships among and between ecosystems. Second, resource managers must be cognizant of the landscape patterns we create over time as a result of our decisions. Finally, resource managers must continually strive to develop innovative strategies that help balance the energy and material exchanges between human land uses and the large landscape system.

The Wildlife and Habitats in Managed Landscape Workshop will focus on five major papers that deal specifically with one or more of these resource management issues. These papers have several characteristics in common.

1. Landscape Level of Resource Management

The scale of the resource problem, be it a clearcut, an insect infestation, a wildlife population collapse or an oil spill, has always been much bigger in impact then our ability to respond to it. Foreman (1988), Fabos (1985), Lyle (1985), Odum (1971) Marsh (1983) and Harris (1984) all speak to the need of employing strategies, action packages of response and restoration work that are equal in magnitude and impact to the spatial scale of disturbance.

The concept of an appropriate level of response was encouraged through federal resource managers' compliance with NEPA and Section 102(c), which required federal agencies to identify: impacts; unavoidable adverse effects; alternatives; long and short term trade-offs and irreversible commitment of resources associated with federal land-use actions.

Now, predictably, the resolution of resource use problems slowly has expanded to view the problem at a scale equal to its impact. In most cases this spatial scale is the landscape scale, where patterns of land use, human agents and impacted ecosystems are most appropriately assessed.

2. The Time Frame of Adequate Response

In Rosenberg's (1988) report on the causes, effects and control of greenhouse warming he brings up the concept of adequate time frames for responding to this crisis. He states that the more rapidly the climate changes, the more difficult it will be for natural ecosystems and human activities to anticipate and adapt to those changes. Viewed in the light of resource uses, all scenarios of habitat change imply a distribution of impacts, of costs and restoration efforts that demand a long term, long range recovery period. The best way we can respond to such magnitudes of impact is to understand the time frames in which either preventative or restorative efforts would be applied to resolve them.

3. Technological Assistance

Technological innovation is a primary reason we are able to think and act in large scales of space and across larger time frames. Were it not for the advent of remote sensing and, more specifically, the application of G.I.S. and landsat thematic mapping techniques, we could not promote the resolution responses suggested by these authors.

The advances of blood chemistry and urine analysis techniques developed by DelGiudice, Mech and Seal (1989) and others has given resource managers a solid basis for rethinking the value of winter habitat. Without the insights brought forth in this highly specialized work we could do little more than hypothesize about the relationship of the nutritional status of deer and the food component of their winter habitat.

These technological advances demonstrate the necessity of merging the evidence of science with intuition (or art) of the resource management discipline. Together these approaches advance us to the next highest order of evolution in our collective fields. These three characteristics will no doubt become a more traditional part of the growing knowledge base, value and belief system of resource management.

Commonalties aside, what of the resource issues and, more importantly, our contribution to their resolution? Do these papers reflect any progress and if so what impacts might they have?

The Spatial Relations Between Ecosystems

These projects do contribute to the improvement in the use of our resources. Perhaps the most notable improvement may be seen in the types and kinds of spatial relationships we plan and design for our ecosystems.

Consider Bissonette's (1989) pine marten project. He proposes long-range landscape planning as a means to maintain both the survival of the pine marten and the old growth forests in western Newfoundland. Certainly the timber industry and pine marten habitat could exist without the presence of the other. But in order for them to co-exist, certain aspects of forest structure and botanical character have to be preserved. The solution requires the preservation and integration of several stages of ecosystems and their spatial distribution across the broader landscape system.

Long-range planning for renewable resources takes on a different role in McComb's work in Kentucky (McComb et al. 1989). Coal revenues currently dominate the regional economy in the southern Appalachians. The surface mining of coal has impacted 10 percent of the commercial forest land in Kentucky since 1954. McComb suggests this dominant use of a fixed resource threatens the future viability of the region in two very significant ways. One is the fixed resource use by surface mining methods which irreversibly commits the entire landscape and its renewable resources to this single use activity. Second, this activity threatens the remaining forest resource base with increased forest management pressures.

McComb's recommendations include a cumulative effects analysis of the current resource uses in this multiple-ownership region of Kentucky. At the very least, this activity could greatly improve the coordination of two very incompatible land-use activities. In so doing, a more rational approach to a very short-term economic decision could be established. This baseline work could lead to a more acceptable reallocation of resource uses in the future.

The rain forests of southeast Alaska have not suffered under the same degree of landscape devastation—yet. If landscape and resource are to be better managed, a major pre-harvest analysis is being recommended. Samson et al. (1989) recommended a comprehensive interagency, interdisciplinary working group to examine all major ecosystems within the managed forest. The goal of this analysis is to identify representative samples of the various plant communities in order to define the range of diverse species found there. Ultimately the harvest cuts would be designed in terms of shape, size and location to preserve some ecosystem types and intensively manage harvests in others.

The Improved Landscape Pattern

A second benefit derived by these projects is the contribution they make to an improved landscape pattern in the greater landscape system. Land-use decisions, whatever their impacts, accumulate in the landscape pattern over time to become part of the overall fabric. These projects, if implemented, select for more favorable landscape patterns and hopefully better ecosystem performance. When land uses are not wisely coordinated or when they threaten productive landscape performances, an unfavorable environmental problem is perpetuated.

Such is the case with the isolation of nature reserves in north Florida. Lines and Harris (1989) are studying ways to remedy the problems associated with landscape preserves when human developments intensify around them. Many of these reserves are not large enough to sustain viable wildlife populations they were designed to protect.

Thematic landsat analysis of these preserves and their surroundings will reveal the kind of landscape additions, forms and sizes that might remedy the isolation problem. The underlying purpose here is to think of these preserves as models to assist us in learning how to sustain wildlife in landscapes located in and around human developments.

The size, shape, location and buffers necessary for a wildlife preserve are not the only parameters that are important for success. There are the more classic questions of food, shelter, water and reproductive areas. In terms of nutrition we have seen perhaps our greatest advances.

DelGiudice, Mech and Seal (1989) offer a wealth of potential management insight through their analytical techniques of mammal nutritional status. They have advanced this technique to a level of refinement in which the resource manger could plan for the future condition of a landscape where wildlife can sustain themselves over the seasons. This information makes it possible for the resource manager to design a more appropriate palette of plant materials to be made available within a desired wildlife species' home range.

Innovative Strategies

These projects give rise to some possible strategies that might be useful in the further advance of wildlife and habitats in managed landscapes. Cain (1968) supported the notion that ecological principles have a direct correspondence to human ecosystems. He continually promoted the idea that conservation should be directed toward the interjection of ecological knowledge into human action patterns. In this sense, ecological principles can be applied to the management of natural resources and to our manner of utilizing human resources as well. This overarching theme sets the stage for two subthemes.

Sustainable Landscape Mosaics

Harris (1984) and Foreman (1988) expand upon this notion suggesting we build sustainable landscape mosaics. Dansereau (1957) promotes this notion further through his laws of community adjustment.

The concept of sustainable landscape mosaics is a workable one. It suggests the reformation of the yet-to-be developed human landscape mosaic in and around a skeletal corps of natural ecosystems where the former subordinates its activities in this natural zone. In so doing, structure and function of the natural zone is given a priority and thereby a genuine social and institutional value. The landscapes become part of the perpetual landbank we can live around and learn from.

The value of such an effort is realistic and achievable since it engages each region and land ownership condition on its own terms. The authors of this workshop have demonstrated details on how this can be accomplished on their specific projects. The concept also engages the right players, namely the land managers, the public and the private enterprise system.

Regenerated Landscapes

One of the most certain impacts of future landscape destruction is the associated reduction in quality of life and health for the individual. Predictions of atmospheric and water supply pollution, coupled with reports on increased crime rates and homelessness, leads us to believe the worst. Certainly these are grounds for concern. There are also grounds for hope and constructive action.

Ulrich (1984) and McCarthy (1987) point out the many benefits contact with the outdoor experience has on the individual. We are discovering the relationship between individual and landscape is a very real and vital part of everyone's cognizance.

This personal and life-long connection with landscapes is the key to promoting the regeneration of new landscapes. Using this concept we can begin to retrofit parts of our human-dominated environments with less intensive uses where native flora and fauna survive.

These regenerated landscapes differ from parks and open spaces in several ways. First, the diversity of the plant materials should reflect a naturally regenerating landscape. In fact, while some portions are planted, major portions should regenerate naturally. The types of plants should be selected from plant palettes that are native and dominant in the area. Use zones would be limited to the periphery and to the pedestrian circulation routes only.

No single scenario of planting schemes nor location should be dominant. The point in establishing these zones would be to build plant environments on lands where their presence would be guaranteed for at least a generation. Forest Service lands, BLM lands, state forest, park lands and even municipal open spaces might be primary candidates. The motive would be to build habitats on marginal lands where native wildlife and people could co-exist.

The ultimate purpose of regenerated landscapes and sustainable landscape mosaics is to elevate the principle of wildlife and habitats on managed landscapes to a new order of consciousness. The concept of landscape diversity is a key to maintaining and protecting natural species. By managing for wildlife on the landscape level we hope to derive benefits for wildlife, landscapes and the human population.

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American Marten: A Case for Landscape-level Management

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This paper reports on the cooperative efforts of research scientists, the Newfoundland government and provincial resource managers to provide for the continued existence of threatened (COSEWIC-Canadian list) American marten (*Martes americana atrata*) in commercially desirable old-growth spruce-fir forest. Achievement of conservation goals while simultaneously providing for economic interests is not necessarily an incompatible endeavor, although previous efforts at reconciling the two have often been less than successful. It is our impression that economic development of natural resources often occurs without adequate planning for resource values. The planning that does occur is usually mandated by federal, state or provincial policies and regulations. This need not be the model we follow.

Perhaps one of the reasons why solutions to complex resource problems seem so difficult to achieve is that our attempts to solve them have been focused at an inappropriate scale. Here we argue that landscape-level management is appropriate and necessary for a growing number of resource conflicts. Using marten in Newfoundland as an example, we show that management strategies can be devised that simultaneously promote marten survival while maintaining commercial logging interests and a viable timber enterprise that supports the economy of western Newfoundland. We first describe marten habitat needs and how they conflict with local economic interests. We then explore the benefits achieved from a landscape approach to the problem.

American marten were once found throughout the province in forested areas, although perhaps never in great numbers (Bergerud 1969, Snyder 1985). Bangs (1897) reported that as early as 1870 "marten were still common in various parts of the island, but from the increasing . . . value of the fur is annually becoming scarcer." Indeed, at this time across northern North America, marten habitat was steadily reduced and changed by settlement and logging (Strickland and Douglas 1983). For many decades following the record harvests of the late 1840s and mid-1850s (Strickland and Douglas 1983), trapping figures reflected a general decline in marten populations (Novak et al. 1987). By 1930 many areas had been severly depleted, and trapping seasons were closed. For example, in New York, marten were common

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throughout the state in the 1800s but by the turn of the century were restricted to the Adirondacks (Grant 1903). In Newfoundland marten were sufficiently rare by 1934 to necessitate closing the trapping season. It has never been reopened. Remnant populations in eastern Newfoundland were probably extinct by 1969 (Bergerud 1969). Marten populations across North America began to rebuild in the mid-1970s (Novak et al. 1987), but Newfoundland populations have remained low. Today, the only remnant viable population is concentrated in old-growth timber found in the Little Grand Lake area of western Newfoundland (Snyder and Hancock 1982, Mayo 1984). A pine marten study area was created in 1973 by the Newfoundland and Labrador Wildlife Division as a refuge where no trapping or snaring has been allowed. Marten were introduced into the headwaters area of the La Poile River (Mayo 1976a), the Main River area (Mayo 1976b), Siviers Island (Porter 1976), and Terra Nova National Park (Bateman 1985) in attempts to establish other populations. It appears that the introduction to Siviers Island and the La Poile River have been unsuccessful, although marten have been reported from the Main River area since 1976 (J. Hancock, personal communication:1987).

Habitat Preference

Marten prefer dense, mature coniferous forest or mixed forest with high overstory density (Marshall 1951, de Vos 1952, Francis and Stephenson 1972, Koehler et al. 1975, Clark and Campbell 1976, Koehler and Hornocker 1977, Soutiere 1979, Pulliainen 1981, Hargis 1982, Douglass et al. 1983, Raine 1983, Spencer et al. 1983, Bateman 1986, Snyder and Bissonette 1987). The reasons for this preference are not clearly understood, but overhead cover from predation, prey abundance and availability, and thermoregulatory needs during winter (Buskirk et al. 1987) appear to be involved. Large clear-cuts have been shown to be detrimental to marten populations in North America (Campbell 1979, Major 979, Soutiere 1979, Thompson 1982, Snyder 1984), and Europe (Gravok 1972). Even regenerating clear-cuts are used infrequently or avoided. In Wyoming, clear-cuts less than one year old were not used by marten (Clark and Campbell 1977) and regenerating clear-cuts in Maine were used only in the late summer when berries were present (Steventon and Major 1982). Commercially clear-cut areas in Maine supported densities two-thirds less than similar uncut areas (Soutiere 1979). In areas of extensive clear-cutting in Newfoundland, Snyder and Bissonette (1987) and Bissonette et al. (1988) found marten concentrated their activities in undisturbed forest.

The Current Problem

During the last 30 years, timber harvesting in western Newfoundland has extended from the Corner Brook area near the paper mill to much more remote stands near the Grand Lake-Little Grand Lake area, the last remaining marten habitat on the island. Corner Brook Pulp & Paper Ltd. currently has access to exemptions within and leases surrounding the pine marten study area and is cutting that timber. Approximately 4,000 of 133,560 ha of forest is cut annually within a larger marten distribution area. This rate will probably increase within the next few years (Snyder 1985). In 1983, forest accounted for about 87 percent of the 140 km^2 area studied by Snyder. Forty-seven percent of the forest has been cut, 18 percent was in residual stands ranging from 1 to 270 ha in size, and 35 percent was in uncut forest. Clear-cutting has continued in this area since 1983. Roughly 5.3 km^2 of the 561 km^2 of forested area on the Environmental Assessment Area has been cut. Although marten are completely protected within the pine marten study area, their habitat is not. It is unknown how many years are needed after clear-cutting for a site to regenerate adequately for marten, but data show that greater than 23 years are needed in Newfoundland (Snyder 1984).

History of the Corner Brook Mill

The Corner Brook Mill began producing paper in 1925 under a tripartite ownership involving the governments of Newfoundland and Great Britain and the Newfoundland Power and Paper Company, a holding company of Armstrong-Whitworth, the builder of the plant (Horwood 1986). In 1926, the mill was sold to the International Power and Paper Corporation of New York. Eric Bowater, later to become chairman of the Bowater Companies, became a director of the Newfoundland Power and Paper Company in 1923, as plans were being made to build the Corner Brook mill. Bowater Paper Mills Ltd. was organized in 1923 in Great Britain. At the same time, Bowater organized a sales organization to sell Corner Brook paper as its sole agent throughout the world. In 1938, Bowater brought International Paper's interest in the mill and the name of the International Power and Paper Company of Newfoundland was changed to Bowaters Newfoundland Paper Mills Ltd. Bowaters operated the plant until 1984 when it was sold to Kruger Incorporated of Montreal (Horwood 1986).

Just prior to this, in 1980, an Environmental Assessment Act was passed in Newfoundland. The Minister of Environment for the province has responsibility for administering the Act and can require any activity to be registered, even if not specifically outlined on Schedule 1 of the Act, if he feels there is a potential environmental impact. Whether or not an assessment is required depends upon government review and public screening of the registration (J. Hancock, personal communication:1987). In late 1981, the Wilderness and Ecological Reserves Advisory Council requested that forestry projects in the Little Grand Lake area of Newfoundland be registered under the Act because of the importance of the area to marten. In January 1982, the Minister of Environment requested that Bowaters register all logging and associated road building activities in the Little Grand Lake area. Bowaters subsequently submitted a registration document. Based on a review of the document by representatives of the provincial and federal government and the public, the Minister directed Bowaters to prepare an environmental impact statement of their forest harvesting operations in the Little Grand Lakes area. The Minister also established the boundaries of the Environmental Assessment Area for the company. In late 1982, Terms of Reference for the environmental impact statement were approved by the Minister of Environment following a review by the Environmental Assessment Committee and the public. The terms required specific component studies for marten and archeology. Bowaters was in the process of selling the Corner Brook plant and little was done about the assessment until the company was sold to Kruger. Negotiations between Kruger (Corner Brook Pulp & Paper Ltd.) and the provincial government resulted in a Cabinet level exemption allowing Kruger to cut 100,000 cords of wood in the Environmental Assessment Area. One condition of the exemption order was that annual cutting plans for the exempted area had to be submitted to the Wildlife Division for approval; another required Kruger to undertake a study in cooperation with the Wildlife Division to determine the impacts of logging on marten. We completed that work in 1987 (Bissonette et al. 1988). Independent of these activities, we conducted an earlier study of marten habitat selection supported by the Newfoundland and Labrador Wildlife Division in 1982–84 (Snyder 1984, Snyder and Bissonette 1987).

Use of Residual Forest Stands by Marten

Newfoundland forests are characterized by occasionally steep topography and numerous hydric sites, including bogs, streams, rivers, and other wet areas. Logging operations characteristically leave residual patches of forest varying in size from less than 1 ha to ⩾40 ha. The primary method of tree harvest has been clear-cutting of contiguous, large tracks of balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*). Old growth stands are most profitably harvested. Some of the best stands of old growth left on the island are found in the Grand Lake-Little Grand Lake area. The question we asked was whether marten used residual stands isolated from continuous old growth forest, and if so, were there identifiable characteristics that would allow us to predict their use.

Field work for our first study (Snyder and Bissonette 1987) was conducted from June 1983 to March 1984. Residual stands were grouped into five size classes, and clear-cuttings into three categories based on the height of balsam fir regeneration. Live trapping was conducted from June–December in 43 residual stands and 35 clear-cuttings. Vegetational characteristics were taken at each trap site. Chi-squared and stepwise logistic regression analyses were conducted to determine which variables accounted for the difference between successful and unsuccessful trap sites. Snow tracking was conducted from January–March. Habitat selection was determined by comparing distance of marten trails observed in each habitat with an expected distance based on area.

Captures in Residuals vs. Clear-cuttings

Fifty-one percent (89.5) marten captures were in residual stands and six (10.5 percent) were in clear-cuttings. Mean captures per 100 trap nights were 2.19 in all residual stands and 0.48 in clear-cuttings; total trap nights equalled 3,593. Residual stands 25–34.5 ha in size had 4.62 captures per 100 trap nights (Snyder and Bissonette 1987). Marten capture rates differed with residual stands size (X^2 = 13.36, df = 4, P = 0.010). Only 5 (10 percent) of 51 captures were in residual stands ⩽15 ha. Thirteen captures would be expected if marten use was independent of residual stand size (Snyder and Bissonette 1987). Tree height, percentage overhead cover, presence of slash and distance to nearest habitat edge contributed most to the difference between residual and clear-cut trap sites. Tree dbh was the only variable contributing significantly to trap success.

Tracking

Marten tracks were followed for 29 km (Snyder and Bissonette 1987). Seventy-four percent of marten trails were located in forested habitat that comprised 46 percent of the area. Clear-cuttings represented 41 percent of the area but only 25 percent of marten travel was recorded there (Snyder and Bissonette 1987). Clearly, marten prefer residual forest over clear-cut and regenerating areas, and will use patches of residual forest if greater than 15 ha. The clear implication is that interior, or core area is required. Our recommendations suggested a change in logging operations from large-scale clear-cuttings to much smaller-scale patch cuts. Indeed, our second study, conducted from November 1985 to August 1987, was designed to assess the impact of an altered harvesting regime. Corner Brook Pulp and Paper Ltd. agreed to intersperse clear-cuttings into a mosaic of cut and uncut areas. Woods operations began with road building in June 1986; clear-cut harvesting began 4 August and ended 7 November, 1986. No harvesting was done in 1987 except for a right-of-way cutting in August to facilitate road building. During the course of the study, 7,860 cords of pulpwood were harvested from 259 ha by clear-cutting; 4.3 km of capitol road and 2.6 km of forest roads were constructed. We studied the impact of the new forest harvest methods on small mammals, the principal prey base of marten. We also documented home range spatial dynamics of marten pre- and post-harvesting to determine if significant changes in spatial use were evident.

Prey Base

In Newfoundland, the depauperate small mammal fauna provides a limited prey base for marten. Only two of the seven small mammal species are endemic: meadow voles (*Microtus pennsylvanicus*), and arctic hares (*Lepus arcticus*). Snowshoe hare (*Lepus americanus*), masked shrew (*Sorex cinerous*), eastern chipmunk (*Tamias striatus*), and red squirrel (*Tamiasciurus hudsonicus*) were introduced in 1864, 1958, 1862, and 1963, respectively (Peterson 1966, Northcott 1974, Northcott et al. 1974, Payne 1976). Deer mice (*Peromyscus maniculatus*), first documented by a single specimen found in 1968 (Gould and Pruitt 1969) appear to have become established in small, isolated pockets in western Newfoundland (Tucker et al. 1989). Only four of the seven species (meadow voles, masked shrews, red squirrels, and snowshoe hare) are found in any abundance. Only meadow voles and masked shrews are abundant in old growth forests of the area. Chipmunk are found in moderate numbers locally in the Barachois Pond Provincial Park area and appear to be spreading throughout the western part of the province. Arctic hare inhabit upland barrens.

Shrews and voles were trapped in control vs. experimental areas in old-growth as well as clear-cut areas three weeks, 1 year, 13 years and 23 years post-logging, using a trapping web design with 240 trap sites, 3 traps per site (Anderson et al. 1983). Trapping was conducted before, during and after logging. The first trapping series occurred in spring 1986 with three webs each placed in a control, as well an experimental area that was cut later. The second series took place in fall of 1986. Three webs were placed in mature timber (control) and in a 3-week old clear-cut. The third and final series occurred in spring 1987. Three webs each were placed in mature timber (control) and in three experimental areas representing 1 year, 13 year, and 23 year cutovers (Bissonette et al. 1988). Small mammal densities were calculated and differences compared with t-tests at $P = 0.05$.

Shrew densities were significantly higher in older cutovers 13 and 23 years of age, but no differences in densities were found between the control old growth and 3 week and 1 year logging areas. Densities in the control equalled 26.6 animals/ha vs. 26.8 for the experimental area prior to logging. At 3 weeks post-logging, mean densities were 15.9 vs. 13.4/ha (control), and 15.7 vs. 10.3/ha (control) 1 year post-logging. Shrew densities increased to 75.1 vs. 15.7/ha (control) in 13 year cutovers, and 51.3 vs. 15.7 animals/ha in 23 year cutovers.

Vole densities were higher 3 weeks post-logging but declined to almost 0 in 1, 3, 13, and 23 year old clear-cuts the following spring. It was apparent that some factor other than habitat was involved in the decline, since densities in the control areas also declined precipitously. As a result, we were unable to determine how structure in older clear-cuts was related to vole densities.

Measures of abundance were obtained for the remaining prey species. None were found in great abundance. Our data indicated that voles and shrews were found in 91 percent and 15 percent of marten scats, respectively (Tucker 1988).

Marten Dynamics

We also studied the effects of logging on marten spatial dynamics. We were interested to learn how logging in established home ranges affected use of that range. Marten were captured, telemetered, and relocated 1–3 times daily from June 1986–August 1987. Relocation data for ten marten on the control and experimental areas were grouped into three treatments of home range use before, during and after logging, and spatial dynamics analyzed. Three indices were used to test for significant autocorrelation within a data set: Psi (Swihart and Slade 1985a), Gamma (Swihart and Slade 1986), and t^2/r^2 (Swihart and Slade 1985b). A non-variance supported estimate was made of population size.

On the control area, two females and three males established home ranges. Both females occupied their home ranges until late 1986 and appeared unaffected by logging operations. All males were present throughout the logging. One expanded his range into the experimental area upon the death of a conspecific. None appeared affected by logging. In the experimental area, home range information was obtained for two females, two male kits and one adult male. One female changed her activity pattern shortly before logging, the other shortly have harvest operations. Their movements showed strong avoidance of clear-cut areas. Throughout the study, adult marten were found in clear-cuts in only 7 of 324 locations (2.2 percent). The two male kits expanded their range throughout the summer and fall of 1966, before dispersing in the fall. Some home range expansion by young marten, independent of harvesting operations or other causes, is expected. Contact was lost with the remaining male before harvest.

We estimated resident marten population size based on mean home range sizes for males and females, and the area of available habitat within the Environmental Assessment Area. Within-sex ranges do not overlap appreciably (Bissonette et al. 1988). According to forest inventory charts, there was approximately 561 km^2 of marten habitat within the assessment area. We defined marten habitat as stands of mature softwood and mixed-wood. Using harmonic mean estimates, we calculated mean female home range sizes to be 6.64 km^2 ($n=4$), and mean male ranges to be 9.19 km^2 ($n=3$). Marten home ranges were well established and represented values as close to the true state of nature as is possible with this sample size. Male and female populations were estimated separately since home ranges overlapped between, but not appreciably within sexes. We calculated that the Environmental Assessment Area can support approximately 150 resident marten; the effective breeding population may be much smaller, depending on sex and age class ratios (Bissonette et al. 1988).

Our results clearly indicate that marten require old-growth habitat and that populations will decline as old-growth timber is cut. In Newfoundland, populations are not dense. Absolute numbers are apparently quite low. An undisturbed interior, or core area, of old-growth must be maintained if marten are to survive. However, economic pressures for cutting as well as the presence of insect defoliators, make "core area" management a *dynamic* concept and practice.

Intervening Variables: Politics and the Economy

Forest operations in Corner Brook date to 1926 and were predicated on a quick return on capital invested. The result was a rapid consumption of nearby wood and an expansion into more remote regions, including the Grand Lake-Little Grand Lake area. A planned cropping to promote sustained yield never materialized (Horwood 1986). Indeed, the economics of old-growth is predicated upon liquidation. Clawson (1976) has projected that a $12 billion inventory in standing old growth timber means a potential annual cost, at modest interest rates, of $600 million (Harris 1984). Given the demand for wood pulp, substantial economic pressure to cut old growth spruce and fir in Newfoundland will continue.

Corner Brook Pulp and Paper Ltd. remains the cornerstone of the economy in western Newfoundland. Any action taken to protect marten or their habitat is mediated by its impact on the economy of the region. Apart from small manufacturing and the service trades, the city of Corner Brook is wholly dependent on the paper industry (Horwood 1986). The industry has tended to be cyclic, not necessarily responding in synchrony with the economy, but rather to surpluses in milled paper goods. The years 1926, 1937, 1958, the early seventies, and 1982–83 were bad economic times for the Corner Brook mill (Horwood 1986). In 1982–83, the mill closed its largest of several machines and 800 people were laid off. The province already was suffering high unemployment. High mortgage rates for homeowners and high bank rates for businessmen exacerbated the situation. Building and home construction was at a low ebb.

When the mill was sold to Krueger in 1984, the federal and provincial governments provided generous subsidies, and the unions representing forest products workers made substantial concessions. The province provided $64 million: $30 in loan guarantees to the banks if Krueger failed, the remaining $34 million in direct and indirect subsidies. Thirty-three million was matched by the federal government under the Federal-Provincial Pulp and Paper Modernization Agreement (Horwood 1986). The union accepted restricted benefits in exchange for job security. Additionally, a hotly contested amendment to the Labor Standards Act (Bill 37) was passed, retroactively shortening the period required for notice of temporary layoffs to one week. The company saved $6.67 million in employee layoff payments (Horwood 1986) before purchasing the mill.

Any actions resulting in the removal of significant amounts of old-growth conifer timber in pine marten habitat will significantly reduce marten numbers. The literature is replete with documentation. Knowledge of marten habitat requirements is not the limiting factor. However, the reality in western Newfoundland is that cutting will continue. Old-growth will be removed. The challenge is to orchestrate woods operations in such a manner as to allow an economic harvest while yet providing for the continued existence of threatened marten and the other species dependent on large expanses of old-growth. However, the scale at which current management practices are conducted does not promote the maximum likelihood of success. The areas involved are insufficient in size, given the annual volume of wood required to run the mill. Estimates of the area of remaining old-growth habitat in western Newfoundland are not available, but according to our calculations (Bissonette et al. 1988), approximately 561 km^2 of old-growth remain within the Environmental Assessment Area, where the greatest marten densities occur. Corner Brook Pulp and Paper Ltd. has cut approximately 4,000 ha of forest annually in the decades prior to 1986 in an area of approximately 134,000 ha, stretching south from the Main River area to Barachois Brook. Snyder (1985) suggests that this rate is likely to increase in the future. Actual harvest will no doubt be mediated by the world supply of milled paper. If the 11-year Corner Brook cycle holds, demand for wood pulp will be high into the mid-1990s. The long rotation times needed to attain the characteristic structure of old growth spruce and fir in Newfoundland, even with silvicultural practices, suggests that a good deal of planning is necessary to effectively manage simultaneously for wood production and for maintenance and enhancement of marten habitat. Once removed, old-growth may require 80–100 years to regenerate. The logistics and expense of recovering large tracts of timber killed by spruce-budworm (*Choristoneura fumiferana*), as well as other primary and secondary organisms (Raske and Sutton 1986) is part of the equation. Forest management units in western Newfoundland rated very high on a vulnerability index to spruce budworm defoliation (Raske 1986). Dead timber is commercially useable for only 2–3 years after defoliation. In western Newfoundland, tree mortality to spruce budworm increased from 137,950 cords in 1981 to 881,225 cords by 1983. Total stand volume containing these trees was 2,847,840 cords over 95,700 ha (Raske and Sutton 1986). It is clear that management on a much larger scale is required.

Landscape Management

The principles of landscape ecology and management provide the necessary tools. Landscapes have been defined as heterogeneous land areas composed of a cluster of interacting ecosystems, or landscape elements, occurring repeatedly across the land area (Forman and Godron 1986). Lndscape level management presupposes knowledge of ecological properties, the physical and biological relationships, that govern the different spatial units in the landscape. Patches, corridors, and the background matrix of vegetation are the units of interest and measure.

Forman and Godron (1986) have suggested that landscape formation is a result of three processes: (1) specific geomorphological processes, (2) colonization patterns of organisms and (3) the disturbance of regimes of individual ecosystems over a shorter time. Landscape ecology, therefore, is similar to systems ecology, addressing structure, functions, and their change over time. However, the landscape approach focuses horizontally on relationships between spatial units, rather than vertically within a spatial unit (Forman and Godron 1986).

The landscape in western Newfoundland is composed not only of old-growth and regenerating areas, but also of bogs, barrens, high elevation heath, ponds and lakes, as well as riparian communities. Marten move across these landscape elements utilizing vegetation patches and corridors as well as interior areas of old-growth while seeking cover and food. The core of the problem then, is how to orchestrate logging with marten habitat requirements across the landscape.

The first step is to represent the entire landscape in a computer interactive format, i.e., a system (GIS) allowing easy and interactive measurement of the distribution of landscape elements, or tesserae, (Forman and Godron 1986) including clear-cuts, regenerating forest and old-growth. Bogs, barrens and other landscape features also are included and assessed for spatial characteristics. Forest type maps can be used to provide the initial map, or better still, satellite imagery, using the most time-appropriate scene.

Quantitative measures of the spatial properties of patches, corridors, and matrices in a GIS-enhanced landscape provide the basis for assessing habitat quality, and the tools for region-wide management. For example, once the type of patch has been determined (disturbance, regenerating, remnant, environmental resource; Forman and Godron 1986), size (area) measurements are simple and informative. Snyder and Bissonette (1987) found that marten are sensitive to patch size of residual forest stands. Diversity of other species also correlates closely with patch size (Whitcomb 1977, Robbins 1980, Ambuel and Temple 1983). Patch shape, measured as the ratio of the perimeter of the patch to the circumference of a circle of identical area, has important biological implications for marten. Temple (1986) has shown graphically how core area varies with patch shape. Patches that tend towards minimum perimeter length, i.e., isodiametric shapes, maximize interior area and minimize edge. Our data (Snyder and Bissonette 1987) and that of others demonstrate that marten populations are denser in undisturbed forest with large core areas. Residual forest patches $\geq$15 ha, and with patch shape values tending towards unity, would appear to be desireable landscape elements for marten if logging must ultimately result in greater habitat heterogeneity. Patch isolation and degree of connectedness also may be important considerations (Fahrig and Merriam 1985). Corridor curvilinearity (measured as a ratio of corridor length to straight line length), and connectivity, (a measure of the number of breaks of specified width) in an otherwise continuous habitat strip, are properties that appear to have biological importance for species requiring continuous cover but who exist in patchy environments. Finally, the relative area of the matrix, the most connected and extensive landscape element (Forman and Godron 1986), is perhaps the most critical requirement for core sensitive specie. One can envision a landscape where the perturbation is so extreme that the patches created by the disturbance become the matrix by virtue of their prevalence and connectedness. For core area species, the most preferred habitat must be the landscape matrix.

Landscape-level management of marten in Newfoundland can be reduced to a series of related questions based on the following guidelines: (1) old-growth should be the matrix element in the landscape and clear-cut patches should be kept within specified sizes; (2) if residual patches result from cutting, they should be no smaller than a specified minimum size, with isodiametric shapes, and corridor access routes, preferably along riparian corridors should be maintained. Additional guidelines regarding spatial arrangement of landscape elements should be incorporated into the management plan.

Some of the questions we can ask are: (1) What is the maximum size of clear-cut allowed? (2) What total amount of wood can be cut per year and still maintain enough old-growth with sufficient interior area to support healthy populations of martens?

(3) What are the optimum locations for timber removal to maximize spatial arrangements of habitat elements? (4) What is the rotation time from clear-cut to characteristic old growth structure? I suggest that the answers to most of these questions are relatively easy to extract, using existing data. The more broad scale questions can be addressed with interactive GIS-based maps.

Finally, transition matrices provide a quantitative way to model change in a landscape. Transition matrices are nothing more than a series of lines of algorithms representing replacement rates for various parameters and arrayed as a table (Forman and Godron 1986). For instance, rotation time, amount of old-growth removed each year, amount remaining, and proportion of regenerating forest in specific age classes might be integrated into one transition matrix. A second might include the dynamics of insect-killed softwood, i.e., its mean rate of appearance within the landscape, expected length of time it has wood value for the mill, and expected removal rate. Two or more matrices can be displayed in an array of several dimensions called a tensor (Johnson and Sharpe 1976, Franklin 1979, Kessell and Potter 1980). The outcome is a predictive model that can be used to orchestrate wood removal on a landscape scale. A helpful property of transition matrices is that regardless of the initial proportions of the various habitat elements that one begins with, if replacement rates remain constant over time, viz., several years of constant wood removal, the proportions of the various habitat elements converge towards a stable equilibrium. It is possible to iterate the methodology and let the biology of marten determine what those optimum proportions are *a priori*.

Landscapes, especially those with significant disturbance regimes, are dynamically changing habitat mosaics. Attempts to perpetuate old-growth in localized areas present near insurmountable problems. Insect-caused needle and cone diseases, fungal tree pathogens, wind-throw, and other life history related mortality factors all contribute to tree loss causing structural changes in the landscape. Likewise, the forces of vegetational succession are constantly at work and significant areas revert to regenerating forest. No old growth stand is exempt. As a result, management aimed at preserving a specific patch of old growth shows little promise of success. Landscape level management is needed. Management across a large landscape eliminates the need to protect any one stand in perpetuity, rather, the landscape elements are managed to maintain a shifting mosaic with predetermined proportions of each habitat element. To the extent we understand the habitat needs of core sensitive species such as marten, we can mimic the spatial arrangements of critical elements to provide for those needs under a high disturbance regime of cutting.

Summary

Environmental assessment legislation, a cyclic resource-based economy, and a perennially scarce species provide the need for a new approach to management of old-growth forest in eastern Canada. We report the results of our work and make the case that management of timber resources in Newfoundland is inextricably intertwined with marten management and must be planned and conducted on a landscape scale. GIS methodology is a necessary component. Management practices designed with ''nature'' must provide the underlying philosophy. Long range landscape planning is required if marten survival and economically feasible timber harvests are to be achieved sympatrically over the long term. Marten management is integrated vertically throughout Newfoundland society, culture, and politics; from the logger in the field and his concerns to put bread on the table, to the paper mill at Corner Brook and its emphasis on annual profits, to the provincial government's interest in providing for a thriving resource-based economy in western Newfoundland, to the civil servants in the Divisions of Wildlife, and Environment, who are charged with conserving the environment and its biota. Laws and regulations that protect wildlife and certain habitat values are in place. We have provided recommendations on how diverse and sometimes contradictory interests can be reconciled under existing legislation by using concepts and precepts from the emerging field of landscape ecology.

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Planning for Basin-level Cumulative Effects in the Appalachian Coal Field

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Introduction

Land use patterns in the Appalachian coal field are likely to change in the next few decades. The cumulative effects of these land uses on wildlife could result in dramatic changes in wildlife community structure. In this paper, we define cumulative effects as the disproportionate increase or decrease in a wildlife population with linear changes in areal habitat availability. Of particular concern is the potential decrease in abundance of species associated with mature forest stands (sawtimber stands at or beyond sawtimber rotation age) due to the depletion and fragmentation of mature forests by surface mining and timber harvesting. Results among studies examining fragmentation influences on wildlife are quite consistent: large blocks of contiguous mature forest support disproportionately more species and more individuals of some species than small forested blocks (Anderson and Robbins 1981). Neotropical migrant warblers inhabiting mature forests may be particularly susceptible to the effects of forest fragmentation. If cumulative effects are important, then land use changes in the near future could have large-scale impacts on some wildlife species.

We propose that a basin (or watershed) is the logical planning unit for assessing cumulative effects of land uses on wildlife. Basins provide habitat for both aquatic and terrestrial species and these habitats are linked by hydrologic and colluvial processes. Further, transportation systems in the region usually follow valleys or ridges, so these systems make logical boundaries for management units.

In this paper, we will describe current and expected land use patterns in the Appalachian coal field, discuss the potential cumulative effects of anticipated land use changes, and suggest research needs and approaches to minimize those impacts on wildlife. While our discussion will focus on the Appalachian coal field, we believe that many of our inferences are relevant to other portions of the eastern hardwood forest.

The Appalachian Coal Field

We define the Appalachian coal field as that portion of the mixed mesophytic forest that lies within the Cumberland Plateau and Cumberland Mountains from West Virginia to North Georgia and North Alabama. Coal mining currently is concentrated in the northern portion of the region. The area encompasses approximately 25 million acres (10 million ha). Approximately 94 percent of the land is privately owned, but parts or all of five national forests and many state forests and state parks lie within the region (Austin 1965).

Over 230 species of terrestrial vertebrates occur in the region. The mixed mesophytic forest has the richest floral, breeding bird, mammal and amphibian communities of any upland eastern U.S. forest type (Hinkle et al. 1989). A high percentage (>60 percent) of the breeding bird community is composed of neotropical migrants.

Past, Present and Future Land Uses

Recent U.S. Forest Service inventories of timber resources in the portion of the central Appalachians underlain by coal (e.g., Craver 1985) lead us to believe that three dominant types of disturbance are likely to occur in the region over the next 20–30 years: (1) surface mining on ridgetops and side-slopes, (2) moderate to high density, single-family housing development along valley bottoms, and (3) harvesting of mature hardwood forest on midslopes and in coves. This combination of forest disturbance has not occurred previously in the Appalachians despite past resource exploitation.

Human Settlement

Prior to European settlement, human populations were low (one per square mile), and some slash and burn agriculture was practiced (Hinkle et al. 1989). Human habitation has always been concentrated in valleys. Consequently, most larger valleys and bottomlands have been disturbed by housing or farming (Barber 1984), and this land use will likely continue despite depressed economies.

Forest Resources

Because disturbance regimes in old-growth eastern hardwood forests are of small scale but high frequency (predominantly windthrow), many animal species likely evolved to inhabit landscapes dominated by mature or old-growth forest. Prior to the 1900s, the forest was comprised predominantly of mature oaks (*Quercus* spp.), hickories (*Carya* spp.), yellow-poplar (*Liriodendron tulipifera*), American chestnut (*Castanea dentata*), American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*) and pines (*Pinus* spp.)(Braun 1950). Timber cutting began in the early 1800s, but forests still comprised 50–60 percent of the land area through the nineteenth century (Hinkle et al. 1989). After 1870, however, timber and coal resource exploitation increased rapidly. In 1889, 61 percent of West Virginia was forested; by 1910, uncut forests represented only 10 percent of the land area. By 1930, most old-growth forests were cut. Currently, second-growth forests comprise about 80 percent of the land area (Hinkle et al. 1989). Both sawtimber volume and acreage of sawtimber stands are increasing in the region (Figure 1), and most stands are 40–80 years old (Figure 2). However, because of poor wood product markets, poor

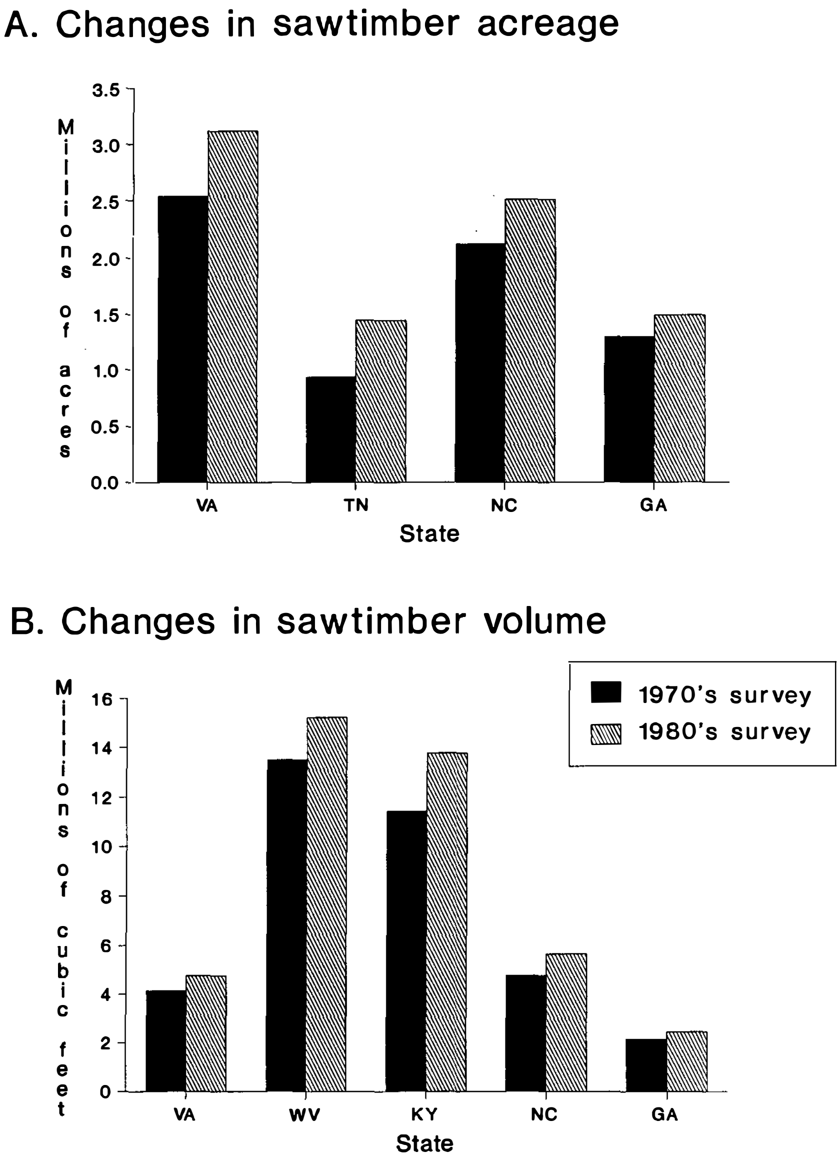

Figure 1. Changes in sawtimber acreage (A) and volume (B) from 1970s to 1980s for selected states in the Appalachian coal region, based on U. S. Forest Service inventory data (Bones 1978, Kingsley and Powell 1977, Brown 1986a,b, Craver 1985, Cost 1974, Knight 1972, Sheffield 1977a,b, Tansey 1983, V. A. Rudis, pers. comm.).

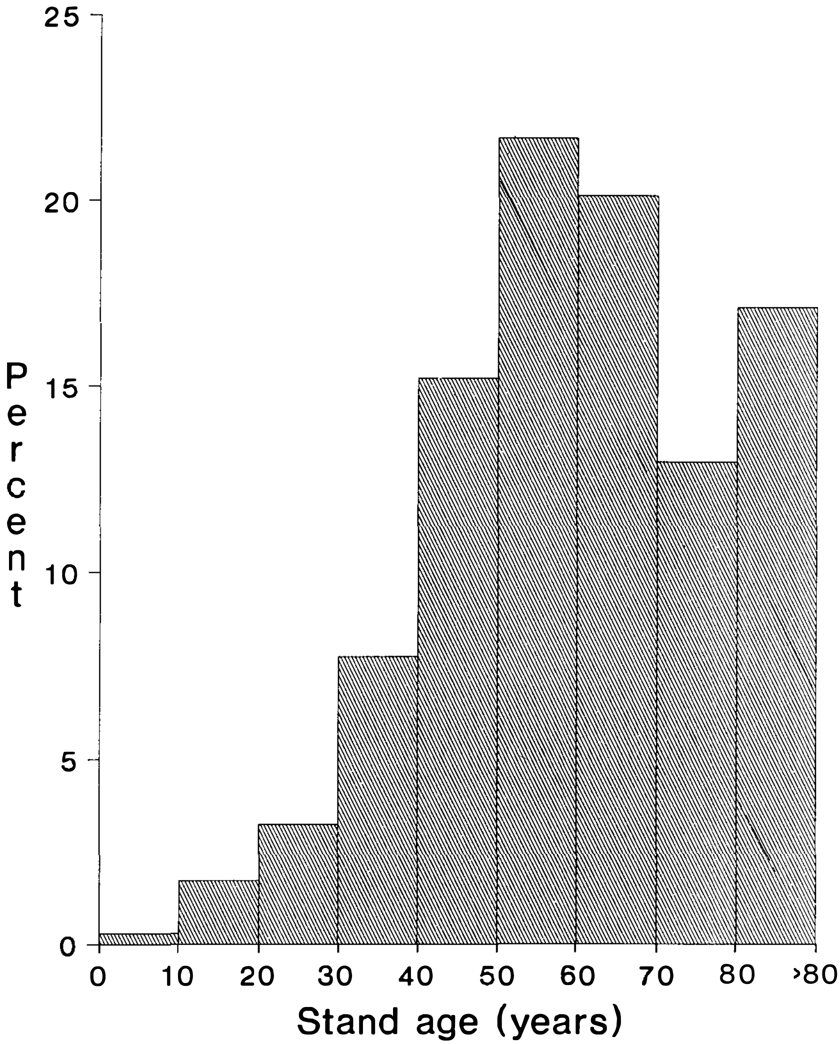

Figure 2. Distribution of growing stock volume (N = 4,828,597 million cubic feet) by stand age class for the mountain regions of North Carolina and Virginia, based on U. S. Forest Service 1985 inventory data (Craver 1985, Brown 1986a,b).

transportation systems, and local economies dominated by coal and/or tourism, the harvest of growing stock is decreasing (Kingsley and Powell 1977, Craver 1985, Brown 1986a,b). Consequently, sawtimber acreage and growing stock are expected to continue increasing for the next 20 years (Kingsley and Powell 1977, Bones 1978). Most stands will be at or beyond rotation age by that time. Although forest products industries currently comprise 15–20 percent of some local economies (Schallau et al. 1985, Maki et al. 1987), the contribution to most local economies is low (<10 percent of the economic base) and Schallau et al. (1986a,b) believe that it will remain low until the next century.

Coal Mining

Since the extensive deforestation of the region in the early 1900s, the coal industry has dominated the regional economy. More than 1 million acres (405,000 ha) have been surface mined in the region (Kingsley and Powell 1977, Bones 1978). Surface mine acreage in Kentucky increased exponentially from the mid-1950s to the mid-1970s (Kingsley and Powell 1977). If all extractable coal is removed from Kentucky's eastern and western coalfields, then roughly 1.3 million acres (527,000 ha) of commercial forest land in Kentucky will be affected (Kingsley and Powell 1977).

Coal is mined using both deep mining and surface mining techniques. Surface mining results in deforestation followed by mountain-top removal or bench mining along contours. The goal of reclamation is to establish vegetative cover on the site within two years in order to minimize erosion. A common practice is to reclaim to grasses (particularly *Festuca arundinacea*) and legumes and then graze the lands. The result is an area dominated by exotic herbaceous plants and patches of black locust (*Robinia pseudoacacia*).

Coal is a non-renewable resource. As coal reserves are exhausted, local economies will either collapse or turn to other resources, such as wood products and tourism. The timber resource will be of an age and size appropriate for harvest within the next 20 years. Transportation systems will already be established along valleys and ridgetops in surface-mined areas, thereby minimizing one constraint on forest management (Kingsley and Powell 1977). We believe that the eventual decline in the coal resource coupled with the growing potential revenue in hardwood products will cause these forests to be harvested with increasing intensity within the next few decades.

Cumulative Effects of Land Uses on Wildlife

There are at least two mechanisms that could lead to decreased habitat quality for species associated with mature forests as a result of surface mining and timber harvesting: reduction of mature forest acreage and fragmentation of mature forest stands.

Mature Forest Wildlife

Continued surface mining and intensive timber management in the future could significantly reduce the abundance and distribution of mature forests and reduce the abundance of wildlife populations dependent on mature forests. Recent studies have documented the importance of mature forests to some wildlife species. McGarigal and Fraser (1984) investigated the influence of forest stand age on great horned owl (*Bubo virginianus*) and barred owl (*Strix varia*) distributions in southwestern Virginia. They documented higher response rates to recorded owl vocalizations in old stands (>80 years) than young stands (<80 years).

Pileated woodpeckers (*Dryocopus pileatus*) (Conner et al. 1975) and several other relatively common species may also be closely associated with mature forests (Odum 1950). Mature, mixed mesophytic forests also provide habitat for species such as red-cockaded woodpeckers (*Picoides borealis*) (Mengel 1965:306) and common ravens (*Corax corax*)(Fowler et al. 1985). Undoubtedly, some of these species were affected adversely by logging of the area in the early 1900s.

Wildlife associations with old-growth forests have recently been documented in the Pacific Northwest (Meslow et al. 1981). Little old-growth remains in eastern hardwood forests, and few studies have been conducted in mature eastern hardwood forests (Carey 1983, Rosenberg et al. 1988). We suggest the need for additional studies in the Appalachians to further identify species dependent upon mature forests and their components and to determine the nature of those dependencies. Additionally, we must determine whether the truncated age distribution of forest stands caused by logging and surface mining is detrimental to these species.

Forest Fragmentation

Intensive timber management and surface mining in the Appalachian coal field will not only reduce the amount and distribution of mature forest but will also produce a fragmented landscape. Mature forest stands will become smaller and more isolated as they become imbedded in a mosaic of young forest stands (created by timber harvesting) and grassland corridors (created by surface mining). The resulting decrease in core areas of mature forest stands and increase in edge could have dramatic effects on the avian community (Gates and Gysel 1978, Temple 1986).

The creation of early seral stage and edge habitats will undoubtedly benefit some wildlife species (McComb 1985, Yahner and Howell 1975), and at moderate levels will probably increase local and regional vertebrate diversity. White-tailed deer (*Odocoileus virginianus*) are abundant in portions of the coal region where clearcutting has increased the proportion of early seral stage habitat. Similarly, species such as white-footed mice (*Peromyscus leucopus*), short-tailed shrews (*Blarina brevicauda*), and white-eyed vireos (*Vireo griseus*) would probably benefit by creation of early seral stage patches in mature forest (McComb 1985). In addition, extensive grasslands formed following surface mine reclamation provide habitat for some species, such as grasshopper sparrows (*Ammodramus savannarum*), bobolinks (*Pooecetes gramineus*), and prairie voles (*Microtus ochrogaster*), that had not previously occurred in the mixed mesophytic forest (Claus et al. 1988, Barbour and Davis 1974:205).

On the other hand, some wildlife species associated with mature forests will be affected adversely. Clearcutting adjacent to mature forest and thinning of mature forest led to decreases in abundances of ovenbirds (*Seiurus aurocapillus*)(Figure 3). Similarly, Webb et al. (1977) and Robbins (1984) reported ovenbirds to be sensitive to forest management and forest fragmentation, respectively. Yahner and Howell (1975) reported that ovenbirds preferred mature forest over surface mine edges, and Allaire (1978) reported a decrease of ovenbirds from 15.2/100 acres (40 ha) to 0.4/100 acres (40 ha) following creation of a surface mine edge adjacent to mature forest. Kentucky warblers (*Oporornis formosus*), worm-eating eating warblers (*Helmitheros vermivorous*), black-and-white warblers (*Mniotilta varia*), and black-throated green warblers (*Dendroica virens*) were similarly affected. Densities of breeding birds decreased 18 percent one year after the mining (Allaire 1978).

Recent observations suggest that brown-headed cowbird (*Molothrus ater*) brood parasitism (Brittingham and Temple 1983) and nest predation by edge-dwelling predators (Yahner and Scott 1988, Wilcove 1985) such as common crows (*Corvus brachyrhynchos*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virgini-*

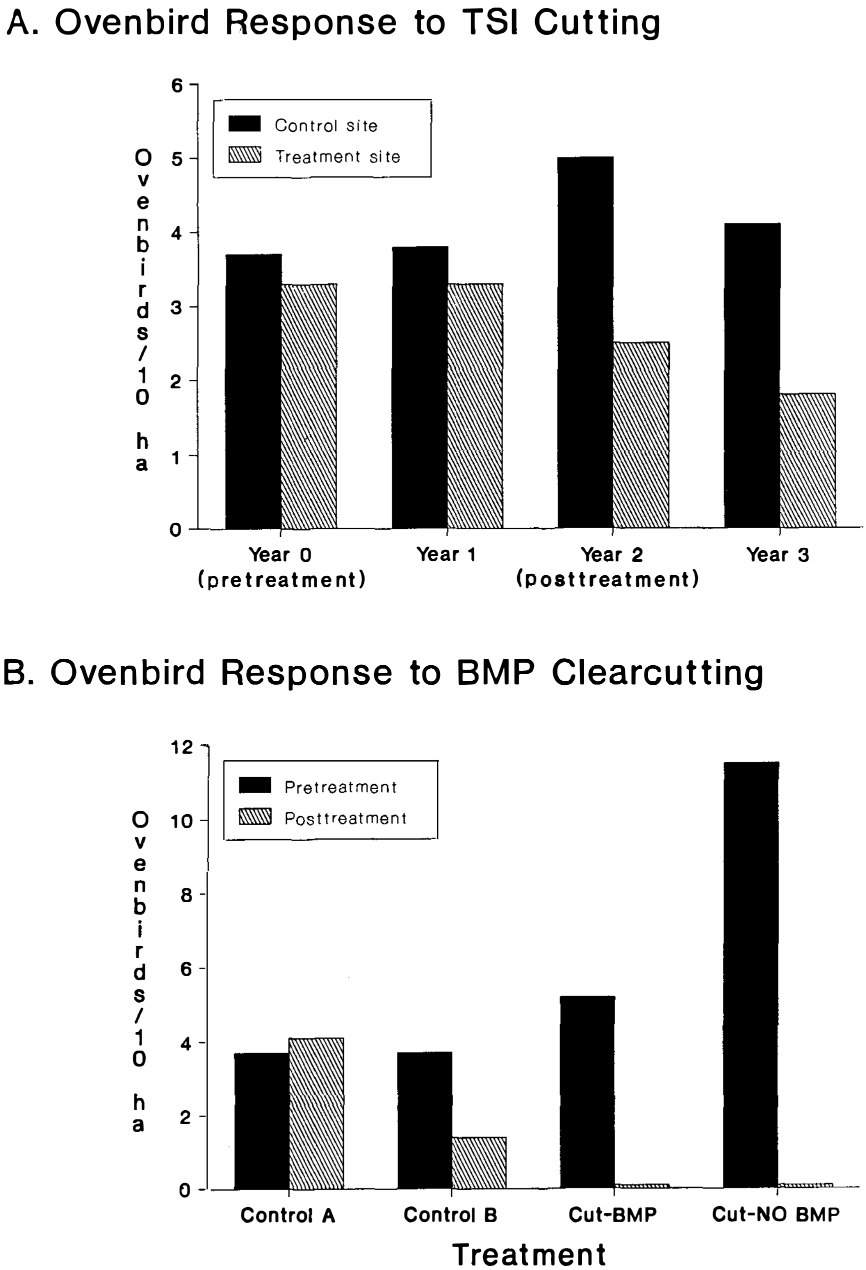

Figure 3. Ovenbird response to timber stand improvement (TSI) cutting (A) and Best Management Practices (BMP) clearcutting (B; control A was a remote site located in the forest interior, control B was adjacent to a clearcut), Robinson Forest, Breathitt County, Kentucky, 1983–86.

anus), black racers (*Coluber constrictor*) and rat snakes (*Elaphe obsoleta*) may be responsible for population declines in mature forest species. In Kentucky, brown-headed cowbirds occurred (1–3 birds/25 acres, 10 ha) in thinned stands and along clearcut edges, but not in mature 60-year-old forest (McComb, unpubl. data). Allaire (1978) reported a slight increase in brown-headed cowbird abundance from 4.1 to 5.3/100 acres (40 ha) following creation of a surface mine edge along a mature forest. Claus et al. (1988) reported flocks of 500–600 brown-headed cowbirds on surface mines reclaimed to grassland. Neotropical migrant warblers inhabiting adjacent mature forests could suffer particularly high levels of brood parasitism (Gates and Gysel 1978, Brittingham and Temple 1983). We suggest that reforestation of surface mines through reclamation should be considered as an alternative to grassland reclamation on surface mines adjacent to mature forests.

These studies suggest that surface mining coupled with intensive timber harvesting could have detrimental effects on some vertebrate species and could affect the structure of vertebrate communities. We believe that additional research is needed to determine the optimal distribution of seral, mature, and old-growth forest stands on the landscape to minimize cumulative effects, and to assess the comparative merits of alternative reclamation strategies.

Minimizing Cumulative Effects

Given the dominance of mature forest in the region, resource managers have the opportunity to proactively plan for the needs of mature forest species. While much remains to be learned about optimal areal and distribution targets of seral stages, we offer the following recommendations to land managers planning future land uses.

First, encourage reforestation of reclaimed surface mines, especially those adjacent to mature forest. Reforestation with native tree species is feasible and tree growth can be rapid on some sites (Plass 1975). Reduction of grassland cover and grazing would reduce habitat quality for brown-headed cowbirds, and regenerating forests may act as buffers between existing grasslands and mature forests (Askins and Philbrick 1987).

Second, carefully plan the location and size of timber harvests so as to minimize reduction in core area of adjacent mature stands. A minimum fragmentation approach of concentrating harvest in one basin while leaving an adjacent basin in mature forest until the harvested basin has regrown may be viable alternative (Franklin and Forman 1987), particularly when structural attributes of old forests are retained in harvest units (large snags, large logs, scattered old trees).

Third, maintain mature forest stands in managed landscapes by extending rotations beyond 80 years to 150–200 years, and identify stands that should be left unharvested to produce old-growth. Although mature forests will dominate the landscape in the near future, very few old-growth forests remain. Linkages between mature forest stands may be important (MacClintock et al. 1977) but will be difficult to attain in this region. Harris (1984:141) suggested using riparian areas to link mature forests in the Pacific Northwest. This option is generally not available in the Appalachian coal field because of high human density in the valleys. These linkages would only be feasible in this region following land-use legislation that would limit human activities in riparian areas, such as along streams designated for protection under the Wild and Scenic Rivers Act.

Finally, base land-use decisions on a regional plan that adequately considers optimal amounts and distributions of seral stages from a wildlife habitat perspective. Success in developing such a plan will require a large-scale study on the optimal spatial arrangements of different habitat components, and the optimal scale for planning and management. However, even with the necessary information in hand, implementation of a regional management plan will be complicated by the patchwork of jurisdictions and surface and mineral ownerships in the region. It may be possible to overcome these difficulties by implementing a coordinating council and a program of landowner incentives. The former could be patterned after the waterfowl flyway councils and would consist of federal and state officials and other interest groups. Thus the council would insure that local interests were not overlooked in creating goals and policies for the region as a whole. Landowner incentives could be patterned after the Conservation Reserve Program, and would be aimed at filling habitat gaps that could not be filled by managing public lands alone.

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Isolation of Nature Reserves in North Florida: Measuring Linkage Exposure

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Introduction

Sunbelt states such as Florida and Texas are similar in one way to many developing countries because intense human population growth and economic development are occurring simultaneously with intense environmental awareness and concern for existing large native mammals. A conservation strategy based on the establishment of nature reserves, coupled with a lack of influence over surrounding land use, commonly results in the reserves being totally isolated by surrounding human development.

Isolation of reserves and wildlife inhabitants by surrounding human populations disrupts the flow of organisms, energy and nutrients between the protected area and formerly contiguous habitats. This presents a significant problem for many wide-ranging terrestrial species that cannot maintain viable populations within the small, isolated nature reserves. Less than 3 percent of the Florida's protected areas are more than 1,000 square kilometers, a size well below the minimum requirement for the survival of large, wide-ranging mammals, such as the black bear (*Ursus americanus*) and Florida panther (*Felis concolor corvi*)(Harris and Eisenberg 1989).

To alleviate some of the effects of habitat fragmentation and facilitate the movement of wide-ranging species, Harris (1985, 1988) and Harris and Wallace (1984), among others, recommend the protection of landscape linkages or wildlife corridors. These generally forested linkages may facilitate the movement of forest wildlife between nature reserves, thus increasing their effective habitat size and mitigating problems associated with isolation.

Several biological arguments against the implementation of corridors have been noted. Narrow corridors may be completely dominated by edge effects that expose the native fauna and flora to forces such as exotic species, increased levels of predation, and nest parasitism (Forman and Godron 1986, Soule and Simberloff 1986). Narrow sections of corridors might increase the exposure of migrating animals to humans and domestic animals, potentially increasing the levels of poaching and disease transmission (Simberloff and Cox 1987).

Study Areas and Methods

Analysis of the spatial characteristics of existing or proposed landscape linkages between North Florida state parks (SP) and National Wildlife Refuges (NWR) reveals levels of relative exposure and presumed conservation value. Imagery derived from the LANDSAT Thematic Mapper (TM) was used to identify these linkages. It is also important to point out that in most cases, the linkages analyzed in this study represent ecological, not legal, connections between nature reserves. The forested linkages chosen for study were:

A. Lower Suwannee NWR—Manatee Springs SP
B. Okefenokee NWR—Osceola NF
C. Lower Suwannee NWR—St. Marks NWR (east)
D. Lower Suwannee NWR—Waccasassa Bay SP
E. Chassahowitzka NWR—Waccasassa Bay SP
F. Manatee Springs SP—Ichetucknee Springs SP
G. St. Marks NWR (east)—St. Marks NWR (west)

The indices used to indicate relative exposure of the seven linkages were: (1) area-to-perimeter ratio; (2) compactness ratio (Figure 1); and (3) minimum linkage width (Figure 2).

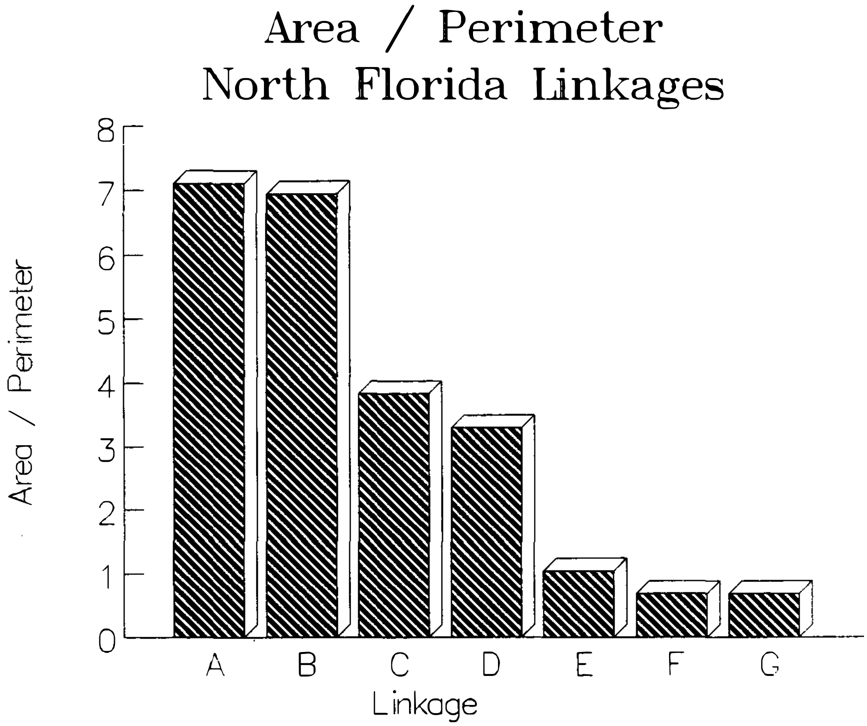

Figure 1. Indices reflecting the size and shape of North Florida linkages.
A. Lower Suwannee–Manatee Springs
B. Okefenokee–Osceola
C. Lower Suwannee–St. Marks (east)
D. Lower Suwannee–Waccasassa Bay
E. Chassahowitzka–Waccasassa Bay
F. Manatee Springs–Ichetucknee Springs
G. St. Marks (east)–St. Marks (west)

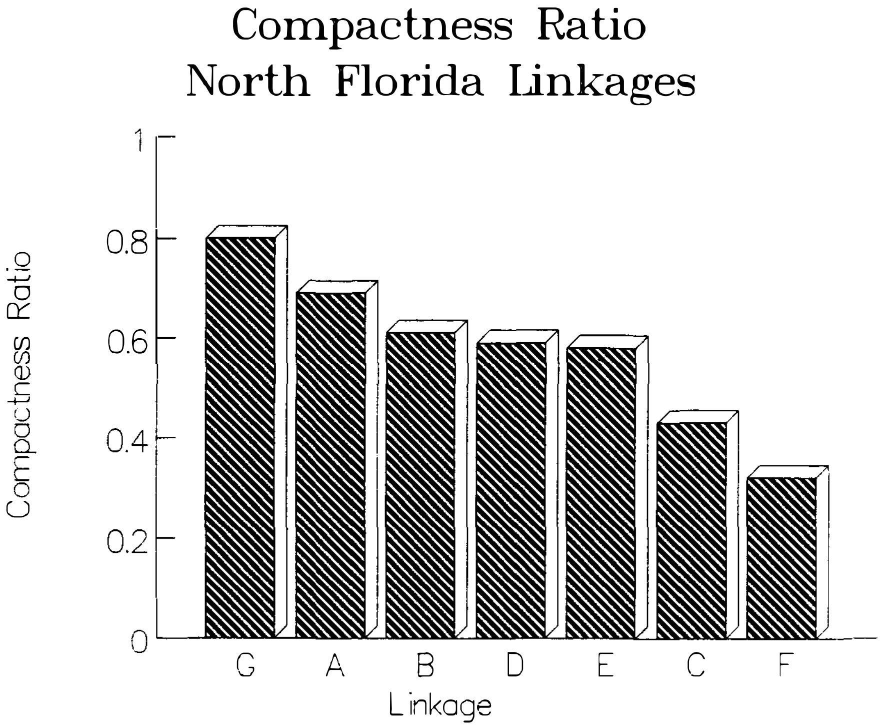

Figure 1. (continued)

Area-to-perimeter (A/P) ratios have previously been used to describe relative exposure of nature reserves to external influences (Schonewald-Cox and Bayless 1986, Diamond 1975), but we know of no attempt to quantify the dimensions of environmental corridors. Linkages that consist of large area and similar shape will exhibit higher A/P ratios than smaller ones. Linkages with the same area but different shapes indicate a decrease in exposure as the shape becomes more circular (Schonewald-Cox and Bayless 1986).

Human-dominated landscapes surrounding most linkages represent significant sources of mortality for migrating or dispersing animals (Mader 1984, Buechner 1987), and thus the linkages could theoretically allow a net outflow of individuals from a system of reserves if it were comprised of linkages with low A/P ratios. Such narrow-shaped linkages could also facilitation the inflow of weedy pests (Janzen 1986, Buechner 1987).

The compactness ratio (S_2) reflects the degree of divergence in shape from a circle (Unwin 1979).

$$S_2 = (a/a_c)^{0.5}$$

where: a = area of linkage
a_c = area of a circle having the same perimeter as the linkage.

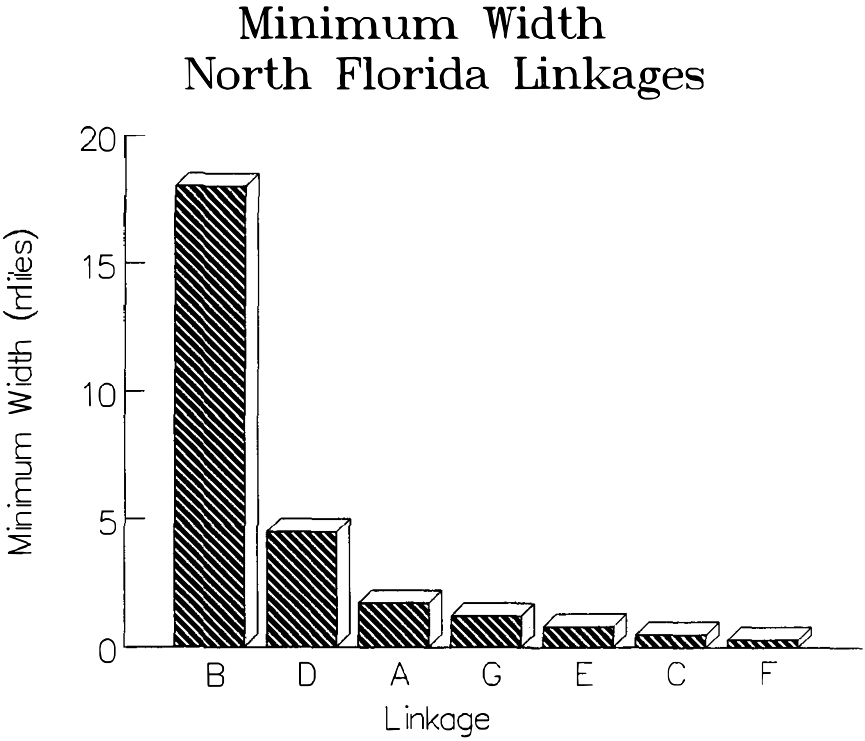

Figure 2. Minimum width of North Florida linkages.

Thus any circle manifests a ratio value of 1.0, and a highly compact landscape linkage with minimal exposure approaches the value of 1.0. Long and narrow or convoluted linkages (greater exposure) reflect decimal values less than one. This index allows discrimination between A/P ratios that result from small size and those resulting from linear shapes.

Minimum width of a linkage provides information about its likely ecological function that is not reflected in either of the above two indices. For example, if a ''bottleneck'' occurred in an otherwise ideal linkage, both the utility for dispersal and the vulnerability to human influences such as poachers would be affected (Forman 1981). Ideally corridors should be sufficiently wide to contain an interior habitat that could be used by deep-forest species without experiencing the negative edge effects of increased predation, nest parasitism, or poaching (Forman and Godron 1981, Brittingham and Temple 1983). Thus the ideal linkage would have no bottlenecks of narrow width (high minimal width), would be large enough to contain interior habitat (high A/P ratio), and approach a circular shape (S2 approaching 1.0).

Exposure of Linkages

Two of the seven linkages found within the North Florida study region have area-to-perimeter ratios less than 1.0 (Figure 3). This indicates that less than a square

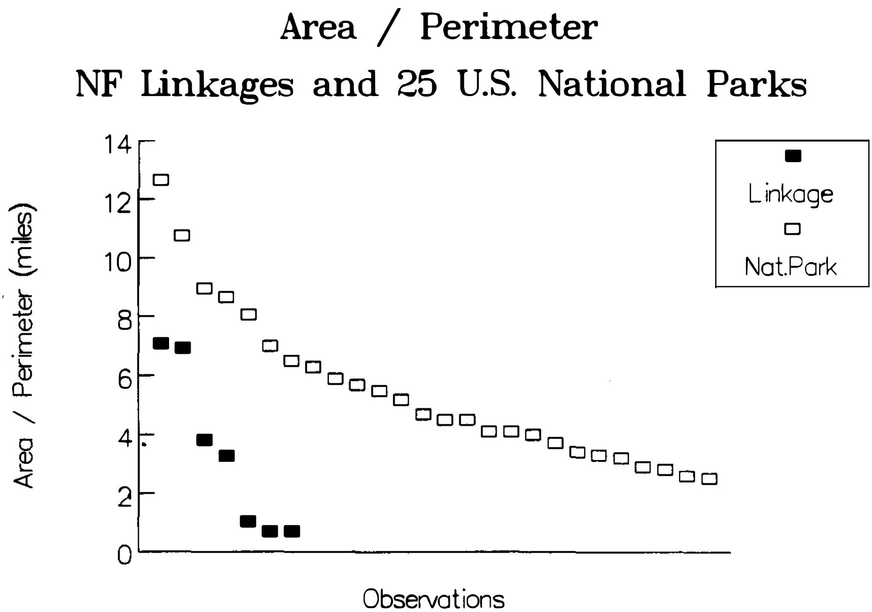

Figure 3. Area/Perimeter for North Florida linkages and 25 largest U. S. national parks.

mile of interior habitat exists for every mile of perimeter. Average distance from an interior point, to the nearest boundary for these linkages is less than a mile.

Two linkages, the Lower Suwannee–Manatee Springs and Okefenokee–Osceola have approximate area-to-perimeter ratios of 7.0. With seven square miles of interior habitat for every mile of perimeter, these linkages have much lower exposure to the surrounding human-dominated landscape than the Manatee Springs–Ichetucknee Springs and St. Marks (east)–(west) linkages (A/P = 0.68). With the highest area-to-perimeter ratios and lowest exposure in the region, the Okefenokee–Osceola and Lower Suwannee–Manatee Springs linkages represent the most suitable linkages for the movement of large mammals such as the black bear or Florida panther (Table 1).

Despite having the same low area-to-perimeter ratio (0.68), the St. Marks (east)–(west) and Manatee Springs–Ichetucknee Springs linkages represent extreme values of the compactness ratio with the study region. The St. Marks (east)–(west) linkage has the highest compactness ratio (0.80), reflecting its circular shape. The Manatee Springs–Ichetucknee Springs linkage, a riparian corridor along the Suwannee River has the lowest compactness ratio (0.32) in response to its linear shape. The high exposure level associated with the St. Marks (east)–(west) linkage is influenced by its small area while the exposure of Manatee Springs–Ichetucknee Springs linkage reflects its convoluted shape. The A/P ratio is useful for comparisons of exposure, but to date there is no standard for defining an area as overexposed. This problem is addressed here by comparing the ratio values of North Florida linkages, to those of the 25 largest U.S. national parks in the lower 48 states (Figure 3).

A/P ratios for even the largest national parks indicate a wide range of exposure levels resulting from differences in both size and shape. Because of its large size

Table 1. Indices reflecting the relative exposure of each linkage.

Linkage	Area/perimeter (miles)	Compactness ratio	Minimum width (miles)
A	7.10	0.69	1.7
B	6.94	0.61	18.0
C	3.83	0.43	0.5
D	3.29	0.59	4.5
E	1.04	0.58	0.8
F	0.68	0.32	0.3
G	0.68	0.80	1.2

and circular shape, Yellowstone National Park has the highest A/P ratio (12.7) and the lowest exposure rating. Because of its elongated shape, Shenandoah National Park has a much lower A/P ratio (2.9) reflecting a higher degree of exposure. The average A/P ratio for all 25 national parks is 5.5.

By comparison, three of the Florida landscape linkages have A/P ratios lower than any of the parks and five have ratios lower than the large park average. Not surprisingly, this suggests a higher degree of exposure for the linkages than for the large national parks. Conversely, two of the Florida linkages (Lower Suwannee–Manatee Springs and Okefenokee–Osceola) have lower exposure ratings than the 5.5 average of the 25 largest parks. It is also important to point out that these A/P ratios are only for the linkages and do not reflect the exposure of the nature reserves they are connecting.

Although many forested linkages connecting north Florida nature reserve have low exposure in terms of the area-to-perimeter ratio, many have narrow sections that lower their value as dispersal routes for interior species. The Lower Suwannee–Manatee Springs linkage has the highest A/P ratio, yet its minimum width is 1.7 miles, much smaller than the Okefenokee–Osceola linkage (18 miles). The Lower Suwannee–St. Marks (east) linkage has a higher A/P ratio than many national parks, however, its minimum width of less than one mile may allow great exposure to dispersing animals.

Conclusions

The fragmentation of North Florida's natural landscape is isolating protected natural areas and contributing to the endangerment of the state's native fauna. Since most nature reserves are too small to support viable populations of many endangered species, connectivity with other protected natural areas should be maintained and in some cases enhanced. We believe that acquisition of remnant forested linkages between existing protected natural areas represents a preferable alternative to isolation and that in most cases the ecological gains far outweigh the small economic costs. Nonetheless, allocation of habitat acquisition funds for linkages should consider the following criteria:

1. relative exposure or suitability of a forested linkage as a dispersal route for plants and animals including interior forest species; and
2. increase in effective habitat size of the interconnected reserves resulting from protection of a linkage.

The Okefenokee–Osceola linkage provides the greatest increase in effective habitat size and the lowest exposure of any linkage in the North Florida study region. The Nature Conservancy has recently purchased the predominance of this linkage for transferral to the USDA Forest Service. This secures the area for future movement of wildlife between the Osceola National Forest and largest national wildlife refuge in the East (Okefenokee). While the Okefenokee–Osceola linkage has relatively low exposure, we believe that numerous other North Florida linkages remain seriously overexposed and mitigative action is recommended. In order to minimize boundary exposure of the reserves and interconnections, landscape linkages should be as wide as possible (Forman and Godron 1986).

As the human population continues to expand, remaining unprotected reserves and linkages will become increasingly exposed to the surrounding human-dominated landscape. This increasing exposure underscores a need for new conservation policies that ensure responsible land use planning in areas surrounding reserves. The lack of planning to date is seriously limiting future options with regard to linkages. As the reserves become increasingly isolated and exposed, they will fail to prevent the extinction wildlife species they are designated to protect.

Acknowledgments

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Conservation of Rain Forests in Southeast Alaska: Report of a Working Group

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Introduction

Rain forests are among the most unique and limited ecosystems worldwide (Alaback 1988). The rain forest in North America, principally along the coast of southeast Alaska, is unique with Sitka spruce 200 feet tall, 400+ years old, with a lush undergrowth of evergreen plants, ferns, and mosses. Wildlife is abundant and unique, ranging in size from the Alaskan brown bear (*Ursus arctos*) to the Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) to Peal's peregrine (*Falco peregrinus pealei*) to the Glacier Bay water shrew (*Sorex alaskanus*).

Most of the rain forest in southeast Alaska is part of the Tongass National Forest and managed for multiple use by the Forest Service (USDA Forest Service 1988). Timber produced on the Tongass National Forest supports local economies and contributes to economies of Pacific Rim nations. Recreation along with commercial fisheries are significant industries and, as with timber, impact regional economies and those of other nations. Furthermore, the unique blend of forest, wildlife and fisheries is significant to native cultures—Tlingit and Haida—both in tradition and as a source of subsistence use, as well as to other Alaskans who live a subsistence lifestyle.

The need for a new way of thinking in conservation of natural resources has been suggested by many authors (Harris 1984, Cairns 1986, Noss 1987, Bourgeron 1988) but examples are few. These authors suggest that success in maintaining biological diversity—perhaps the most important resource on public lands (Wilcove 1988)—increases when the focus of conservation efforts is at the landscape level in contrast to an emphasis on a species, population or individual (Noss 1983). The purpose of this paper is to summarize concepts developed by an interagency, interdisciplinary working group for the long-term management of North America's rain forest, given the recent landscape emphasis in conservation of biological diversity.

The rain forest in southeast Alaska extends north to south 500 miles, is about 100 miles wide, and is a mosaic of small to large offshore islands, deep fiords and mainland, all with differing plant assemblages that extend from shoreline to well above tree line. Some, but not all plant communities, are intensively managed for timber harvest, a land use that does affect size of a plant community and, in some cases, composition.

A workshop was held 25 and 26 May 1988 at the Juneau Ranger District, Tongass National Forest, to increase our understanding about the role of old-growth rain forest habitat and how best to manage old-growth to maximize habitat value to associated species. The workshop was based on a recommendation from the 1988 USDA Forest Service Alaska Region Biologists' Conference to address specific management questions associated with developing and implementing an old-growth wildlife management prescription for the Tongass National Forest.

The approach taken by the working group was one of scale. First, define ecological units in southeast Alaska, specifically the old-growth rain forest plant communities. Second, establish a province system that captures representative samples of plant communities and thereby habitat for all species dependent on or closely associated with that old-growth habitat. Third, recommend size, shape and distribution of habitats in a way to increase the likelihood that viable populations of old-growth associated species will be maintained on the Tongass National Forest—a legal mandate on all National Forests. In addition, the future for biological diversity on public lands rests not just with preserving representative samples of pristine ecosystems, but with innovative management of intensively used landscapes. The third set of recommendations is to enhance biological diversity on intensively managed lands.

Old-growth Habitats

Southeast Alaska is an area of coastal mainland and islands isolated from Canada and other regions of Alaska by high mountain ranges. These lands also include the largest remaining reserve of old-growth forest in the United States. Interest in southeast Alaska old-growth forests and wildlife-fishery resources associated with these habitats has increased in the last decade (Schoen et al. 1981, Schoen and Kirchoff 1988). Although recent scientific literature has increased our ability to define general characteristics of late successional forests, working definitions specific to southeast Alaska are needed to guide current planning efforts and to clarify issues in management of fish and wildlife resources dependent on late successional forests.

At least three concepts need to be considered in the development of an ecological definition of old-growth in southeast Alaska. First, the ecological definition should be community specific. Data available for the Alaska Region include plant association and timber inventory information developed by the Forest Service. Second, the definition should be multifaceted and include criteria related to the presence of large and/or old trees, intermediate sized trees that contribute to a deep multilayered canopy, a coarse woody debris—particularly snags and down logs—a varied species composition. Such ecological characteristics are important to distinguish clearly the characteristics of old-growth from either the early seedling-sapling or mature, even-aged forest successional stages. Third, area is a key element in an ecological definition. Sufficient stand size is important to preserve interior forest dynamics, maintain microclimate associated with old-growth stands and ensure the long term survival of old-growth stands.

In southeast Alaska at least seven forest series exhibit a late successional component. They include three highly productive Sitka spruce-western hemlock associations (upland, riparian and beach), a moderately productive Sitka spruce-western hemlock, mixed conifer and subalpine-mountain hemlock. The basic criteria or minimum standards for each of the seven associations are summarized in Table 1.

Old-growth Distribution

The landscape of southeast Alaska is a mosaic of heterogeneous landforms, vegetation types and offshore islands that vary in size and shape. Most animal species that occupy that landscape are neither threatened nor endangered, range from abundant and widespread to uncommon and localized, and may be found in only a portion of southeast Alaska. Managing for viable populations and biological diversity in southeast Alaska must consider this landscape mosaic, extent and distribution of old-growth as influenced by timber management, and islands.

To meet diversity and viable population requirements as outlined in the Regulations to the National Forest Management Act (1976), the workshop identified 18 provinces

Table 1. Description of seven old-growth associations found in Southeast Alaska. They are the highly productive Sitka spruce-western hemlock (HPU), highly productive Sitka spruce-western hemlock riparian (HPR), highly productive Sitka spruce-beach fringe (HPB), moderately productive western hemlock (MO), cedar-western hemlock (CWH), mixed conifer (MC) and subalpine mountain hemlock (SMH). Height is in feet, diameter in inches, age in years, area in acres, and all values are equal or greater than. Minimum area includes a core area and surrounding tree buffer of three tree heights. The buffer may be forest types other than core, type with a tree height at least 75 percent of core height.

Tree/stand characteristics	HPU	HPR	HPB	MP	CWH	MC	SMH
Tree height	120	130	130	80	80	60	45
Tree diameter	25	30	30	25	15	13	12
Tree age	200	200	200	200	200	200	200
Multilayered canopy	yes	yes	yes	yes	yes	yes	yes
Discontinuous canopy	yes	yes	yes	yes	yes	yes	yes
Snag height	12	30	20	15	15		15
Snag diameter	25	30	30	15	15		10
Snag number	2	2	2	8	2	15	8
Woody debre length	5	50	50	20	20		
Woody debre diameter	25	30	30	10	15		30
Woody debre number	4	4	4	8	4		4
Minium area[a]	120		60	100	60	50	60
Minimum core size	60			50	35	30	35
Minimum core width	900		500	800	700	700	750
Minimum no. old-growth trees/acre	90–110	90–110	90–110	70–89	70–89	40–69	<40

[a] Minimum riparian area is a core area as wide as the riparian corridor. The buffer is the natural adjacent plan community. Core area is ½ mile in length. Minimum beach area is the width of the beach fringe zone 500' from mean high tide. Length is based on requirements of bald eagles in southeast Alaska and is slightlly more than 1 mile. A 1 mile by 500 foot zone results in a minimum area of 60 acres.

within southeast Alaska to account for differences in latitude, altitude, maritime versus terrestrial climates and other geographic factors that affect the distribution of old-growth habitat types (Figure 1). An additional degree of resolution may be needed to meet viability requirements for species with limited distributions, and units of land averaging about 100,000 acres have been proposed for the revision of the Tongass Land Management Plan. This broad-scale geographic approach to viable populations and biological diversity is similar to recommendations of Urban et al. (1987) and Scott et al. (1987) and is employed in successful conservation programs by the Nature Conservancy (Rousch 1985).

Managing for Old-growth

How to develop alternatives for size, shape and distribution of old-growth within a project area, often a watershed, is a task frequently encountered by biologists and other resource managers (Mealey et al. 1982, Harris 1984, Franklin and Formann 1987). During the past decade, a number of authors have raised the issue that patches of habitat need to be large enough to maintain breeding populations of wildlife dependent upon that habitat type. Among examples used to emphasize the need for large habitat patches are the eastern wood warbler complex (Wilcove 1985), resident and migratory grassland birds (Samson 1980, Risser 1986), grizzly bear (*Ursus arctos*) (Shaffer and Samson 1985), and northern spotted owl (*Strix occindentalis*) (USDA Forest Service 1986). Furthermore, there is a need to emphasize a circular shape in managing habitat patches (Temple 1983) and to consider corridors that connect distant habitat patches (Harris 1984). The circular shape of habitat patches is thought to reduce negative effects of edge habitats to some species by minimizing reduction of patch size resulting from windthrow. Corridors are viewed as important to allow for dispersal of individuals between habitat patches when individual patches are too small to support viable populations of some species.

The approach taken in the workshop was to offer general guidelines for managing old-growth rain forest within a watershed. Underlying each guidelines is an emphasis on large, continuous blocks of old-growth forest needed to maintain viable populations. An increasing number of species-specific recommendations for patch size is available based on habitat suitability models developed for the Tongass Land Management Plan. In addition, no consideration was given to other land use requirements including the visual quality of the landscape, protecting anadromous fish resources and the economics/techniques of timber harvest. The importance of these needs in forest land management were recognized during the workshop.

The three guidelines offered in this paper address management prescriptions that emphasize (1) timber, (2) timber-wildlife and (2) wildlife. In addition, five recommendations are offered to enhance diversity through time in harvest areas.

Timber Emphasis

Important in the timber emphasis is the harvest of timber in vertical, wide continuous strips (Figure 2). Size of old-growth patch to be harvested should be equal to or exceed in size a functional old-growth stand as outlined under old-growth series definitions. This will allow regeneration of functional, persistent old-growth stands given a sufficiently long timber rotation. The upper portion of the watershed should be harvested first. This will retain important lowland habitats during most of the first

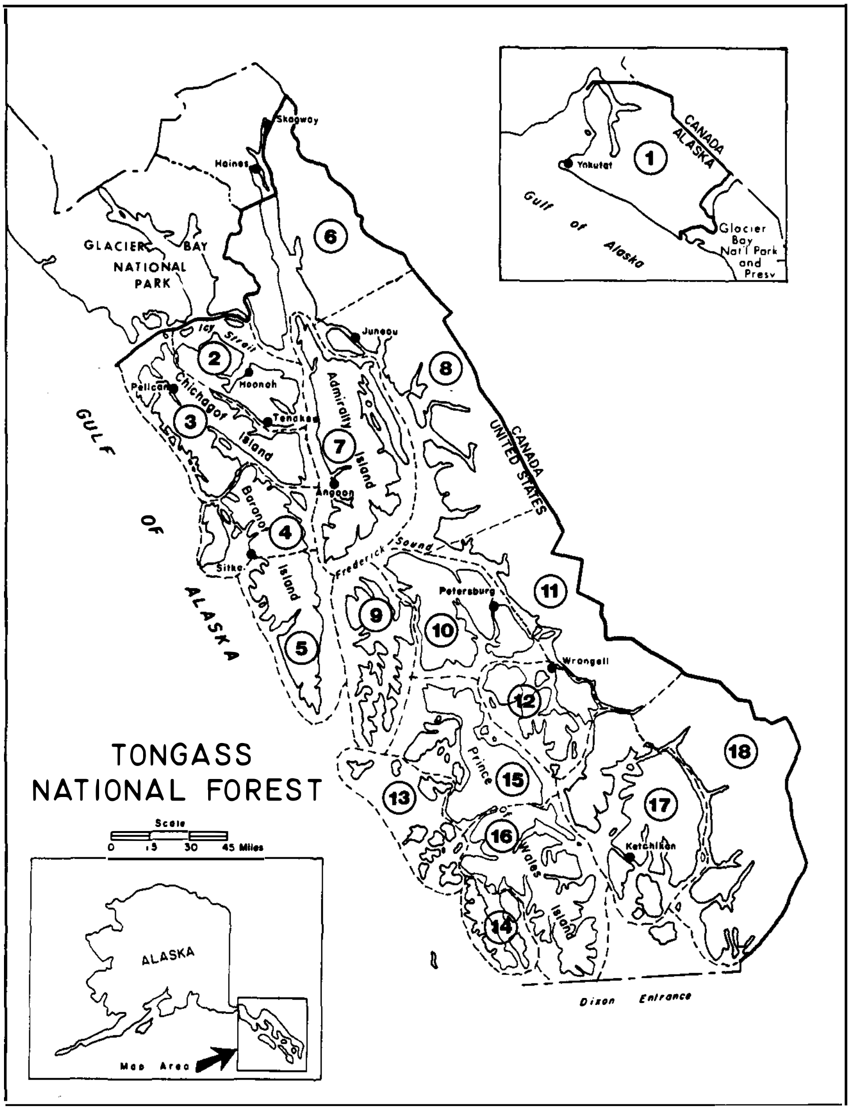

Figure 1. Eighteen provinces in southeast Alaska. They are (1) Yakutat, (2) Eastern Chichagof, (3) Western Chichagof, (4) Northern Baranof, (5) Southern Baranof, (6) Northern Lynn Canal, (7) Admiralty, (8) Taku-Endicott, (9) Kuiu, (10) Kupreanof, (11) Stikine, (12) Zarembo-Etolin-Wrangell, (13) Coronation-Heceta-Suemez Islands, (14) Dall-Sukkwan-Long Islands, (15) North Prince of Wales, (16) South Prince of Wales, (17) Reillagigedo-Island-Cleveland Peninsula and (18) Misty Fiords.

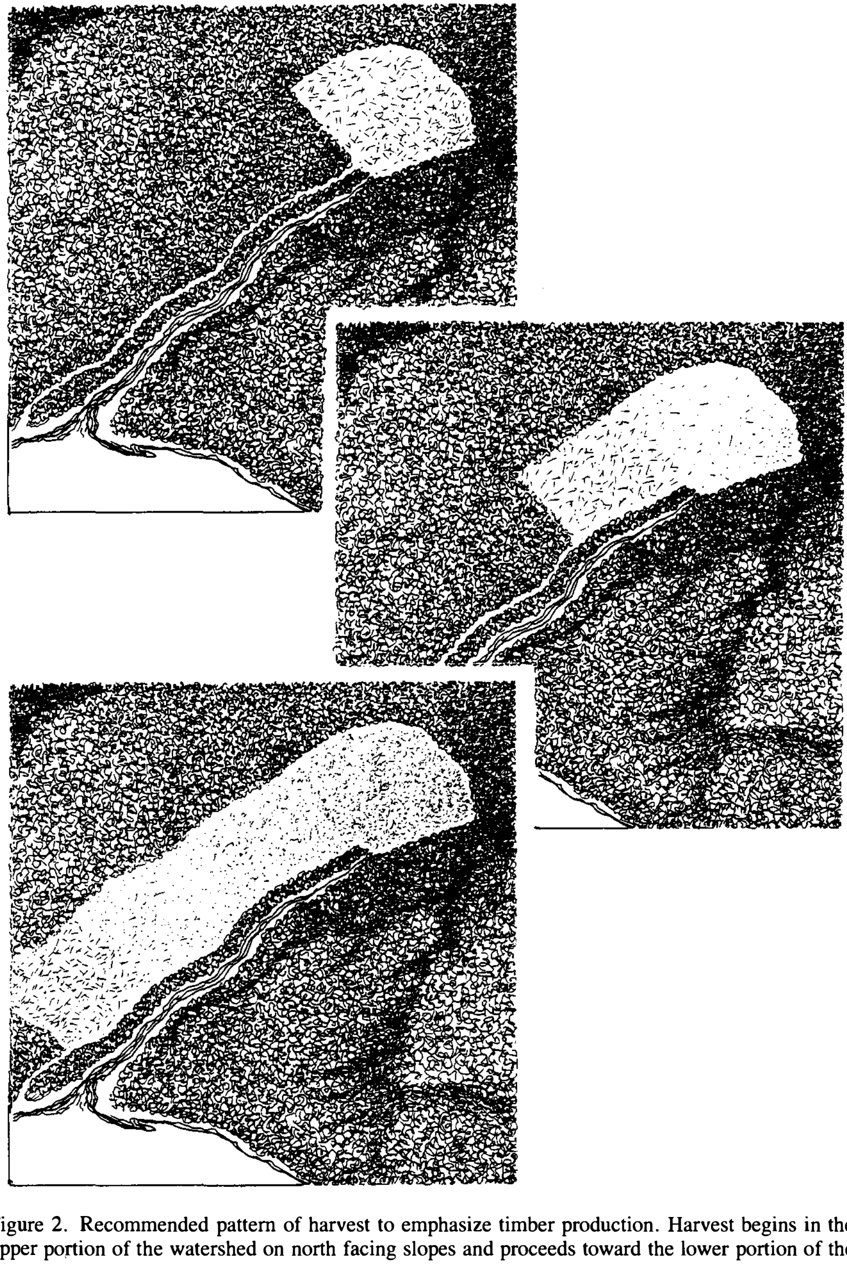

Figure 2. Recommended pattern of harvest to emphasize timber production. Harvest begins in the upper portion of the watershed on north facing slopes and proceeds toward the lower portion of the watershed.

rotation. This approach will maximize the availability at any point in time of remaining lowland old-growth. Lowland old-growth habitats are particularly important to Sitka black-tailed deer, brown bears, bald eagles (*Haliaeetus leucocephalus*), and other wildlife.

In addition, the north aspect should be harvested in large vertical adjoining units before entering the south-facing slope. Where possible the south-facing slope should be maintained as a contiguous unit of old-growth habitat types. South-facing slopes provide critical late winter habitat needed by wildlife, particularly the Sitka black-tailed deer. Maintaining large blocks of old-growth from the riparian and or shoreline up to treeline will provide a complete array of habitats and allow for seasonal movements between lowland and upland habitats.

Timber-Wildlife Emphasis

The extent of timber harvest would be less in areas with this management emphasis than where timber is the emphasis, otherwise, the same guidelines apply. Although information to establish minimum old-growth forest patch size for species of wildlife in southeast Alaska is becoming available, a conservative approach requires that old-growth stands be maintained as large, continuous blocks connected by suitable travel corridors along riparian and beach fringe (Figure 3). This will increase the likelihood that the stands will be large enough for species that have not been adequately studied and stands will persist through time due to reduced extent of edge exposed to wind. Such an approach will also maximize at any point in time amount of contiguous old-growth habitat for wildlife. Most of the time, blocks of old-growth will be mosaics of a combination of several old-growth types and may include naturally occurring muskegs.

Wildlife Emphasis–No Entry

The assumption under the wildlife emphasis is that continuous, undisturbed old-growth provides maximum benefit to those species dependent upon or closely associated with old-growth. Maintenance of entire watersheds of old-growth forest would maintain viable populations for most if not all species. The group recommends that at least one watershed within each province be left intact.

Harvest and Biological Diversity

Five additional guidelines recommended by the workshop that relate to the timber and timber-wildlife emphases are:

1. Harvest areas should be large and continuous. Harvest of old-growth should proceed from the periphery inward. The "locus method" illustrated in Figure 4 leaves at any point in time the largest contiguous block of old-growth within any cutting unit. This approach is important to provide the maximum amount of old-growth and to minimize the amount of edge habitat vulnerable to windthrow.
2. Harvest areas should be "sloppy" and include small patches of green trees, brushy openings, and snags. Leaving green trees will through time provide needed snag habitat within often monotypic second growth stands. Likewise,

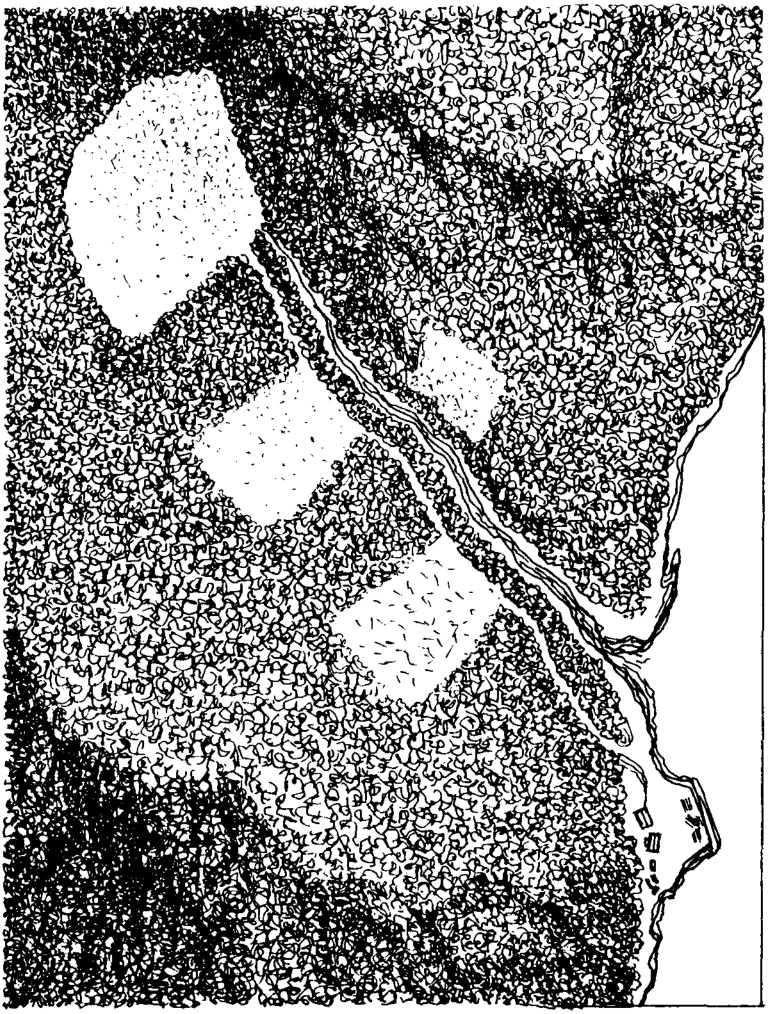

Figure 3. Recommended pattern of timber harvest to emphasize timber-wildlife production. Harvest units are large and extend from riparian areas to tree line.

brushy openings provide forage for species such as the Sitka black tailed deer for which typical second growth stands have limited value. The purpose is to increase through time the diversity of habitats available to wildlife in managed forests.

3. Edges of harvest units should be "feathered" rather than sharp. This reduces vulnerability (in contrast to a distinct edge) of forest stands to windthrow—a significant source for loss of old-growth timber resources.
4. Old-growth habitat types should be harvested to ensure the continued existence of each old-growth forest type and the relative availability of each type.

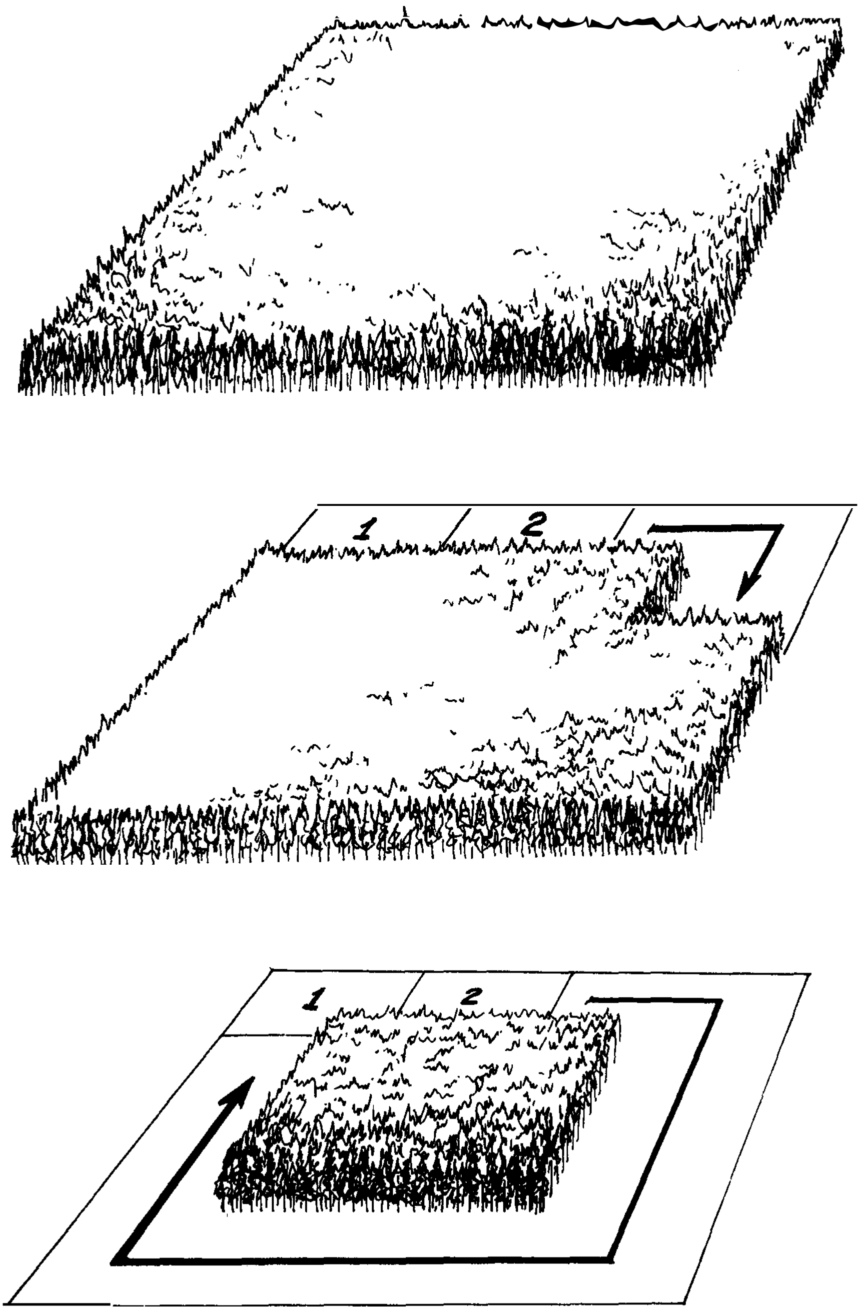

Figure 4. A forest stand illustrating the ''locust'' method of timber harvest. The locust method retains the most old growth at any point in time and reduces extent of edge habitats.

5. Habitat models for management indicator species identified for the Tongass Land Management Plan revision should be used to prioritize which areas should be retained for old-growth forest wildlife habitat.

Islands: A Special Case

The complex of mainland and offshore islands in southeast Alaska varies in size from small to large and in distance to mainland. Rarely in any archipelago are all islands able to maintain viable populations of large, widely ranging species. Some islands may not even maintain populations of small, common species. In almost every island system, dispersal is important in maintaining island populations.

Whether a given barrier serves to reduce species dispersal from one island to another is dependent upon the life history of individual species (MacArthur and Wilson 1967), which are poorly understood in southeast Alaska. Managers, however, must consider how many, what size, and which islands are needed to maintain well-distributed and viable population of wildlife species in southeast Alaska.

One alternative is to maintain all old-growth habitats on islands up to a given size. The minimum size of an island to consider would be that required to maintain a viable population of a species thought to represent island species. A major approach to estimate viable population size has been to calculate Ne, the net effective breeding population size. Ne provides for short term genetic diversity and therefore viability. Generally, 50 reproductively active individuals, half of which are females, are considered a short-term viable population using the Ne approach, 500 are considered necessary for long-term viability.

A common small mammal on islands in southeast Alaska is the ermine (*Mustela erminea*). Possible genetic isolation of this species on islands has resulted in the development of a unique subspecies. This subspecies has a home range size that is thought to encompass home range characteristics of other island wildlife for which viability is a concern. The multiplication of 50 times the average home range size of an ermine (40 acres) suggests that at least 2,000 acres of forest habitat would be needed to maintain a viable population. The literature suggests that home ranges may be as large as 84 acres, but overlap among individuals is evident (Lockie 1966). Under this alternative and based on the validation of ermine home range and habitat use (Fay 1985), islands with less than 2,000 acres of forest habitat should receive very little manipulation to maintain necessary habitat features.

A second alternative to manage islands for viable populations and biological diversity would be to establish boundaries for management to include a cluster of islands that would support a viable population within a planning unit. In this alternative, combined area of the island cluster would be equal to that needed to maintain a viable population, given that all islands within the cluster would be within the mean dispersal distance for a species. As mentioned above, dispersal distances vary by species but may range upwards to several miles for large animals such as deer, bear or moose. With such dispersal, even one individual per generation is believed adequate to maintain genetic heterozygosity at a level needed to maintain a viable population (Samson et al. 1985).

A third alternative would be an ''umbilicus'' of islands that would maintain dispersal between mainland and offshore islands. Given the lack of information on distribution and dispersal abilities for most species in southeast Alaska, the likelihood of establishing island links is limited. The theory and concept behind such an approach, however, has been discussed by Diamond and Gilpin (1983).

Discussion and Summary

Perhaps no other current topic rivals biological diversity in terms of concern and interest among conservationists and scientists (Roberts 1988). Several conservation groups and scientists argue for critical areas or ''hotspots'' of diversity managed through a system of preserves. Counter to this approach is a recognition that most species neither live in pristine areas or pristine areas of a size and composition adequate to maintain viable populations. Rather, most species live on lands often used for timbering, mining and other resource production. Thus the future for biological diversity—particularly on public lands managed for multiple use—rests with ecologically sound management of this semi-natural matrix.

Resource managers recognize that number, size and juxtaposition of habitat patches created by land management influences whether viable population requirements in regulations to the National Forest Management Act (1976) and other legislation are fulfilled, as well as achieving stated wildlife population objectives which in all likelihood will be well above any threshold viability level. Less evident in current land management, however, is concern for another conservation goal: biological diversity.

A useful definition of biological diversity ''is to maintain in a healthy state both the species and the ecological processes historically native to a natural landscape'' (Wilcove and Samson 1987:331). A number of plausible concepts—diversity (Samson and Knopf 1982), gap theory (Shugart 1985), landscape ecology (Forman and Godron 1986), hierarchy theory (White 1987) and others—may determine patterns in biological diversity. The conventional wisdom of research to test each concept is complicated by interplay of species, communities and ecosystems that may be subtle yet important (Urban et al. 1987). Recent examples in conservation do suggest that guidelines, whether or not accepted by ones' peers, aid in reaching a consensus on controversial issues (Soule and Simberloff 1986). In this vein the working group as a consensus offers the following recommendations on a controversial issue—the conservation of rain forest in southeast Alaska—and suggests this approach has application to other ecosystems.

1. Consider the semi-natural matrix as a focus in management and identify key biological units, particularly old-growth communities precisely defined in ecological terms.
2. Provide for the distribution of key biological units by physiographic province or geographically defined region at a scale where patterns of natural disturbance are considered.
3. Conduct timber harvest so that (A) some remaining old-growth patches persist in perpetuity. (B) Be ''sloppy'' in harvesting timber. Leave green trees, brushy areas and other areas of natural disturbance in place at harvest to provide habitat heterogeneity within otherwise often monotypic second growth stands. (C) Maintain large, continuous blocks of old-growth forest that provide the variety and distribution of habitats needed by wildlife.
4. Consider the uniqueness of the ecosystem and species native to that natural landscape. Southeast Alaska has several unique ecosystems and provides unique

challenges to resource managers. For example, how do we maintain viable populations on offshore islands? Many interesting questions persist. Should land managers try to produce all resources—wildlife, timber, etc.—on small land areas everywhere or should larger areas be used depending on management emphasis? For example, perhaps some watersheds should be managed for timber while others remain intact for wildlife. Unique ecosystems may require unique solutions and consensus by technical working groups provides managers with sound background for their decisions.

It is important to note that change in resource management practices are not new. A decade ago fishery managers removed debris from stream channels. Today, maintenance of logs and other woody debris in streams and rivers is critical in management. Total fire control has shifted to allow some natural fire to burn and prescribed fire is used regularly in forest, grassland and wetland management. Habitat management for predators (and even reintroductions) is a significant shift from broad-scale eradication of two or more decades ago.

In summary, the Queen of hearts in Lew Carroll's *Through the Looking Glass* tells Alice ''now, here, you see, it takes all the running that you can do to keep in the same place.'' We as professional resource managers must do more than staying in place. As Aldo Leopold (1933) wrote in *Game Management*: ''all factions, whatever their own differences, should unite to make available the known facts'' and ''bring all theories susceptible to local trial to the test of actual experience.'' We hope as a diverse working group that ideas and concepts presented in this paper continue to be given serious consideration and test in the Tongass Land Management Plan revision, thus conservation of one of North America's great natural resources.

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Browse Diversity and Physiological Status of White-tailed Deer During Winter

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Introduction

Estimation of carrying capacity is the principal means by which biologists and managers relate the health and dynamics of deer (*Odocoileus* spp.) populations to the quality of their changing habitat (Mautz 1978, Harlow 1984, McCullough 1984). Although many habitat factors influence carrying capacity, ecologists concur that ultimately nutrition has the most direct effect on health, size and productivity of deer herds (Verme and Ullrey 1972, Mautz 1978, Robbins 1983). Management decisions related to deer carrying capacity are often based on evaluations of vegetational conditions; however, the value of this information is limited by the accuracy of the assessment and may be misleading (Van Horne 1983), especially when used as an indirect measure of deer condition or nutritional status. A more refined understanding of the relationship between browse quantity and quality and the physiological status of deer is needed for more informed decisions related to carrying capacity (Halls 1984).

The obvious and direct consequences of gross habitat deterioration and poor nutrition on deer reproduction and survival have been well-documented (Morton and Cheatum 1946; Cheatum and Severinghaus 1950; Julander et al. 1961; Verme 1965, 1969; Smith and LeCount 1979). However, recent evidence has indicated that there are subtle and indirect nutritional influences as well (Nelson and Mech 1986, Mech et al. 1987, O'Gara and Harris 1988).

Thorough examination and understanding of these influences and of the relationship between habitat (i.e., food resources) and deer condition requires the ability to detect and quantify subtle temporal and spatial differences in deer nutrition (DelGiudice et al. 1989). Urinalysis as a direct, sensitive means of assessing the physiological status of deer (Warren et al. 1981, 1982; DelGiudice et al. 1987, 1988a) combined with

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analyses of snow-urine (urine deposited in snow), a technique that permits sequential and frequent sampling of free-ranging deer (DelGiudice et al. 1988*b*, 1989), should help fulfill this requirement. Our objective in this study was to examine the relationship between browse availability and use in winter yards of white-tailed deer (*O. virginianus*) and the physiological status of deer in those yards from early to late winter.

Study Area

Three winter yards located within the east-central Superior National Forest (SNF) in northeastern Minnesota (48°N, 92°W) (DelGiudice et al. 1989) were included in our study. The Kawishiwi (KAW), Snort Lake (SL) and Isabella (ISA) yards occupied 7, 6 and 27 km^2, respectively (Nelson and Mech 1987). Kawishiwi and SL each held 40–50 deer; about 400 deer concentrated in the ISA yard (Nelson and Mech 1986, 1987).

Northeastern Minnesota is characterized by undulant topography and a continental climate (Anon. 1978). Approximately 127 cm of snow fell from mid-November 1984 to early April 1985 (National Oceanic and Atmospheric Administration 1984, 1985). DelGiudice et al. (1989) provide additional weather information for the study area.

Mixed coniferous-deciduous stands were prominent on the uplands and included balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), jack pine (*Pinus banksiana*), and northern white cedar (*Thuja occidentalis*). Beaked hazel (*Corylus cornuta*), mountain maple (*Acer spicatum*), red-osier dogwood (*Cornus stolonifera*), and speckled alder (*Alnus rugosa*) are shrubs apparent on the site (Wetzel et al. 1975). Conifer swamps were associated with the lowlands, populated by black spruce (*Picea mariana*), tamarack (*Larix laricinia*), northern white cedar, bog birch (*Betula pumila*), and Labrador tea (*Ledum groenlandicum*). Logging of hardwoods occurred on site for pulp production and to enhance deer habitat quality (T. R. Biebighauser, U. S. For. Serv., pers. comm.).

Methods

We compared food habits of deer in the three yards during winter 1984–85 to determine if there was a relationship between percent browse availability and use and nutritional status as assessed by chemical analysis of snow-urine. We employed a technique for examining food habits similar to that used earlier in the same region (Wetzel et al. 1975). During early (15 January–15 February) and late (16 February–15 March) winter, we located fresh deer tracks in each yard after a new snowfall. Availability and fresh browsing of six "indicator" species (mountain maple, red-osier dogwood, trembling aspen, beaked hazel, paper birch, and balsam fir) and a seventh category called "other" were documented within 1 m of both sides of the tracks for about 450 m. We chose the six indicator species because of their varied levels of importance to deer (Wetzel et al. 1975, Rogers et al. 1981). A freshly browsed twig was recorded as an "instance of use" (Wetzel et al. 1975). Each twig of current year's growth was enumerated as available browse. Significantly ($P <$

0.05) greater percent use compared to percent availability indicated preference for a species; less use suggested avoidance (Wetzel et al. 1975).

Deer were tracked and food habits recorded 14–23 times in each yard during both early and late winter. We divided a map of each yard into 10 grid cells, and sampling was distributed over the cells. Percent browse availability and use data were subjected to arc-sine transformation before comparisons were made by analysis of variance. Duncan's multiple range test was employed to make group comparisons at $P < 0.05$.

We collected snow-urine samples after recent snowfalls during five 2-week intervals: (1) 1–15 January; (2) 16–31 January; (3) 1–15 February; (4) 1–15 March; and (5) 16–31 March (DelGiudice et al. 1989). Collections began at ISA during Interval 2. Snow-urine samples were assayed for urea nitrogen (U), sodium (Na), potassium (k), phosphorus (P), and creatinine (C). Urea N and electrolyte data were compared as ratios to C to control extraneous variability associated with single urine samples and to correct for dilution by snow. Details of the snow-urine collections and chemical analyses are described elsewhere (DelGiudice et al. 1989).

Results

Browse Availability and Use

In the general study area mean proportional availability of trembling aspen declined from early (6.3 ± 1.2 percent [SE]) to late (3.4 ± 0.9 percent) winter ($P < 0.05$). Similarly, red-osier dogwood availability tended ($P = 0.08$) to diminish (2.7 ± 0.7 percent versus 1.3 ± 0.5 percent); percent use also decreased ($P < 0.05$) during late winter (10.6 ± 2.8 percent versus 4.7 ± 1.5 percent). Availability of balsam fir was greater ($P < 0.05$) in late winter (16.0 ± 1.8 percent) than during early winter (11.5 ± 1.8 percent). Mountain maple was highly preferred throughout winter, and red-osier dogwood was preferred during early winter and selected according to availability in late winter.

During early and late winter, significant ($P < 0.001$) differences in proportional browse availability and selection occurred among the seven browse categories within each of the three yards (tables 1 and 2). At KAW, mean availability of browse classified as "other" (15 spp.) was greater than that of all other categories during early and late winter (tables 1 and 2). Although mountain maple was more available than only a few other indicator species throughout winter (tables 1 and 2), its selection by deer was similar to that of "other" and greater than that of all remaining indicator species (tables 1 and 2). Use of "other" (8–10 spp.) was only greater than that of a few other indicator species during early winter (Table 1), but during late winter it comprised a greater portion of the deer's diet than all other indicator species except mountain maple (Table 2). All remaining indicator species were selected in proportion to availability throughout winter.

Similar to KAW, browse classified as "other" was most available (19 spp.) at SL during early and late winter (tables 1 and 2). However, "other" (11 spp.) was browsed more frequently than any other indicator species throughout winter as well. Selection of "other" included the following: willows (*Salix* spp.), speckled alder, pin cherry (*Prunus pennsylvanica*), choke cherry (*P. virginiana*), honeysuckle (*Lonicera* spp.), blueberry (*Vaccinium* sp.), northern white cedar, black ash (*Fraxinus nigra*), bog birch, and two unidentified species. Mountain maple was browsed more

Table 1. Proportional availability and use (%) of twigs of seven indicator species of browse by white-tailed deer in three yards in northeastern Minnesota, early winter (15 Jan–15 Feb), 1985.

Indicator browse species	Kawishiwi				Snort Lake				Isabella			
	Availability		Use		Availability		Use		Availability		Use	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Trails n	18		18		21		21		15		15	
Mountain maple	21.8A[a]	6.3	35.2A	9.2	8.0A	2.7	22.1A	6.2	5.1AB	2.8	20.3AB	7.9
Red-osier dogwood	4.0BC	1.8	14.5BC	6.6	2.3A	1.0	7.2B	3.1	1.5B	0.7	7.5BC	4.6
Trembling aspen	8.2AB	2.0	2.0C	0.7	5.8A	2.3	0.9B	0.5	4.4AB	1.5	4.5C	4.5
Beaked hazel	15.3AC[b]	4.6	14.4BC[c]	6.7	8.6A	2.4	4.9B	2.7	46.7C	7.6	30.4A	8.2
Paper birch	1.4B	0.5	2.9C	1.1	3.6A	1.8	7.5B	3.2	4.9AB	1.7	7.0BC	3.9
Balsam fir	14.8AC	4.1	0.0C	0.0	7.9A	2.6	0.5B	0.5	12.0AD	2.4	0.0C	0.0
Other[d]	34.8D[e]	7.5	25.5AB[e]	8.6	63.7B	8.2	47.4C	9.4	25.4D	6.9	23.3A	5.9
Total	100.3		94.5[f]		99.9		90.5[f]		100.0		93.0[f]	

[a]Mean values in a column with different letters are different ($P < 0.05$).
[b]Significant difference ($P < 0.05$) between Isabella and Kawishiwi and Snort Lake.
[c]Significant difference ($P < 0.05$) between Isabella and Snort Lake.
[d]Includes an additional 13–17 and 8–10 species available and selected, respectively.
[e]Significant difference ($P < 0.05$) between Snort Lake and Kawishiwi and Isabella.
[f]The remaining portion is attributable to no selection by deer of available browse.

Table 2. Proportional availability and use (%) of twigs of seven indicator species of browse by white-tailed deer in three yards in northeastern Minnesota, late winter (16 Feb–15 Mar), 1985.

Indicator browse species	Kawishiwi				Snort Lake				Isabella			
	Availability		Use		Availability		Use		Availability		Use	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Trails *n*	21		21		19		19		22		22	
Mountain maple	21.0A[a]	6.3	35.7A	9.0	12.3AB	4.4	21.9A	6.9	12.6	4.0	23.9	5.9
Red-osier dogwood	0.7B	0.6	2.7BC	1.6	1.2A	0.7	4.1B	2.5	1.9	1.2	6.0	3.4
Trembling aspen	4.3B	1.8	9.6BC	4.2	5.5AB	2.2	3.8B	2.3	0.9	0.3	0.6	0.5
Beaked hazel	18.2A[b]	4.9	15.9C[b]	5.7	17.6B	5.5	13.0AB	5.1	39.3	5.8	42.5	6.8
Paper birch	0.9B	0.4	1.9BC	0.9	3.3A	1.7	3.7B	1.6	3.2	1.3	4.7	2.1
Balsam fir	20.5A	3.8	0.0B	0.0	12.6B	2.8	0.7B	0.7	14.5	2.8	0.7	0.5
Other[c]	34.4C[d]	4.5	34.2A[d]	8.0	47.6C	8.7	52.9C	9.5	27.9	5.4	21.6	6.7
Total	100.3		100.0		100.1		100.1		100.3		100.0	

[a]Mean values in a column with different letters are different ($P < 0.05$).
[b]Significant ($P < 0.05$) difference between Isabella and Kawishiwi and Snort Lake.
[c]Includes an additional 12–14 and 8–11 species available and selected, respectively.
[d]Significant ($P < 0.05$) difference between Snort Lake and Isabella.

frequently than each of the five remaining indicator species in early winter, even though there were no differences in availability (Table 1). Although greater use of mountain maple than of most species continued during late winter, selection of beaked hazel was similar at this time (Table 2).

In contrast to KAW and SL, beaked hazel at ISA was most available in early winter (Table 1). During the same period, availability of "other" (15 spp.) was greater than that of most other indicator species. By late winter, availabilities of "other" (13 spp.) and beaked hazed were similar, and each was more available than each of the other indicator species (Table 2). During early winter, beaked hazel and "other" (8 spp.) were selected by deer more than any other indicator species except mountain maple (Table 1); however, mean proportional use of beaked hazel by late winter was greater than that of all other categories, including "other" and mountain maple (Table 2).

Balsam fir was avoided with respect to consumption in all three yards throughout winter. Trembling aspen was avoided during early winter and browsed according to availability during late winter at KAW and SL. However, at ISA it was browsed in proportion to availability throughout winter.

Winter yard comparisons. Mountain maple, red-osier dogwood, trembling aspen, beaked hazel, paper birch, and balsam fir accounted collectively for 66 percent and 72–75 percent of available browse in the KAW and ISA yards, respectively, throughout winter (tables 1 and 2). These species represented only 36 and 52 percent of browse available to deer at SL during early and late winter. Throughout winter, beaked hazel was more available at ISA than at KAW and SL (tables 1 and 2). Availability of browse classified as "other" was greater at SL than at KAW during early winter and greater than at ISA throughout winter (tables 1 and 2).

Mountain maple, red-osier dogwood, trembling aspen, beaked hazel, paper birch, and balsam fir collectively constituted 66–69 percent and 70–78 percent of browse selected by deer at KAW and ISA (tables 1 and 2). During early winter, just two species, mountain maple and beaked hazel, together represented almost two-thirds and three-quarters of this use at KAW and ISA, respectively (Table 1). By late winter, this portion of use by deer increased to ≥ three-quarters in both yards (Table 2).

All winter, mean selection of beaked hazel at ISA was greater than at SL (tables 1 and 2). During late winter, use of beaked hazel at ISA was greater than at KAW as well (Table 2). Only 23 and 22 percent of total browse used by deer at ISA was attributable to "other" during early and late winter. At KAW, "other" was associated with 26 and 34 percent of total browse use during these periods. However, use of the numerous browse species of this category by SL deer during early winter (47 percent) was greater than by deer at KAW and ISA (Table 1). During late winter, mean use of "other" at SL (53 percent) remained greater than at ISA, but was similar to its use at KAW (Table 2).

Snow-urine Profiles

Urea nitrogen:C declined steadily in snow-urines at KAW ($P < 0.0001$) and ISA ($P < 0.001$) throughout winter; whereas U:C remained stable through early March at SL, then declined ($P < 0.05$) during late March (Figure 1) (DelGiudice et al. 1989). Mean U:C was greater ($P < 0.05$) in snow-urines at SL than in samples at KAW and ISA during early March (DelGiudice et al. 1989).

At KAW, snow-urine Na:C ($P < 0.005$) and K:C ($P < 0.15$) decreased progressively until March when both ratios increased significantly (P 0.05) (Figure 1) (DelGiudice et al. 1989). Sodium:C ($P < 0.01$) and K:C ($P < 0.05$) at ISA also decreased progressively, but remained diminished through late March (Figure 1) (DelGiudice et al. 1989). At SL, Na:C remained stable through late March; K:C was unaltered through early March but became elevated ($P < 0.05$) during late March (Figure 1) (DelGiudice et al. (1989).

At KAW and SL, mean P:C did not change throughout most of winter, but P:C increased ($P < 0.05$) by late March in both yards (Figure 1) (DelGiudice et al. 1989). Snow-urine P:C at ISA increased ($P < 0.01$) slightly until late March when it declined ($P < 0.05$) (Figure 1).

Discussion

Generally, frequent browsing of mountain maple and beaked hazel by deer, and preferences for mountain maple and red-osier dogwood in the study area, were similar

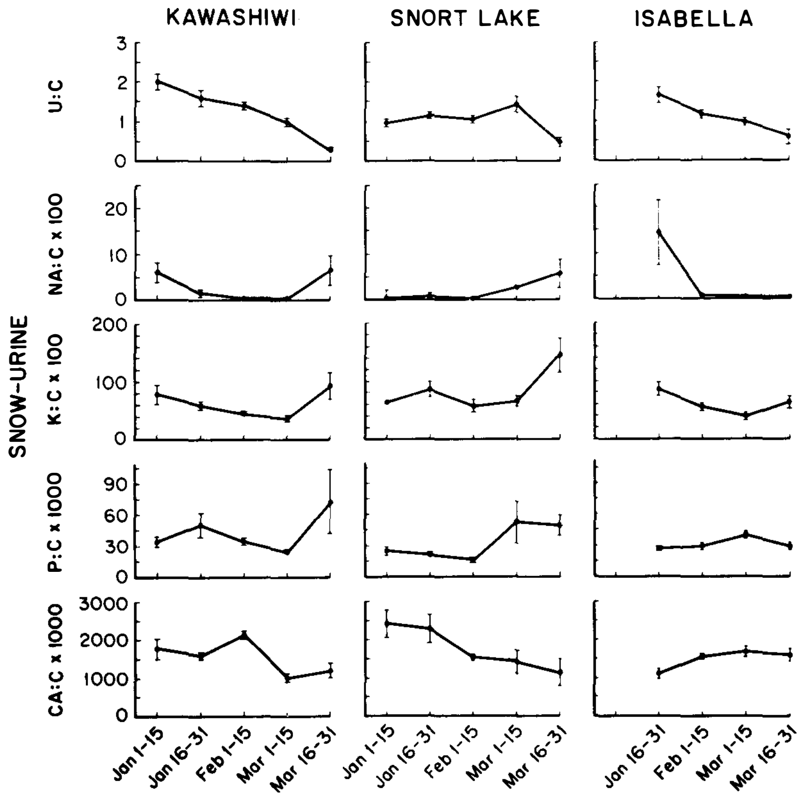

Figure 1. Mean (± SE) ratios of urea nitrogen (U), sodium (Na), potassium (K), and phosphorus (P) to creatinine (C) in white-tailed deer urine in snow (snow-urine) collected during five 2-week intervals in the Kawishiwi, Snort Lake, and Isabella yards, northeastern Minnesota, 1985 (compiled from DelGiudice et al. 1989).

to findings from previous studies (Wambaugh 1973, Wetzel et al. 1975). Although percent availability and use of most browse species did not change as winter progressed, increasing snow depth appeared to influence the decline in availability of already scarce red-osier dogwood and trembling aspen, which inhabit primarily open areas where snow accumulation is greatest. Similarly, diminished browsing of red-osier dogwood coincided with a period when snow covered many of the low-growing dogwoods, and deer used coniferous cover heavily (Wetzel et al. 1975). Low use of trembling aspen was consistent with observations during past winters (Wambaugh 1973, Wetzel et al. 1975, Mooty 1976) and may be related to its limited nutritive quality (Ullrey et al. 1971).

Complete avoidance by deer of balsam fir for food throughout winter suggested that nutritional inadequacy was not severe enough for deer to select this lower quality browse (Ullrey et al. 1968, Klein 1970). Furthermore, rebrowsing of previously selected current year's growth was not observed (G. D. DelGiudice, unpubl. data). Rogers et al. (1981) noted that consumption of balsam fir by starved deer (Aldous and Smith 1938) during late winter was much greater than by deer considered to be in good condition (Wetzel 1972).

Sequential collection and chemical analysis of snow-urine directly and physiologically confirmed that deer in all three yards remained in an early phase of undernutrition throughout winter (DelGiudice and Seal 1988, DelGiudice et al. 1989). Low levels of U:C (<4.0) and electrolyte ratios with C (Figure 1) conformed with documented patterns of reduced home-range size and decreased movement and feeding by deer as snow accumulates (Rongstad and Tester 1969, Ozoga and Verme 1970, Moen 1978). These ratios also indicated that fat reserves of deer were not exhausted and that extensive endogenous protein catabolism was not occurring (Waid and Warren 1984, Torbit et al. 1985, DelGiudice and Seal 1988, DelGiudice et al. 1989).

Early undernutrition was associated with diverse diets in deer of all three yards as suggested by the varied use of the six indicator species and the continued importance of numerous species that constituted the seventh category of "other." However, there were differences among yards in browse availability, dietary diversity, and the nutritional status of deer (Figure 1) (DelGiudice et al. 1989).

Steady declines of U:C, Na:C, and K:C in snow-urines of KAW and ISA deer from early and late January, respectively, to early March (Figure 1) indicated progressive nutritional deprivation (DelGiudice et al. 1989) and reflected physiological mechanisms of nutrient conservation (Robbins et al. 1974, Robbins 1983). The diet of SL deer was more diverse, and unaltered mean levels of U:C, Na:C, K:C, and P:C until early March in these deer (Figure 1) suggested that they were able to maintain a more constant level of nutritional adequacy (DelGiudice et al. 1989). By early March, when snow was deepest, greater U:C ratios in SL deer than in KAW and ISA deer indicated that dietary protein availability was greater in the former (DelGiudice et al. 1989). Crude protein and mineral contents vary widely among browse species in the general area (Peek et al. 1976, DelGiudice 1988), but locational influences within species and season were likely minor (Short et al. 1966).

Similar to domestic ruminants, deer selection of plant species appears to be related to content of specific nutrients (Swift 1948, Weir and Torell 1959). Dietary diversity probably provides more adequate levels of various nutrients by overcoming specific mineral deficiencies that limit digestion of some plants (Church 1977:138, Hanson and Jones 1977:254). Furthermore, evidence has shown that deer maintain body weights better on more heterogeneous diets during winter, and even plants consumed in small quantities are probably nutritionally beneficial (Dahlberg and Guettinger 1956, Verme and Ullrey 1972).

Dietary diversity of SL deer was evidenced by their greater selection of the 11 additional browse species of ''other'' compared to each of the remaining six indicator species and by the major portion of their diet that ''other'' comprised throughout winter (tables 1 and 2). Although ''other'' species were consistently present at KAW and ISA, sparser availability at KAW during early winter, and at ISA throughout winter, compared to SL indicated less variety of available browse. Similarly, the lower proportional use of this browse category reflected less variety in the diets of KAW deer in early winter and ISA deer during the entire winter compared to the diets of SL deer.

The more limited dietary diversity of KAW and ISA deer also was reflected by the observation that just two species (mountain maple and beaked hazel) constituted most of their diet. This was particularly evident at ISA, where consistently greater browsing of beaked hazel and less selection of ''other'' species compared to SL deer, suggested dramatic differences in diet diversity throughout winter. Deeper snow at ISA (DelGiudice et al. 1989) and the association of beaked hazel with dense, coniferous cover probably contributed to the deer's frequent selection of beaked hazel as a forage item (Wetzel et al. 1975). This was indicated further by the change from similar proportional selection by ISA deer of beaked hazel, mountain maple, and ''other'' during early winter to the predominance of beaked hazel in their diet during late winter when snow was deepest (DelGiudice et al. 1989).

Browse composition on site, plant availability and snow depth are the primary factors affecting the winter diet of free-ranging ruminants (LeResche and Davis 1973). An additional indicator of the more diminished nutrition available at ISA was the deer's selection of trembling aspen according to availability throughout winter (Klein 1970, Ullrey et al. 1971. Deer at KAW and SL avoided trembling aspen during early winter and used this species in proportion to availability in late winter.

During late winter, the similar availability and consumption of ''other'' by KAW and SL deer was indicative of a relative increase in dietary diversity in KAW deer, even though mountain maple still constituted a major portion of their diet. Although greater U:C ratios during early March (Figure 1) suggested greater nutritional intake in SL deer than KAW deer, the apparent increase in dietary diversity in KAW deer during late winter may have contributed to initiation of a similar nutritional recovery during late March (DelGiudice et al. 1989). The late winter recovery in SL and KAW deer was indicated by significant ($P < 0.05$) elevations of Na:C, K:C, and P:C during late March (Figure 1) and was associated with minimal snow cover (< 18 cm) at both yards (DelGiudice et al. 1989), as well as elevated metabolic demands and feeding activity (Silver et al. 1969, Ozoga and Verme 1970, DelGiudice et al. 1987).

Increased nitrogen retention and accretion efficiency, concomitant with the improved dietary protein supply subsequent to protein deficiency, was probably responsible for the lack of simultaneous elevations of U:C ratios in KAW and SL deer (Figure 1) (Deb.Hovell et al. 1987, DelGiudice et al. 1989). Absence of a similar nutritional recovery in ISA deer by late March, indicated by C ratios of U, Na, K, and P that remained diminished, seemed attributable to prolonged deep snow (≥ 35 cm) and less dietary diversity.

Management Implications

We have shown by simultaneous study of deer physiology (via snow-urine analysis) and browse availability and selection in three yards that subtle differences in available food resources and diet diversity may be accompanied by quantifiable differences or changes in the metabolic status of free-ranging deer as winter progresses. The ability to sequentially detect and quantify such disparities is an important step towards a more accurate understanding of the ecological relationship between deer condition and habitat quality and what constitutes optimum deer habitat. Our data also reflected the obvious potential of snow cover to affect browse availability and thus, deer nutritional status. Although certain environmental vagaries are beyond the control of managers, our data strongly suggest that maximizing browse diversity should be a key consideration in management plans for deer habitat improvement. The seemingly subtle nutritional effects reported herein may have important implications related to deer reproduction and survival, and dictate further study.

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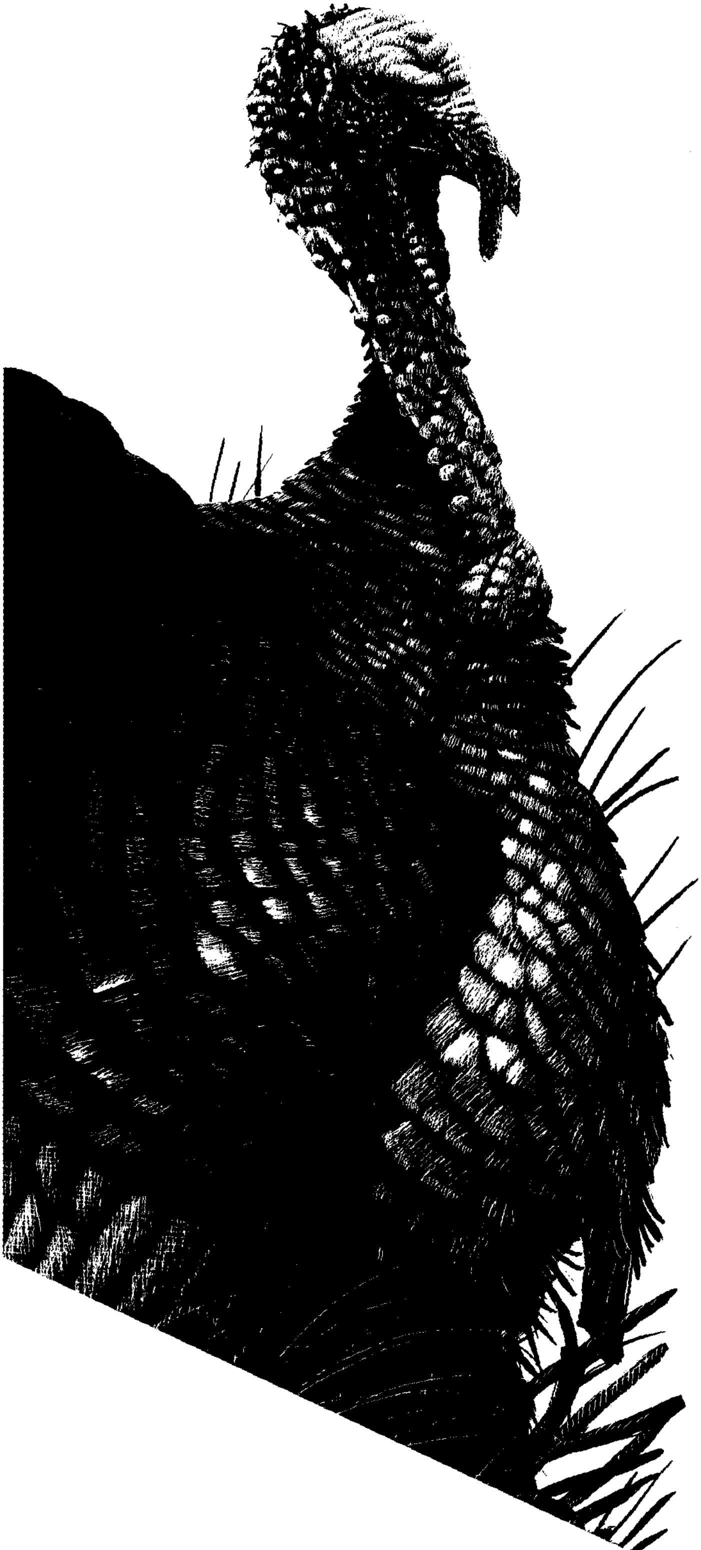

Special Session 3.
Access to Public and Private Land for Recreation

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Introductory Remarks

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One of my compatriots from Montana, Paul F. Berg, often makes the statement "If you can't use it—what good is it?" Without reasonable access to land, the outdoors person becomes a non-entity and/or disappears.

The purpose of this session is to discuss past and present trends dealing with access to private and public lands for recreation. Private and public lands, however, are very separate and different entities and must be dealt with accordingly.

Public Lands

In most western states (except Texas) private lands are often interspersed with large and small tracts of public lands. Population pressures are not as constantly severe, but during hunting seasons both the public and private lands are subjected to relatively heavy pressure for access. Thirty years ago, both the public and private lands were easily accessible because (1) fewer people were involved, and (2) big game numbers and values were relatively insignificant.

The Montana Public Land Access Association, Incorporated, (PLAAI) which I represent, is really a symptom of a much larger problem, and I will attempt to develop an understanding of the major problem during this entire session. Fundamentally, the major problem is not the mere access by people to either public or private land. The major problem or opportunity is that wildlife has taken on an unprecedented value in today's society. Consequently, entrepreneurs from all walks of life are trying to privatize/commercialize the recreational values of wildlife and "make a buck." Today, we will therefore deal primarily with the wildlife aspects of access to public and private lands for recreation.

Today's highly successful North American wildlife conservation system is based on three fundamental historical policies: (1) denial of economic value to dead wildlife, (2) allocation of surplus wildlife by law and (3) non-frivolous use of wildlife. The application of these concepts developed the best system of wildlife conservation in the world, and also resulted in the creation of a $60 billion service and manufacturing industry based on living wildlife. There are very strong trends in North America today that would, in time, diminish this highly successful wildlife conservation system.

About two-thirds of the United States is private land. The other one-third is publicly owned and managed by some 7 federal and 50 state entities. The public has a legally declared right to hunt wildlife on most of the public lands, but private lands are available only by consent of the private landowner. If reasonable public access to most of the public lands is maintained, public wildlife recreationists will continue to have a solid base upon which to build and flourish. Continuing loss of access to public lands will diminish the North American wildlife conservation system.

Our first goal today is to discuss a methodology for obtaining and maintaining legal access to our public lands, which is the foundation and key to keeping intact the best wildlife conservation system in the world.

Our first panel will deal with recreational public access symptoms, problems, and possible solutions concerning federal lands in North America.

Private Lands

Basically, private lands are under the total control of the landowner. Today's legal concept is that a landowner has every right to deny access to his neighbors, or anyone else, for good reasons, bad reasons, or no reason at all, assuming that a prescriptive or public right has not already been established to cross such lands by historical use.

Idealistically, access to private lands for the average recreational land user would be free. The trend, however, is towards charging every-increasing fees for access to private lands. Reasonable access to public lands will, however, help keep private land access fees more reasonable because of competition.

There is strong evidence that private wildlife management endeavors can improve both the quality and quantity of wildlife. Yet, it is very important to separate wildlife privatization-commercialization and fee hunting. Authorities assigned to state wildlife agencies cannot be granted to landowners, yet, landowners should be allowed to make a reasonable amount of money from wildlife using their land. The future of much hunting is keyed to private lands, and landowners needs and wants must be recognized.

Leopold in 1930 noted that landowners can be encouraged in three optional ways to raise wildlife: "1) buy him out, and become the landowners, 2) compensate him directly or indirectly for producing a game crop and for the privilege of harvesting it, and 3) cede him the title to game, so that he will own it and can buy and sell it just as he owns, buys and sells his poultry." Williamson noted in 1988 that "option 1 is still impractical, and option 3 is unacceptable. Therefore, option 2, compensating the landowner, seems to be one logical route to improving game populations and hunting on private land."

Our second panel is designed to illustrate some of the ongoing efforts to recognize and develop option 2 approaches on private land.

Public Land Users and Feudal Lords

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Introduction

We believe the nation's founding fathers would be shocked to learn the truth about access to public land problems in Montana today. Public land users frequently find once-used public roads claimed as private roads. By closing roads short of the public lands, landowners and state and local governments allow a system resembling feudalism and privatization or public resources by road closure. Like feudal lords, landowners contiguous to public land believe control of public roads and resources on large blocks of public land is an extention of their private property rights. Public land users, the vassals, can use public land by paying homage and defending the lords' politics.

Montana feudalism should not exist. The U. S. Constitution and Bill of Rights were drafted to avoid systems of feudalism, and the government was not allowed to grant titles of nobility. Both wildlife and public roads were retained for the government to administer fairly for its people. The Public Land Access Association, Inc. (PLAAI) was organized in 1985 under the Montana Non-Profit Corporation Act to promote legal public access to the boundaries of public lands and equal opportunity for all legitimate public land users.

Historical

Montana retains about one-third of the state in public ownership. Along with these large tracts of public land favorable to wildlife, two federal acts marked turning points for wildlife restoration in Montana. The Lacey Act of 1900, with the vigorous enforcement that began with President Theodore Roosevelt, eventually brought an end to the large-scale use of wild meat and animal parts in the marketplace. The second was the 1937 Pittman-Robertson Federal Aid in Wildlife Restoration Act, which provided Montana the incentives for a successful wildlife restoration and management program.

When county governments were first established, they were made responsible for development of a countywide public road system. The roads that once accessed public land still exist today as primitive roads. Contiguous landowners have appropriated many of these primitive roads, usually just a short length between their rural mailbox and the public land boundary.

Many stock ranches have been acquired by wealthy non-residents and foreign investors. Most are intent on building feudal retreats, including control over adjoining public land. These are often people who have made a lot of money and tend to use it getting their own way. They donate to wilderness organizations, universities, privatization and political campaigns. None donate to public access.

The Public Land Access Problem

Public access east of the Continental Divide in Montana is a serious problem where nearly 13 million acres (56 percent) of the 23 million acres of public land (state and federal) are considered legally inaccessible (Hawkes 1986). Montana is a strong advocate of rural private property rights. The state is often an apologist for public rights, and frequently sides with private interests to become a legal and political bully of its people. Recently, for example, the state was joined by the Farm Bureau Federation and the Stockgrowers Association to prevent public access and implementation of multiple use for state lands required by statutes (*Bozeman Daily Chronicle*, September 14, 1988). The Montana State School Land Management Policy favors a contiguous landowner over the school trust fund.

The Stockgrowers Association promoted the "Sagebrush Rebellion" of 1981, calling for transfer of federal lands to state ownership (Lopach et al. 1983). They rationalized their defeat, saying they had "sent a message" to the federal agencies. Some private landowners have a long history of hostility to managers who promote conservation and multiple use.

The success of the state wildlife conservation program has attracted attention to people intent upon privatization and commercialization, and the access problem is part of a larger problem in North America described by Geist (1988), where determined efforts by the private sector are being made to gain control of public wildlife. With Montana's current political atmosphere it is relatively easy to control public land for private benefits.

Motives for controlling wildlife and other public resources can be better understood by short analysis of some recent interactions between the private sector and the government.

The Dude Rancher, Outfitter and Guide Industry

Members of this industry, frequently contiguous landowners themselves, were the first to realize the value in privatization of public resources. They soon viewed a wilderness designation under the 1964 Wilderness Act as a place with clientele guaranteed by law. With big game populations steadily increasing, the industry was soon asking for more guaranteed clientele from the state legislators.

Their wildest dreams included a law requiring that all hunters employ the industry. Only part of that dream could be realized because of hostile resident hunter reaction. A less inclusive law was passed, requiring nonresident hunters be accompanied by a licensed resident hunter. For the price of a resident hunting license the industry was legally in business.

In the 1970s the industry was defined by law, and an Outfitter's Advisory Council was established and assigned to the Department of Fish, Wildlife and Parks at the State Fish and Game Commission level. The council promoted benefits for themselves from within the department, which was soon facetiously dubbed the "Montana Department of Outfitters, Guides and Parks" because it became their promoter, instead of their regulator.

More clients were guaranteed the industry in 1972 when nonresident hunters were required to employ an outfitter to hunt upon national forest wilderness areas, federal game refuges and state game ranges. This was challenged in 1973, and struck down by the Montana Supreme Court in 1975 (*State vs. Jack*, No. 12881). When Chief

Justice Harrison delivered the opinion, the state was reminded again that ". . .the ownership of wildlife was held by the state in trust for its people."

The next industry tactic was to control hunting license issuance. In 1975 the President of the Montana Outfitters and Guides Association asked the Director of the Fish and Game Department (now Fish, Wildlife and Parks) for a portion of the 17,000 nonresident licenses for outfitters. Director Woodgerd refused the request by letter (Director Wesley R. Woodgerd to President Tag Rittel, January 22, 1976) citing as basis the Montana Constitution, Article II Section 4, and the U.S. Constitution, Amendment 14. Also, the state law establishing the nonresident license made no provisons for treating outfitters in a favored manner.

In 1985 the industry tried another tactic and finally struck paydirt. They demanded nonresident big game hunting licenses be set aside for hunters who booked their hunts with licensed outfitters. After considerable controversy, the Department Director, James Flynn, who was sworn into office under the same constitutional oath as Wesley Woodgerd 10 years earlier, announced a new license sale procedure for 1986.

The goal of the new procedure was termed "The fairest possible system for all those involved" and divided the 17,000 nonresident licenses into two separate groups; 5,600 licenses for hunters that booked their hunts with licensed outfitters, and 11,400 for hunters not using outfitters (Aasheim 1985). If this allocation of public resources to the private sector was illegal at the time, it was made legal by the next legislative assembly. Neither actions have been adequately tested in court.

State and Federal Government

A study of access to public lands in Montana (Ciliberti 1974) suggests that redress for access problems includes ". . . legislation, court litigation and public petition to local commissions. . . ." Ciliberti felt considerable access had been lost by default through public apathy, fear of personal retribution or inadequate funds to finance court litigation.

Unfortunately for public land users, Montana's road laws are the best kept secrets in government today. When landowners contend public and private rights cannot coexist, the legislative and administrative branches pretend public rights do not exist.

The most important road laws are administered by counties. They make it possible for citizens to establish, alter or abandon rural county roads, and establish roads by prescription. Most county commissions exhibit little institutional memory of roads or laws. They seldom consider the public right to use public land without political pressure. Yet they receive millions of dollars from public lands in their counties. Payments are made to counties and the state under seven federal land laws (Clark 1984). Payment in lieu of tax (PILT) payments by the BLM to Montana in F.Y. 1984 was $8.5 million. Under the Forest Service 25 Percent Law, $7.8 million in F.Y. 1984 was paid to counties containing national forest lands. The 25 percent money is earmarked for roads and public schools at the county level. County commissions are prone to take the money and then abandon a road to the public land, leaving it for the nearest landowner, granting him rights like those once enjoyed by nobility and feudal lords in Europe.

The Montana Department of Fish, Wildlife and Parks sportsmen/landowner relations program clearly articulates landowner rights and sportsmen responsibilities, but not public rights and trustee responsibilities. Preferential treatment for certain classes of people is evident in license issuance and certain research and management programs. They have actively supported closing of public access roads for certain classes of people—to public lands in Sweet Grass County and in the Dupuyer Creek Drainage on a Boone and Crockett Club ranch in Teton County.

Even with the Montana outfitter's council at the state level, little was done to regulate the industry. Like man-made wind-borne pollutants, entrepreneurs have arrived from near and from afar to settle on both public and private land. They prostitute the concept of wilderness as a sanctuary from human encroachment and commercialism. In 1984 Montana licensed 563 outfitters and 1,086 guides, and at least seven outfitters were running guide schools (Hawkes 1986). "It is difficult to imagine a more obvious example of the over-commercialization of the big game hunting resource," he wrote. Alaska at the time had 310 licensed in the industry.

The Gallatin national Forest in 1988 developed a policy to regulate the industry. Outfitters resented the public access implications of the day-use policy and appealed. In the *Bozeman Daily Chronicle*, August 8, 1988, "discrimination" was claimed. One outfitter said, "They want to throw us all into the same spots [with the public] and that means I can't provide a quality hunt." According to his advertising brochure, this outfitter controls 25,000 acres of private property and national forest land for the exclusive use of his paying clientele.

Non-profit, Tax-exempt Conservation Organizations

Certain organizations with field offices in Bozeman are inimical to public access to public land and often support private control. For public land, they promote minimum logging, minimum public access and maximum wilderness, where recreation is legally limited to certain classes of people only. Scary scenarios about federal land management and lots of media coverage are stock for their demands.

The Gallatin National Forest, for example, in 1984 provided a draft Environmental Assessment concerning need for improved public access to national forest land bordering Yellowstone National Park. The program was basically to reopen former public roads, but the response indicated support for the status quo by organizations whose memberships included landowners, outfitters, dude ranchers, environmentalists and wilderness advocates.

A letter from the Montana Wilderness Association to the Forest Supervisor, October 31, 1984, objected to the program, saying this was an ". . . ill-advised and unnecessary program. . . ." and that ". . . the Gallatin National Forest must rise above this conventional wisdom and realize that . . . difficulty of access . . . is precisely what the country and its resources need. . . ." The letter also proclaimed the environmental assessment inadequate.

Washington Post staff writer Michael Dobbs, June 23, 1987, quoted the executive director of the Greater Yellowstone Coalition, "The private landowners have, on the whole, proved to be excellent stewards of the natural resources," also that the Coalition ". . . has supported local landowners in their disputes with public access groups."

Clifton Merritt, executive director of the American Wilderness Alliance, in *The Guide Outfitter*, November/December 1985, wrote that "Ranchers with wilderness in their 'backyards' have much to gain." He articulated their benefits without mentioning public rights.

The Madison-Gallatin Alliance took issue with the Gallatin National Forest over a recently acquired, historical, motor vehicle access road to the forest. When the access was opened for public use during the hunting season (*Bozeman Daily Chronicle*, January 15, 1989) the Alliance appealed the public access saying it was "premature, unwarranted and illegal."

These actions by tax-exempt organizations warrant Internal Revenue Service monitoring. Terms like public interest, common good, scientific information and general welfare describing tax-exempt status in *IRS Publication 557* do not clearly define the obligations. However, it is clear that tax-exempt organizations should not be operated for the benefit of contiguous landowners.

Summary and Recommendations

Montana rewards feudal lords. Their gifts include: control of public roads, direct and indirect agriculture subsidies, subsidized country living, exclusive use of large blocks of public land, hunting license control, and outfitters are allowed to set camps and hunt from within the best elk habitat on public land.

Landowners and taxpayers in Montana by law provide for public sidewalks and roads adjoining their property. Landowners contiguous to public land receive preferential treatment and tacit exemptions from the idea that a road runs both ways. The privateers that promote such ideas need to be treated the same as public land users would be treated if they tried to privatize access to city shopping centers, hospitals, county courthouses and public parks.

Obviously, reform of Montana feudalism in the public interest will be costly and hard to accomplish peacefully. PLAAI suggests the following to aid in the reform:

1. State and county governments should not be granted federal payments in lieu of taxes for federal lands unless they provide reasonable public access to those lands.
2. Requiring public access as a qualification for leasing of resources on public lands, including enclosed public land.
3. Provide the land management agencies the funds for an access program unrelated to timber management or resource extraction.
4. Ask state and federal elected and appointed officials to support public users when landowners take political routes to maintain their de facto privatization of public land and resources. Both federal agencies and county commissions have ample authority to resolve access deficiencies, but political influences limit their use.
5. Montana needs institutional leadership to provide a constant focus on access problems. The major recreation arm of the state should be assigned a watchdog role with responsibility for public land access. Access to public land boundaries is primarily a state and county function. Since they have not functioned well, that role needs to be institutionalized at the state level and supported with general taxes.
6. The closure of prescriptive-right roads appears to be a most pressing issue at this time. Legislation is needed to forever enjoin from closure all routes once used by the public to access public land, and assign them to a primitive county roads system open for travel at the users risk.

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Access to the Gallatin National Forest: A Case Study

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The Gallatin National Forest is located in Southwest Montana adjacent to the northern boundary of Yellowstone National Park. It is a key component of the public land base which comprises the region known commonly as the "Greater Yellowstone Area." The forest encompasses six Rocky Mountain ranges: the Crazy, Bridger, Absaroka, Beartooth, Madison, and Gallatin mountains. The forest offers quality big game hunting, blue ribbon trout fishing, spectacular scenery and has an estimated 2.5 million visitor days of recreation use annually.

Specifically, the forest contains approximately 1.7 million acres of federal lands with the ownership pattern being "checkerboard" with private ownership across most of the forest. This pattern is a result of early railroad land grants, which gave alternate sections to the Northern Pacific Railroad prior to the turn of the century. The primary transportation system in the area consists of a combination of state and county roads located mainly along the valley floor, with few of these roads leading to the national forest boundary. In most instances, the lower elevation lands adjacent to the public roads are in private ownership, with the national forest boundary beginning in the foothills.

The main issues associated with the management of the Gallatin are final wilderness allocation, wildlife management (which includes threatened and endangered species such as the grizzly bear and bald eagle), and an emerging issue associated with lack of reasonable public and administrative access. All of these regional issues are primarily focused on the Gallatin.

The Gallatin National Forest Plan identified 47 areas where access is needed to implement our forest plan direction, involving approximately one-third of the public lands. In addition to these key access points to the forest, the majority of the internal trail system, which contains approximately 1,800 miles, also crosses intermingled private ownership. On the trail segments that cross the private lands, the United States does not have documented trail easements. Increasingly, landowners are attempting to close or restrict use on these segments of the National Forest System trails.

Prior to the mid-1950s, the public and Forest Service had uncontested access to most areas of the forest on existing roads and/or trails that are located in most drainages. Many of the existing facilities were developed as a result of national forest activities in these areas. For various reasons, the adjacent private landowners have increasingly challenged the use of the existing road and/or trails, which has resulted in the closure of many of these facilities to the general public. Forest users who have used these facilities for decades are now being faced with trespass actions. The Forest Service officials in many situations now must seek permission to use these facilities to gain access for various administrative needs. Forest personnel can generally obtain conditional permission for administrative access from adjacent private landowners; however, frequently an appointment is required with the landowner to arrange for the access, which in many cases presents a timing problem. Permission is sometimes conditioned, depending on what type of activity is planned on the national forest, and is often more difficult to obtain during hunting season.

The Gallatin, county governments, and interest groups such as the Public Land Access Association (PLAA) are working in a complimentary manner to improve the access situation. County governments, primarily motivated by sportsmen and wildlife organizations, and PLAA are focusing their efforts on state law provisions to perfect outstanding access rights, either through prescriptive use, or by "proving-up" on forgotten public road petitions and/or dedications.

The Gallatin is primarily using land adjustment authorities and direct easement acquisitions to secure the needed access. The principal means available to the Gallatin are as follows:

Land ownership adjustments. Land exchanges and/or purchases that resolve access in addition to providing an overall public benefit are given the highest priority for consideration. In a few cases access can be obtained directly by adjusting the ownership pattern; however, in most instances, in addition to adjusting the ownership pattern, easements are required to provide the needed access. As a general rule, the Forest will not make a land exchange with an adjacent private landowner who controls access to the National Forest unless resolution of the access is made a part of the exchange package. The needed easements are then either donated or acquired directly upon consummation of the exchange.

The Small Tracts Act is another form of ownership adjustment that we are using to resolve access. Under this authority, the Forest Service can sell, interchange or exchange small parcels of National Forest System lands associated with innocent encroachments, unneeded road right-of-ways and mineral survey fractions. The procedures under this authority are very streamlined, and by using this tool, the forest can easily convey qualifying parcels for needed easements and, in most cases, also offset cash payments by either parties.

Proving up on outstanding public rights. Over the past decade the forest has cooperated with local county governments in researching old public records for evidence of forgotten petitions which established public roads leading to the national forest. In cases where the evidence is challenged, the issue has to be taken to court for final resolution. The counties have been willing, due to strong public support and interest, to bring these cases to state court and in many instances have been successful in establishing outstanding public rights.

Typically in these cases the forest will complete the record search, provide additional evidence, give testimony and, once resolved, assist the county in reopening the old roadways to make them usable for multi-purpose access to the national forest. The forest has also cooperated by performing periodic maintenance on these facilities.

Reciprocity. Under Title V of the Federal Land Policy and Management Act, the United States may condition a special use authorization to require the holder to grant a needed right-of-way across nonfederal lands directly or indirectly owned or controlled by the applicant for a right-of-way across federal lands.

In lay terms, if an individual desires to obtain a right-of-way across national forest lands, the Forest Service can condition this grant on obtaining a reciprocal right-of-way grant needed by the United States.

Due to the checkerboard ownership pattern on the Gallatin, we have a large number of requests from the intermingled private landowners for right-of-ways across the national forest. The forest actively uses this provision or condition as a means of resolving access needs to and within the national forest. We strive to be fair in imposing this condition in order to be consistent with the theme of being equivalent or reciprocal. Most landowners, although they sometimes don't agree to the condition, tend to understand and identify with this "business-like" approach. If they desire rights from the public for their benefit, then they may have to grant rights that the public needs.

Direct right-of-way acquisition. This is the principal means of securing needed right-of-ways to the forest. It can be a very complex process that involves the evaluation of many transportation and access alternatives and their associated impacts both on the federal lands and the involved private landowner. Broad public involvement is solicited throughout the entire process and documentation tends to be super adequate in anticipation of appeals and procedural challenges. In some instances, permission is not granted by the involved private landowner for on-site evaluations of the various access alternatives. He may also elect not to provide input or participate in the evaluation process. In these cases the forest must rely on photo interpretive techniques to obtain needed information to complete its assessment and obtain a description of the desired right-of-way area. Often the process is reopened when the landowner later elects to participate and to provide input on the alternatives. Ownership changes also tend to result in extensions in this process, and appeals can result in additional delays.

After the formal decision is made on the selected alternative, an appraisal is then completed to arrive at the amount of estimated compensation, and negotiations are initiated. Condemnation action is considered only as a last resort, when all negotiation efforts have failed and it is obvious that a willing seller arrangement cannot be obtained. Approximately 10 percent of the right-of-way acquisition cases on the Gallatin have been acquired through condemnation proceedings. This is somewhat higher than the typical Service-wide figure of less than 3 percent.

Cost share cooperative agreements. Most checkerboard forests have cooperative agreements with large intermingled corporate landowners, such as Burlington Northern Railroad Company. These agreements provide for the granting of needed easements between the parties and the sharing of road development costs. They are mainly a means of obtaining internal access and generally do not involve needed access to the forest boundary. In most cases the cooperator does not make an effort to obtain access across other private lands but waits for the Forest Service to do so.

How are we doing on the Gallatin National Forest? Over the last 15 years, the Gallatin has maintained the most aggressive and ambitious access program in Region One of the Forest Service. Our annual goal has been to secure from three to five new access points to the forest. In the last decade we have resolved or secured 30 key access points by concentrating our efforts in ares where willing seller situations were thought to exist. We anticipate that at the current rate it will take 30 years to secure and develop the access needs identified in our forest plan. We also anticipate that the need for eminent domain or condemnation action will likely increase in the future.

In addition to pursuing the access needs identified in our forest plan, we are taking aggressive action to resolve the challenges on our internal trail system. In cooperation with the United States Attorney, we have prepared a test case and will be pursuing a "quiet-title" action based upon the theory of prescriptive use. We are hopeful that this case will resolve the trail status issue not only on the Gallatin, but for every National Forest facing the situation.

Keystone Access Recommendations

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These recommendations on access are the result of a year-long consensus-building effort conducted by The Keystone Center, an organization devoted to the resolution of controversial public policy issues. It involved people from federal and state land management agencies, county government, Congress, private landowner groups, environmental organizations and outdoor recreation groups. The goal was to develop recommendations on how to obtain and manage public access across private land to federal land—particularly to land managed by the Forest Service and Bureau of Land Management (BLM). The effort was characterized by a frank, good faith exchange of ideas between representatives with extremely diverse perspectives. It resulted in the generation of creative, consensus results.

The participants believe that increased public access to federal lands can be achieved without requiring major new studies or programs and their attendant costs. Rather, there needs to be:

1. Strong policy direction for action by federal, state, and local public leaders;
2. Partnerships involving leaders of land user and landowner organizations and those managing public access corridors at the local, state, and national level;
3. Timely, forthright and innovative development and implementation of plans to obtain access by field managers in close cooperation with local government, private landowners and public land users; and
4. A coordinated incorporation of public access needs into the land use planning processes of federal, state and county land management officials. Specific issues and proposed recommendations follow.

Data Collection

Issue. Data about access is currently often unavailable, inadequate and inconsistent between agencies.

Recommendation. Data should be collected and aggregated in a way that better illustrates the public access picture. Data is needed on the amount of public access currently available, how much more is needed, the acreage closed due to lack of public access, and the estimated cost of acquiring the needed access. The data should be comparable between land management agencies and it should be updated on a regular basis.

Planning

Issue. Access tends to be dealt with too generally at the land management planning level and too narrowly and too late during the access acquisition phase.

Recommendation. planning for public access must occur both at the decision-making level and at the access-acquisition level, effectively linking the two with the timely and appropriate involvement of public agencies, local government, land users and private landowners. Public access planning should examine the full range of resource needs, costs, impacts and types of access needed in relationship to management goals.

Obtaining Access—Approaches

Issue. The approaches currently available to the land manager have several drawbacks and do not offer enough variety and flexibility for all access acquisition situations.

Recommendation. A full array of tools, both existing and evolving, should be considered when investigating public access options and acquisitions. The need for access may be temporary or permanent, depending on the proposed use and management goals.

Appraisal and Negotiation

Issue. Current approval and negotiation processes are not flexible enough to enable land managers to settle many access acquisition cases.

Recommendation. Appraisals and negotiations should be made as flexible as possible.

Management of the Impacts of Access

Issue. The key to the resolution of many access controversies is mitigating or eliminating adverse access impacts on private landowners. Landowners will generally continue to resist providing access across their land until they have confidence that potential adverse impacts will be avoided or promptly mitigated.

Recommendation. Mitigation of anticipated adverse impacts should be vigorously pursued as a critical first step to reducing access conflicts. Impact mitigation should be an integral component in developing future public access acquisition plans. Consideration also should be given to the impacts which may result if access is not provided.

Enforcement

Issue. There will always be a relatively small segment of the public whose actions and abuses can only be controlled by vigorous enforcement efforts.

Recommendation. Enforcement of trespass laws and regulations should be vigorously pursued by land managers and public access advocates, and should entail the provision of adequate resources. When existing access to public lands is suddenly cut off—the "locked gate" confrontation—the public land manger should act promptly—in cooperation with users, local government, and land owners—to effect a positive resolution of the situation.

Liability

Issue. There is a sense that liability insurance for private landowners may increase as a result of an access corridor across their private property.

Recommendation. States should review and consider modifying their liability statutes. They also should consider establishment of insurance pools. Federal and state agencies should explore legislative and regulatory opportunities to minimize liability concerns by landowners who provide access.

Revenues

Issue. There is a need to develop revenue sources to pay for obtaining access.

Recommendation. Revenue needs should be analyzed and incorporated into access planning. Existing revenue sources should be bolstered by seeking new or increased revenue for enforcement, maintenance, and mitigation of impacts of access, as well as to acquire new access.

Information

Issue. Adequate information about access opportunities and restrictions is not currently available.

Recommendation. Consistent information about public access opportunities and restrictions should be developed and disseminated between agencies. Information clearinghouses at national, regional, and/or state levels should be promoted and supported as a means for receiving and disseminating information about public access issues.

Ethics and Education

Issue. Uninformed public land users often unwittingly abuse resources, both private and public.

Recommendation. Existing educational initiatives should be enhanced and new programs developed to promote a responsible land ethic and to encourage respect and care for natural resources and private property.

Continuation of the Dialogue Process

Issue. The dialogue between agencies and interest groups which was begun during the Keystone process should be continued.

Recommendation. Task forces at the national, regional and/or state level should be established to oversee the development, integration and continued implementation of these and future public land access policy recommendations.

Access to Public Land: The Keystone Dialogue Project

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Access to public lands is an emerging critical issue in the western United States. More than 50 percent of the land in the western states is owned by federal and state governments; however, in most areas access to those lands is either nonexistent or limited. A surge in demand for public land access by a variety of users is rapidly turning the issue into one of the most complex and controversial public policy conflicts in the West. Entangled in the controversy are local, state, and federal agencies, private landowners, recreationists, environmentalists, ranchers, miners, the oil and gas industry, public utilities and the timber industry.

The Bureau of Land Management (BLM) estimates that 25 million of its acres, including 60 percent of the 8 million acres it administers in Montana, lack public access. The Forest Service estimates that about 10 percent of National Forest land is without access nationwide, with two states containing up to 20 percent without access. Controversy over access has heated up recently both because of increases in demand and problems with availability. This is exacerbated by the trend toward closure of previously open private lands (e.g., for fee hunting and gamefarms), which is shifting more recreational use to the public lands. Demand for access by public agencies for management purposes has also grown sharply with the enactment of statutes requiring more attention to planning and monitoring. Commodity users (e.g., miners, oil and gas producers, and the timber industry) continually need access to new areas for exploration and development of natural resources.

The availability of access in many areas has decreased recently because private landowners, who in the West have often traditionally allowed public access across their lands, are increasingly unwilling to do so. They are facing problems with liability and, as demand has grown, more vandalism and litter. The availability of access has also been affected negatively by fiscal constraints common to many western communities whose road budgets are being strained. Many local roads that previously provided access to public lands are now closed or going unmaintained. Finally, access acquisition proposals are increasingly under scrutiny because of their potential negative environmental impacts.

The interest groups involved in the access controversy have vastly different perspectives on the issues. Due to dramatic increases in a wide variety of kinds of recreational use of public land, recreationists are demanding access into areas now closed, more access into areas where access is now difficult, improvements on existing routes, as well as better signing and maps. Environmentalists' concerns about access to public land focuses on protection of amenity and ecological values: on how access corridors will impact wildlife, soils, water and scenic quality. While in many cases they favor more access, they often differ sharply with other groups on the type of access to be provided (e.g., supporting a a trail but opposing a road) and on where access is appropriate. Ranchers who have public land grazing allotments need access in order to move and manage their livestock. However, because of problems with opened gates, harassment of animals and damage to forage, they need restrictions on access for others.

Among the access difficulties facing the timber industry are opposition from environmentalists to development of roads for timber harvesting on public land, reductions in Forest Service road budgets, and the closure of county roads, which are the primary interface with the Forest Service transportation network.

One of the basic rights of property ownership is the ability to exclude others. Property owners who acquire land with that expectation often bitterly oppose attempts by government or interest groups to develop access across their private land. Liability, vandalism, litter, noise and intrusions on privacy are significant and widely shared concerns.

The emerging problem begged for some action and potential solutions, but with so many interests involved, a single entity would certainly have difficulty putting an agreed upon solution together. The Forest Service and BLM began to look for some forum to bring the matter to the table for all interests to investigate. Discussions were held with third parties, including the Keystone Center in Colorado, that had considerable experience in resolving problems requiring consensus among varying interests.

Keystone Center Staff began to make inquiries of federal agency personnel and groups interested in the access problem on ways and means of opening discussions on the problem. In 1988 the center submitted a formal proposal to the Forest Service and BLM. The proposal was accepted and financed by the two agencies.

The center formed a steering committee of key agency and interested people to help guide proposals. As a result of this effort, three suggested major topics of discussion were developed, and interested agency, state, county, industry, congressional, private and environmental groups were identified. Each of these were invited to participate. Nearly every entity accepted the invitation. more than 40 participants from this broad variety of interests gathered at the Keystone Center in Colorado early in 1988 for dialogue that was to last for nearly a year.

The first order of business for the group was to consider and agree on main topic areas. The final topics were: (1) obtaining access, (2) appraisal and vegetation problems, and (3) management of the impacts of access. The group was then divided into three groups to begin identifying problems and potential solutions in these three broad areas and any ancillary and associated elements. Throughout the ensuing year, in three general meetings and several individual group meetings, the participants would consider their subject matter, present results in plenary sessions, gain ideas from other participants and outside interests between sessions, and review draft material developed by the facilitators at the Keystone Center. The end result is a final consensus report identifying numerous facets of the access problem and making a number of recommendations. The final report was completed March 7, 1989.

The Political and Institutional Impediments to Obtaining Access to Public Lands[1]

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Introduction

Obtaining public access to public lands is an issue of growing concern to sportsmen, recreationists, and others who enjoy the nation's public resources. A Congressional Research Service Report (Backiel and Baldwin 1986) aptly described the issue:

> *When federal land is surrounded, or intermingled with, private lands, access to these federal lands is often possible only by crossing the private land. In certain situations, access across private lands is denied, which can affect the public's use and federal management of these public lands.*

This issue is not new. The problem of obtaining access to public lands has surfaced in most major studies of public land management needs. (USDA Economic Research Service 1968, Public Land Law Review Commission 1968, Report of the President's Commission on American Outdoors 1986). However, a number of factors have served as impediments to resolving access problems.

The Nature of Public Access Problems

The federal government manages one-third of the nation's land base in the U.S. with the USDA Forest Service, the Bureau of Land Management (BLM) and the National Park Service in the Department of the Interior managing the majority of these lands. Increased public pressure for use of these land, particularly for recreational purposes, has occurred.

Americans place a high value on recreation and the outdoors. The most recent National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 1987) revealed that in 1985, a record 141 million Americans, age 16 and over, participated in wildlife-associated recreation and spent $55 billion in pursuing these activities. Not only are more and more Americans participating in outdoor recreation, but they are turning to public lands to satisfy their recreational

[1]The views expressed are those of the authors and are not intended to represent the official views of the U.S. Forest Service or the House Committee on Agriculture.

demand. For example, in 1986, national forests, which account for 191 million acres of public land, provided 226.5 million visitor days of recreational use.

There is little doubt that access to public lands is an issue in the western United States. More than 50 percent of the land in the western states is managed by federal and state governments. In many areas of the West access to these lands is either nonexistent or limited. For example, in Montana the Forest Service (1986) estimates that 15 percent of the land it manages has no public access. The BLM, in a *Wall Street Journal* (Slocum 1986) article, stated that the public lacks access to at least 60 percent of the 8 million acres it manages in Montana. A memorandum from the BLM state Director of Colorado (1985) characterizes the situation in Colorado as follows, ". . . [S]tatistical data . . . revealed that approximately 61 percent of the 8.2 million surface acres that BLM manages in Colorado does not possess legal access. In addition, much of the access that has been obtained in the past does not afford public access."

Obtaining access to public lands is a growing concern of western state residents. Preserving access to public lands for recreation use was rated by over 85 percent of the respondents to the 1986 Governor's Task Force on Idahoans Outdoors opinion survey as being an outdoor recreation issue of great importance (Idaho Department of Parks and Recreation 1976). Only one of the other 11 issues rated received a higher percentage and that was "maintaining existing outdoor lands and facilities for recreation." In Montana, a Forest Service (1986) task force report on access stated, "During the past year an emerging issue has solidified the public statewide, identifying access to public lands as one of their highest concerns. This concern has surfaced in many forms. At recent Governor's meetings with the public, both roads and trail access to public lands surfaced as a key issue. In addition, sportsmen's groups statewide have put forth resolutions that attest to the level of interest and resolve." Former Montana Governor Ted Schwinden, after returning from a Colorado conference on access, predicted that once a Montana wilderness bill passes Congress, the lands access question would move to the top of the list of the state's outdoor issues (Missoulian 1988). The access problem is particularly critical in the western states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah Washington, and Wyoming. However, the issue is not limited to the West. The Forest Service (1988) estimates that nearly 10 percent of the national forest acres in the Southern Region and 3 percent in the Eastern Region are without public access.

Impediments to Resolving Public Access Problems

A number of impediments exist to resolving problems associated with obtaining access to public lands. For the sake of discussion, these problems will be characterized as either institutional (i.e., associated with long-established practices or principles) or political.

Institutional Impediments

Land ownership patterns. As anyone who is familiar with the history of the settlement of the West knows, the long-standing goal of government policy was to promote western expansion and settlement through the transfer of public lands into private hands. During the nineteenth century, a number of laws were enacted with the intent of providing "incentives" for moving to the frontier and helping to tame the West.

For example, the Homestead Act of 1862 granted 160 acres to every other settler who, through certain required activities, demonstrated his or her intent to establish a home on the frontier. Similarly, but on a larger scale, the railroad land grants authorized the establishment of corridors through western public lands and the transfer to railroad ownership of alternating sections of public lands adjacent to the corridors. These grants were responsible for the transfer of more than 150 million acres of federal lands to private ownership, resulting in the checkerboard pattern of alternating public and private lands that characterizes many parts of the West.

These laws, and the policies which underlie them, did help to achieve their primary aim—to accelerate habitation of the West. However, these policies are also largely responsible for the "crazyquilt" of land ownership in the West and the complex private/public land management problems, such as obtaining access, that have resulted.

Private property rights versus the public trust. One element of the dilemma associated with resolving public access problems is the increasing conflict between the priority placed on protecting private property rights as a tenet of American philosophy and law and the "public trust" doctrine.

The "public trust" doctrine, the doctrine that the public possesses certain rights associated with natural resources has its origins in the writings of Justinian in Roman Law (Lazarous 1986). The public trust doctrine historically concerned public rights in navigable waters and their submerged beds but new case law has seen trust interests extended to include recreation.

A doctrine of equal importance and focus in the access debate is the doctrine of private property rights. At issue is the question, "Does an individual owning property have the right to prevent public access to public land that has been deemed suitable for specified public use?" Of course, the other side of this issue is, "Are private property rights threatened when actions are taken for the purpose of protecting the public trust?"

Joseph Sax (1970) in his assessment of the public trust doctrine states "Three types of restrictions on governmental authority are often thought to be imposed by the public trust: first, the property subject to the trust must not only be used for a public purpose, but it must be held available for use by the general public; second, the property may not be sold, even for a fair cash equivalent, and third, the property must be maintained for particular types of uses." Lazarous (1986) in his review of public trust litigation since Sax's article points out an emerging complication of the issue faced by governmental authorities. He states ". . . public access undoubtedly the single most important trust guarantee is often at odds with modern environmental conservation and protection laws. Increasingly, those laws must restrict access to protect resources."

Agency personnel have numerous tools at their disposal to attempt to resolve public access problems. One of these tools is condemnation. However, concern for protection of private rights, reinforced in recent years by a conservative administration, has led to hesitancy on the part of agency personnel to use condemnation to protect the public trust.

The nature and extent of access problems are poorly documented. While increasingly recognized as an important public land management concern, the true nature and extent of the access problem has never been documented. For example, the number of acres of public lands which are not accessible, the kinds of access restrictions that exist and the activities that are limited as a result, have not been documented by the federal land management agencies affected. Only limited efforts have been initiated to correct this deficiency.

This failure to document access needs is in part due to the fact that access was not a problem for the most part, in the past. Public land managers could reasonably assume that past access routes would be preserved and that a "gentleman's agreement" between public and private parties would protect the interests of both. However, increased public demand for access to public resources; landowner concern for liability, vandalism, and litter; rapid changes in land ownership and the subdividision of large private land holdings have created a need to inventory existing access routes, to formalize current agreements and to seek new means of access where it is not longer available.

In a memo dated April 14, 1987, from the BLM Boise District Manager to the Department of Interior, the manager states, "Attached is our response to your request for identifying existing and potential public access problems within the Boise District. Be advised that the list represents only the tip of the iceberg. We have undoubtedly missed some existing problems and the potential problems are very large. Much of the road access to public lands in the district, currently crosses private lands. Legal access has in most cases not been acquired. These areas remain open to hunters and fisherman only due to the permissiveness of the current land owner. With increasing pressure of public use of recreational resources, I anticipate more and more access routes will be closed in the years ahead."

The access issue is not static. Its rapidly evolving nature requires that current access across private lands be documented so that changes in land ownership patterns, landowner attitudes, and budgets that may affect access can be documented.

Federal agencies have limited resources to attempt to resolve access problems. The BLM, Forest Service, and National Park Service have suffered from limited funds and manpower to resolve access problems. These limitations have grown more severe in recent years as priority shifted from land acquisition (as one tool of resolving access problems) to stewardship of lands already in federal ownership.

Manpower limitations have a disproportionate effect on an agency's ability to resolve access problems because of their highly localized and specific nature. Resolution of access problems requires a knowledge of the specific circumstances of the problem, an ability to communicate directly with the affected parties, and, when acquisition or condemnation is used to resolve the difficulty, manpower investments in surveys, land value appraisals and negotiations. The personal nature of these issues, and the large investment of time required by agency personnel to deal with them, constraints the number of cases that can be addressed.

Limited financial resources, needed to acquire partial or fee simple interest in rights of way, are also severely constraining.

In its FY 89 budget justification, the BLM estimated that up to 30 million acres of public land in the 11 western states lack legal access and that over 8,000 easements would be needed to solve the problem. The FY 89 estimate is 5 million acres more than the 25 million acres that the BLM reported in the FY 87 budget justification. Although the BLM data has been reported to Congress for years, the funding requested has never been appropriated.

The Forest Service, in its budget justifications, has never provided the Congress with even as much information as the BLM. This summer, however, the Forest Service completed a state-by-state, forest-by-forest analysis that provides an estimate of acres without access, rights-of-way needed, miles of roads or trails needed and the amount of dollars needed to provide access. The estimate of funds needed to provide access, based on completed or draft national forest plans, was $164 million dollars.

Unfortunately, the limited financial resources of BLM and the Forest Service requires that they seek to negotiate other than non-monetary agreements to resolve access needs—a solution that flies in the face of manpower shortages.

Political Concerns

While certain institutional impediments have limited the ability of federal agencies to deal with access problems, other impediments of a political nature also exist.

Access problems are not perceived to be significant national concerns. For a number of reasons, obtaining access to public lands has not been perceived as a national concern. In part, this is the result of the failure of the affected agencies to assess the nature and extent of existing access problems and communicate these concerns to the Congress. But other reasons have contributed to the failure to make this a priority federal issue.

First, with some notable exceptions, this issue has failed to generate significant local concern beyond those interest groups that may have been affected. In the states of Montana and Idaho, local conservation organizations, sportsman's groups and outdoor clubs have united to publicize this issue. In Montana, for example, organizations like Public Land Access, Inc. and Sportsmen Access Association have become active in the last three years in attempting to resolve and publicize access issues.

Second, in part as a result of the lack of grassroots focus on access concerns, national conservation and sporting organizations have failed to make "obtaining public access" one of their priority items. Since these organizations help to influence Congressional agendas and aid in setting national conservation priorities, their failure to focus on access as an issue has limited the liklihood that either the federal agencies or the Congress will attempt to address this matter.

Finally, given the disproportionately fewer number of Members of Congress who represent rural states in comparison to representatives from more populated regions, it becomes increasingly difficult to focus Congressional attention on matters that may be characterized as "affecting only a few members." While some members of the Congressional delegations of the western states are aware of public land access problems, lack of strong constituent concern reinforced by the support of national conservation organizations limits the liklihood that western members will elevate public land access to national prominence.

The strength of concern for private property rights. Many western legislators have strongly held beliefs regarding the importance of protecting private property rights. This attitude was perhaps best reflected in the evolution of the "Sagebrush Rebellion," which emphasized states' rights over federal and private property rights over public concerns and originated, as a concept, in the West.

Given this orientation toward the protection of individual property rights, which is reinforced by the organizations that represent many western state landowners, problems associated with public land access may be viewed in a different light by westerners than by legislator from other parts of the nation.

Reluctance to interfere in the concerns of another member's district or state. It is a matter of principle in the Congress that Members seek to avoid "interferring" in the affairs of another Member's state or district. This attitude is both a result of the belief that the individual who represents a given area should "know what is best" for his or her own constituents and recognition of the fact that Members would prefer not to have others interfering in matters in their own district.

Since public land access concerns, for the most part, affect western states, other Members might be hesitant to intercede to deal with this issue. For this reason, unless or until public access becomes a national concern, the public land access issue must largely originate from individuals within the affected states.

Possible Remedies to Public Access Concerns

The institutional and political impediments cited above reflect only some of the obstacles to dealing with public land access concerns on a national scale. In fact, it may not be appropriate or necessary to deal with this issue at the federal level. This, clearly, is a decision for others to make.

However, should federal actions be deemed appropriate for addressing access problems, then certain actions must be taken as antecedents to dealing with these concerns.

The nature and scope of public access "problems" must be determined. While the BLM and Forest Service have taken steps in this regard, other actions are needed. Specifically, an inventory of existing access (e.g., rights of way) as well as public access needs must be conducted that includes an assessment of the acres affected, the types of access required and options available, and the costs associated with acquiring access. Preferably, this assessment should be tied to the ongoing land management planning efforts of both agencies, and should include some judgments regarding the relative priority of each access problem. Based on this assessment, the extent of the problem, nationwide can be judged and appropriate solutions formulated.

Next, the agencies need to assess the tools at their disposal to resolve access problems to determine if administrative remedies are adequate or if new legislative authorities and funding are needed.

The Congressional Research Service (Baldwin 1986) completed a legal analysis of the access issue which found "current authority exists, at common law and by statute for the federal government to abate such actions on adjoining private lands, but this authority does not provide adequate redress in all instances." It is here that Congressional involvement could be helpful.

One area in which remedial action may be required is in improving the land exchange and acquisition authorities of the BLM and Forest Service. While some improvements were made last year in enacting the Federal land Exchange Facilitation Act (P.L. 100-409), still others are needed. Specifically, the Forest Service and the BLM conduct their land management activities under a wide range of legal authorities. The Forest Service, in particular, cites some 80 laws as the basis for their land exchange and acquisition activities. Review of these authorities and consolidation in the form of one comprehensive and updated statute may be in order.

Finally, once the nature and extent of the access problem has been documented, and the limits of existing remedies determined, then the Forest Service and the BLM, as well as local and national conservation groups (and other affected interests), need to bring their concerns to the Congress. To date, neither the agencies nor the interest groups have given this issue the attention it seems to warrant.

One word of caution, however. Public land access issues, given their relationship to private property rights, can quickly ignite controversy and result in confrontation. Clearly, the rights of the public and the private land owner must be respected in any discussion of access issues. Unless this occurs, suspicion on the part of both parties will hinder the development of effective solutions.

If sufficient public focus is placed on access concerns, and an effective dialogue can be initiated, then agencies and/or legislators are likely to respond. However, the significance of the public land access problem must be demonstrated before a federal response is likely.

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Legal Trafficking and Paid Hunting Threaten Conservation

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Introduction

There exists a confusion dangerous to wildlife which equates "public ownership" with "the tragedy of the commons." This confusion is perpetuated by business publications such as *The Globe and Mail* of Toronto (i.e., Roseborough 1986), or *The Economist* (Oct. 22, 1988 p. 21, a British journal) in an unsigned article entitled "privatising America's West. Profits from the wild." This confusion, buttressed by inadequate research, leads to the conclusion that public wildlife cannot be managed "well." Consequently, it should be turned over to private ownership, to ranchers, forest companies, mining companies—corporate owners leasing land for management and profit. Few confusions could be more damaging to wildlife, here or abroad.

The Economist ignored the great achievements of North American wildlife conservation compared to that of Europe. It failed to point out the ramifications of markets in dead wildlife in protecting or policing the resource. It failed to point out the many damaging consequences of private control of wildlife (that is, paid hunting) to conservation or to civic liberties. It apparently never realized that on private land dedicated to a market economy, management will reflect markets, not ecology. It failed to point out that the economics of wildlife as practiced in North America, contrary to Europe, have given rise to a huge, job intensive service industry of the order of $60 billion annually, making publicly managed wildlife a great creator of wealth. It assumed that, today, wildlife in North America is treated as a "commons." It is not. Nor has wildlife been treated here as a "commons" for over 70 years. *The Economist* is oblivious of the fact that, some 80 years ago wildlife was indeed treated as a "commons" in North America, and that it led to the expected tragic results, but also to the rise of an effective system of nature and wildlife conservation which today serves as a model even to Europeans. Above all, *The Economist* failed to comprehend that the primary objective of a system of wildlife conservation is to conserve wildlife, not to make money.

The allure of wildlife is so great that throughout western history the powerful have repeatedly abrogated wildlife from public to private use (*see* Geist 1988). Current attempts in North America to again exert private control over wildlife may be the beginning of that historically common expropriation.

The Tragedy of the Commons Misused

When Garret Hardin (1968) published the "Tragedy of the Commons," followed a year later by Beryl Crowe's (1969) response "The Tragedy of the Commons Revisited," they popularized a notion that deserves critical attention. It is the notion of *uncontrolled* access to a public good. Hardin used a system of pasturing in Great Britain to illustrate the point. He referred to a piece of ground, the commons, to which villagers had access to graze their stock. This was the last vestige of land not claimed by the feudal system in personal ownership by the king to be given to his vassals in return for loyalty and service. Crowe states that the commons was an expression of British common law predating the Roman conquest (54 BC). However, the Anglo-Saxons conquering Britain (sixth century AD) had similar laws that allowed "freeman" access to land not held in private ownership. It is this free, uncontrolled access to public land and its resources the feudal system all but abolished, beginning with the Frankish kings (seventh century AD) on the continent (Plochmann 1979), to be fully extended to Britain by the Norman conquerors after 1066 AD (Lund 1980).

The essence of the tragedy of the commons is that each herder perceives that adding one more cow gives him a benefit of 1, and distributes the cost among all herders (*n*), so that the cost to each is only $1/n$. His gain is much greater than his neighbor's loss. Since each economically rational herder thinks so, adding another cow, and another, etc. the commons becomes overgrazed and, predictably, all lose out. Adam Smith's "unseen hand" and laissez-faire lead not to an increase in the public good, but to very public disasters. The essence of the commons is not public ownership, but the *absence of controls over exploitation*, an absence of responsibility for care, planning and restitution.

The "tragedy of the commons" was acted out on North America's wildlife remorsely in the nineteenth century. Species once abundant were exterminated or reduced to tiny remnants. This is recorded in some detail in Hornaday (1913), Hewitt (1921), Mathissen (1959), Hampton (1971), Lund (1980) and others, such as the reports of the Canadian Commission on Conservation from 1910–1919. These sources contain vital historic information. The "commons" was a consequence of more than public ownership. It was maintained by a conviction in the superabundance of nature and by an abhorrence for controls over private initiative, thus giving free reign to "laissez-faire" (Smith and Witty 1970, 1972). Wildlife destruction was also a deliberate military policy to undercut the resistance of the Plains Indians, as it proved impossible to subdue them in battle (Ambrose 1975).

It is in response to the destruction of wildlife by unfettered exploitation, a true "tragedy of the commons," that North America's system of wildlife management took its shape. In an epic battle stretching over 60 years, a small North American elite placed effective controls over the exploitation of public resources, terminating the commons and reversing the tragedy. It became the most successful system of wildlife and nature conservation ever to arise. A phoenix did rise from the ashes of America's dead wildlife.

It is instructive to reflect on the final decades of the nineteenth century. Wildlife was food and clothing for natives, trappers, settlers, explorers, army and police units and labor gangs building railways, operating mines and herding cattle. As the railways linked the resources of the west with the markets of the east, an unparalleled destruction befell wildlife as market hunters, mostly whites, but also natives, killed wildlife for its meat, hides, furs and feathers. Pigs were driven into nesting colonies of pigeons and waterfowl to fatten on young and eggs. Punt gunners and netters collected in masses waterfowl, shorebirds and songbirds. Americans were connoisseurs whose "jaded palates" demanded for "conspicuous consumption" nearly everything that walked, crawled or flew (see restaurant menus, Ranhofer 1893). Living birds replaced clay pigeons in sporting shoots in the east, while in the west the destruction of wildlife, buffalo in particular, was a military objective to solve the ''Indian problem'' (Abrose 1975). Wildlife could not last, and it didn't.

There were many efforts to save wildlife in its blackest hour. The despair can be illustrated by the fact that the United States Cavalry became the protector of wildlife in national parks (Hampton 1971). The army, once orchestrating wildlife destruction to subdue Indians, made an about face and became a protector of wildlife. On the 17th of August 1886, Captain Moses Harris rode into Mammoth Hotspring of Yellowstone National Park at the head of troop M, 1st U.S. Cavalry; on the 20th he relieved superintendent D. W. Wear of his duties. The 20th of August 1886 was the first day of modern wildlife management in North America.

Not that there were not earlier efforts at control and protection. What distinguishes the army as a manager of wildlife are the decisions of the first three captains, the ''austere, correct, unyielding'' Moses Harris, the indomitable F.A. Boutell and the able George S. Anderson, to protect what was left of Yellowstone's great natural wonders. Their decisions, closely watched and defended by a U.S. congressman named Theodore Roosevelt, foreshadowed what was to become policy in the management of public resources continent-wide some 30–40 years later. Whatever the contributions of others, the publicly owned national parks were the testing ground for practices for preservation and controlled development, that is, *conservation* as perceived by the future Commissions on Conservation (Smith and Witty 1970). Without the decision to place under military control a fledgling system of national parks, this great contribution of North America to occidental culture might not have survived infancy (Hampton 1971).

Six giants of North American natural resource conservation stand out. These were, in the U.S., President Theodore Roosevelt, his capable and farsighted chief forester Gifford Pinchot and the popularizer of wildlife's plight, the acidulous William T. Hornaday. In Canada it was Prime Minister Sir Winfrid Laurier, his chairman of the Commission on Conservation, the remarkable Clifford Sifton, and C. Gordon Hewitt who wrote *The Conservation of Wild Life of Canada*. These men made possible the fruition of the aspirations of those who recognized only too clearly the need for an end to the commons. Commissions on conservation worked in close cooperation on both side of the border, so that Canada and the United States emerged with all but identical policies to conserve wildlife. On the shoulders of the six giants came to stand the work of the great Aldo Leopold (1933). To claim that today North America's wildlife is subject to the tragedy of the commons as *The Economist* states, is a misuse of that concept.

A Brief Historic Perspective on North American Conservation

As discussed in detail in Geist (1988), North America's wildlife conservation is based on four *primary policies*: These are: (1) the *public ownership* of wildlife *de jure* and (usually) *de facto*. (2) The *elimination* of markets in the meat, parts and products of game animals, shore and song birds, that is, of *vulnerable* wildlife, while retaining markets in furs of the less vulnerable furbearers. History had demonstrated how quickly a price on dead large mammals, waterfowl, pigeons, shorebirds and songbirds could decimate stocks of these animals, while viable populations of furbearers could be retained. (3) The allocation of the material benefits of wildlife *by law*, not by the marketplace, birthright, land ownership or social position. This policy makes every citizen a *de jure* "shareholder" in wildlife and a *de facto* shareholder in most jurisdictions. It generates a sense of proprietorship in those that regularly avail themselves of *their* allocation of wildlife. (4) The prohibition on *frivolous* killing of wildlife. It prohibits the waste of wildlife once such is killed; recognizes subsistence hunting as a priority and permits the destruction of noxious wildlife. On sport or trophy hunting, both unpopular with the American public (MacDonald 1987), this policy is ambiguous.

This fourth policy is eroded by the notions of hunting as "sport" or "fun," and of wildlife as a "recreational" resource. Hunting has therefore been attacked as a frivolous blood-sport, as unworthy, needless, cruel destruction, and as a degradation of those who hunt (Amory 1974). Current public views do not support killing wildlife for sport, much encouraged by the article in The *Economist*, but do support such killing for food (MacDonald 1987).

In practice these policies insure that the killing of wildlife is economically a liability. Not only is it costly to legally kill wildlife, but it must not be abandoned under penalty of law. To hunt requires unrecoverable investment in equipment, effort and time, which has deterrent value—but, and this is in need of attention, which generates demand for services and goods by over 150 million wildlife users!

From the outset legislatures granted some exceptions to these basic policies. Texas gave *de facto* control over wildlife to landowners with a trespass act, allowing allocation of wildlife by the pocketbook, thereby denying many *de jure* shareholders in wildlife access to their resource. In the North West Territories of Canada, the sale of wildlife meat remained legal. There are exceptions in other provinces and states.

Achievements of North American Conservation

The four primary policies and public ownership of wildlife, brought about not only the return of wildlife, but created the most successful, economically most productive system of wildlife conservation. These achievements as detailed by Geist (1988) are: (1) The recovery of wildlife that had been decimated. (2) The development of a large, labor intensive service and manufacturing industry that sprouted about living wildlife. In 1985 some $55.5 billion were spent in the United States by the public on hunting, fishing and wildlife viewing (about $15,200.00 per square mile of the United States). (3) The development of the profession of wildlife management. (4) Public involvement with wildlife through a large number of conservation societies. (5) Americans taxed themselves on behalf of wildlife (Pitman-Robertson, Dingell-Johnson and Fish and Wildlife Conservation Acts of 1980, Drabelle 1985*b*). (6) North Americans created an extensive system of protected areas for wildlife such as national parks (Hampton 1971), wildlife refuges (Drabelle 1985*a*), ecological reserves and made wildlife an object of management on public lands. (7) North Americans negotiated international treaties to protect wildlife, beginning with the 1911 Fur Seal Treaty, and the better known Convention for the Protection of Migratory Birds (1916) between Great Britain and the United States (Hewitt 1921, Chandler 1985). (8) North Americans preserved viable populations of large predators.

(9) North Americans developed an inexpensive, civil and fairly effective system of wildlife protection that allowed wildlife to recover, despite much opportunity for illegal killing, and ready access by the public to firearms.

While the results of the North American system of wildlife conservation are outstanding compared to management of private wildlife in Europe, or in Texas, political accountability and the commensuration of differing convictions make it a difficult system to professional wildlife managers. Managers of private wildlife in Europe and elsewhere, not accountable to the public, tend escape all this.

Dangers to Wildlife Conservation

North American wildlife conservation is now endangered: special interest groups have begun distorting legislation in Canada to allow trafficking in dead wildlife. They aim to create a venison market in North America and take advantage of a fraction of the public disaffected with western medicine, to which wildlife parts may be sold as folk medicine. They aim to raise wildlife in agricultural fashion and to sell it in retail outlets. Oriental markets currently pay well for the velvet antlers, tails, and sex organs of deer, and the gall bladders, paws, claws, teeth and milk of bears. I have dealt with this in detail in Geist (1988).

Legal trafficking in wildlife removes the most important protection from wildlife, *the absence of a market*. Criminals already take advantage of the trade in wildlife parts. Difficult as it is now to apprehend wildlife law violators, with a multiplicity of retail outlets and facilities to launder illegal wildlife, the situation becomes hopeless. A study by Boxall and Smith (1987) shows that only about 1 percent of wildlife violations are reported; only one in five are successfully prosecuted. With illegal kills of the same order as legal kills (Spalding 1987, Boxall and Smith 1987), any encouragement to kill wildlife illegally for profit would undermine all efforts to save common, let alone rare species. Investigative reporting uncovered a growing black market in "wildlife medicine" in North America (Cowan 1987).

Furthermore, game ranching for paid hunting or wildlife parts threatens genetic pollution of America's wildlife, as has happened in Europe (Harrington 1973, Lowe and Gardiner 1975, Bartos et al. 1981). White-tailed deer in the southern U.S. have been crossbred with northern forms in the mistaken belief of producing larger antlers (Geist 1985*b*). Game ranching cannot compete except by husbanding and cross breeding native species with exotics.

North American large mammals today, due to megafaunal extinctions, are either derived from Siberian immigrants (not resistant to competition or the diseases of Eurasian counterparts), or they are derived from old, indigenous primitive American forms that are expert at scramble, not contest completion. This is, they have not been able to compete against Eurasian forms (Geist 1985*b*, 1988). Parasitologists warn of disease and parasite introductions (Holmes 1982, Samuel 1987). *Asiatic sheep and goats on western ranches for "trophy hunting" is a time bomb that will destroy bighorn sheep*. That exotics can be permanently kept behind fences is not born out by experience here or abroad (Massey 1986*b*, Rennie 1986). The current legislation to allow "game ranching" in Saskatchewan, British Columbia and Alberta is not merely a cavalier treatment of conservation, it is a breach of the "Guidelines for Wildlife Policy in Canada," as well as the "World Conservation Strategy."

Game ranching brings not only predator eradication, genetic pollution and the introduction of foreign diseases (Pruitt 1985, Klein 1980, Geist 1988). Its proponents also foresee the conversion of public land into large game or "trophy ranches," where deer, bred for antler production, are sold to trophy hunters as happened in New Zealand (Massey 1986*a*), and as a means of *de facto* eliminating native hunting rights (Kahdren 1983).

Conservation is threatened by attempt to hand wildlife over to private exploitation, to raise it for trophy or sport hunting (White 1987, Roseborough 1986). This development, paid hunting, *The Economist* lauds greatly. The famous German system of wildlife management is *de facto* game ranching of this type. It is production oriented to favored species, with extermination of large predators, artificial feeding, agricultural type habitat manipulations, introductions of non-native species and strains, and genetic manipulation of wildlife (Beninde 1937, Draskovich 1951, Stahl 1979, Eggeling 1983). While delivering only fair wildlife production and economic return, the German wildlife management system is a poor *conservation* system, and reflects a history of autocratic rule. It has lost support among the German public (*Der Spiegel* 1983, 37[4]91–100, 37[4]102–105); it is a system struggling to survive (Schroeder 1986).

Not only does paid hunting lead to poor conservation, but it also threatens the very heart of the North American system of wildlife management. Paid hunting must discriminate against the young or newly married or anyone with a modest income. That is, *paid hunting must kill recruitment*. Yet, the essence of the North American system is based on broad public participation in an annual wildlife harvest of the land. Paid hunting appears to me to be an excellent strategy to alienate Americans from hunting.

The claims on behalf of conservation by trophy ranching, or African style game ranching (Dasmann 1964), and various schemes to farm and market dead wildlife are mostly unfounded (Ehrenfeld 1974, 1981, Geist 1985*a*, 1988). One must also point out that wildlife policies have had non-trivial implications for civic liberties (*see* Caughley 1983, Geist 1988).

The elite uses of wildlife for "conspicuous consumption" (Veblen 1899), as a symbol of their social status (Lund 1980). Hunting became a preoccupation which, historically, took on dimensions large enough to bankrupt rulers and generate peasant revolts (Stahl 1979:227). Resentment and envy is then directed against the privileged; wildlife becomes a symbol of detested privilege and power. Some, unhappy with the curtailment of personal freedoms, kill wildlife, less for gain than to spite the privileged. Poaching now, however, has the support of the public, and poachers become folk heroes (Robin Hood syndrome). The elite tends to protect "their" wildlife even with force of arms. This leads to bloodshed (*see* Ausser 1947:67–75). In the long run, an alienated public, unpracticed in regarding wildlife as *theirs* to cherish, use and protect, loses interest (Swenson 1983, Lund 1980), or exterminates wildlife the moment the powers of land and wildlife owners slackens, of which Ausser (1947:58–59), Roedel (1971:64–78), and Stahl (1979:27–30) cited European examples. The brutality with which the mighty have protected "their" wildlife is, historically, startling. This confrontation is not just ancient history; there is evidence that it is beginning to happen in New Zealand (Massey 1986*b*, Rennie 1986) and armed patrolling against "trespassers" is current history in the southern U.S.

Not only wildlife and the public will lose from the current drift of events, encouraged by *The Economist*, so have service and manufacturing industries. Policies giving market value to *living* wildlife generate more income then policies giving economic value to *dead* wildlife, even with a cautious interpretation of German, Canadian and U.S. Figures (Geist 1988). Not economically efficient, but inefficient exploitation must be the goal in conservation: to fish *inefficiently* is to use a dry fly, to fish *efficiently* is to use dynamite.

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Access System for Private Lands in New Mexico

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Introduction

Economic and social values of wildlife vary with time and by species (langenau 1987). Management of wildlife varies as economic recession and prosperity ebb and flow. Langenau (1982) reported that "Economic hardship have resulted in reduced concern with environmental values, thereby permitting another cycle of resource abuse and economic prosperity." He also reported that periods of economic prosperity in the U.S. have been associated with resource abuse, followed by public outrage, environmental legislation, and subsequent recession. (Langenau 1987).

Wildlife agencies can expect and have been receiving political and economic pressure to create legislation to allow payment for wildlife damages, and direct profits from ranching for wildlife programs. Washington State's Wildlife Commission this past year defeated a proposal for increasing landowner incentives. New Mexico State University hosted an international symposium on wildlife ranching, and West Virginia University scheduled a conference on natural resources-based income opportunities for April 1989.

Private Land Allocation System

Aldo Leopold (1930) in his *Report to the Committee on American Wildlife Policy* wrote: "Recognize the landowner as the custodian of public game on all private land, protect him from the irresponsible shooter, and compensate him for putting his land in productive condition. Compensate him either publicly or privately, with either cash, service, or protection, for the use of his land and for his labor, on conditions that he preserves the game seed and otherwise safeguards the public interest. In short, make game management a partnership enterprise to which the landowner, the sportsman, and the public each contributes appropriate services, and from which each derives appropriate rewards."

In New Mexico, a private land allocation system of some kind has been in effect since the 1930s. During the 1930s the New Mexico Department of Game and Fish created a compensatory license for landowners who had elk damage on their property. The system has evolved over the years into a multimillion dollar industry.

Land ownership of New Mexico's 77.8 million acres is intermixed, with 44 percent private, 35 percent federal, 12 percent state and 9 percent Indian lands.

Private holdings constitute the largest category of land ownership in New Mexico. In 15 of the 33 counties, 50 percent or more of the land is privately owned. In those counties, located mainly in northeastern and eastern quadrants of the state, land grants, ranching and homesteading have been the deciding focus in land acquisition. Those areas contain 50 percent of the elk hunting and 90 percent of the pronghorn hunting that occur in New Mexico.

In the private land allocation system (system), the Department determines the number of authorizations, licenses, bag limits, season dates and lengths available in each game management unit (unit). The criteria for establishing numbers of public and private land elk licenses within each unit are herd objectives, estimated elk populations, estimated elk occupied habitat, relative elk densities, past harvest data and estimated population trends. The landowner signs a contract with the Department for a number of authorizations proportional to the amount of his deeded land versus total deeded lands within the unit, and the amount of elk use on that ranch. Pronghorn authorizations are proportional to the amount of deeded versus public or state land within the ranch boundary. Each authorization allows for the purchase of one license from the Department. Licenses are allotted for public lands within the unit and issued through public drawings. Landowners market authorizations through access privileges by direct sales to hunters, or leasing those privileges to guides or outfitters. Accommodations range from full to self-service of any kind. Market value is based on the level of services, amount or type of game and ranch reputation. That range has been reported from $0 to $5,000 depending on the species, reputation, ranch location and recommendations.

The system provides a direct monetary incentive for landowners to propagate, protect and increase wildlife populations on deeded lands. The value of a big game animal is whatever a landowner and a consumer are willing to pay in the marketplace for the harvesting opportunity (White 1987). Some landowners believe that wildlife has not paid its own way. They have not been able to derive incomes from wildlife that were comparable to those derived from livestock, crops, timber and other products (White 1987)

The flow of wildlife both out of and into private land benefits wildlife and society. The critical factor is that appropriate habitats exist for wildlife to overflow into. Case in point: New Mexico's elk and pronghorn populations were restored almost entirely on public and state lands. The results were that wildlife overflowed onto available habitats regardless of ownership.

The system promotes hunting opportunities on private lands that might not be available otherwise. In New Mexico, the system involves approximately 1,250 ranches and 7,600 licenses for elk and pronghorn combined. Although some ranches may hunt less under the system, it is because they are running a "quality trophy" operation that could lead to underutilization of the resource. Those operations are generally surrounded by ranches that use most or all of the authorizations. The threat of underutilization is thus minimized. Public access is granted to license holders without charge through a contract signed between the Department and landowner in exchange for an authorization.

The management of game populations is more intense under this system. The Department directs hunt efforts to specific temporal, spacial as well as sex and age classes. The optimum management of elk and pronghorn by ranch within an area results in a more uniform harvest from the entire population and permits maximum hunter opportunity. That uniform harvest results from all or most ranches being open to hunting.

If private lands are closed to hunting, inappropriate harvests within units could result. A consequence of not reaching or approximating harvest objectives, such as reducing a given herd effectively, can lead to property damage by wildlife.

The system compensates the landowner for damages by wildlife or sportsmen to his property. Landowners see authorizations as a compensatory vehicle for the recovery of losses. Fence damage and forage eaten by wildlife are considered losses by landowner. Authorizations provide a vehicle for recovering those expenses caused by wildlife or related activities without draining the Department's budget.

The system benefits the state and local economy by providing additional jobs and requests for services. Economic development is not the primary responsibility of the Department, but it is a political reality. Benefits to the economy occur as a consequence of actions taken by the State Game Commission from Department recommendations. The Department is committed to hold all the state's wildlife resources and their habitats in trust for the enjoyment, appreciation, economic benefit and scientific instruction of present and future generations.

The system reduced competition in public drawings by 20 percent. In 1987—8,831 elk and pronghorn hunters did not enter the public drawing but were in the allocation system. There were 9,739 elk and pronghorn hunters in the public hunts. The number of applicants for public elk and antelope drawings were 22,776. A potential of 20 percent less applicants were in the public drawing in 1987. The system also reduced trespass by allowing access in exchange for authorizations.

The system maximized license revenue to the state. Approximately 2,800 non-residents were attracted to the state to hunt elk and pronghorn, which resulted in $450,279 in revenue to the Department. In New Mexico, the overall percentage of non-residents hunting and fishing represent approximately 10–12 percent of the user population, but generate 40+ percent of the Department's license sales.

The Department sets hunt strategies, season dates, bag limits, license and authorization numbers for all hunts. Landowners can decide if they want to hunt and how many of their authorizations they want to use. Cooperation by the Department and landowners has led to more game areas open for hunting.

The system does provide various incentives and spin-offs that benefit wildlife. However, there are disadvantages to the system. Most of them are from the sportsmen's perspective. The impression that wildlife is given away by the state and sold by landowners is paramount to sportsmen. The tendency is for sportsmen to harbor resentment toward landowners who profit from marketing access to wildlife resources. Sportsmen resent the Department for apparently not representing them by protecting public ownership of game. The trading, brokering, dealing and speculating in authorizations resulting from the system are also highly resented.

Grazing can be reduced because of monetary incentives; however, most operators can also be expected to continue grazing their lands to capacity, accepting any gains from wildlife as a supplement to their normal operation.

There are no guarantees that landowners won't demand monetary compensation from the state. However, with the passage of time, authorizations tend to become a matter of property rights rather than a cooperative. Additionally, landowners believe that authorization numbers should be adjusted upward regardless of population trends or objectives set by the Department.

Sportsmen believe the system is discriminatory in favor of landowners and non-residents. They believe that landowners and non-residents hunt in the best areas and harvest the biggest trophies. A reasonable number of non-residents is generally accepted, but situations where all or most authorizations are bought by non-residents' causes antagonism toward the system.

The Department maintains the landowner has an assumed risk without claim to depredation. Authorizations are issued for the management of wildlife populations not for compensation. The courts have ruled that wildlife agencies are not liable for damages resulting from wildlife and that landowners have the right to protect their property. What we must do is work cooperatively so that wildlife benefits from our efforts. Authorizations make it convenient for landowners to book clients. The state sets the hunt strategies which best fit the populations. It is that cooperation that has benefited wildlife, landowners and sportsmen alike.

The system does allow the landowner, sportsman and the Department to become cooperators in wildlife management. That cooperation can lead to management of wildlife on private lands and a decrease of livestock on public lands. The objectives of the cooperators should be to raise the maximum amount of wildlife for the enjoyment of all. The land status should not be a hindrance to our goals. If the landowner removes livestock or, at the very lest, tolerates more wildlife on his deeded lands, we have come closer to our goal, ''more wildlife on all lands.''

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Factors Influencing Land Access Selection by Hunters in Alabama

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Introduction

Many Americans identify hunting as one of their most preferred outdoor recreation activities. Between 1955 and 1980 the number of United States hunters increased 42 percent and the number of hunter days increased 129 percent (USDI Fish and Wildlife Service 1982). In addition, it is estimated that 1.5 million acres (0.61 million ha) of wildlife habitat in the United States are lost annually due to urban development projects and changes in agricultural practices (Doig 1986). This increasing demand for hunting areas and decreasing supply of wildlife habitat has contributed to the creation of a market for land leases and fee hunting ares in the United States. That market is clearly differentiated across regions of the nation. Fee hunting systems are most prevalent in areas of the United States will little public land. Wiggers and Rootes (1986) report the southcentral region of the United States to have the most highly developed fee hunting system.

As the market for land leasing and fee hunting in the United States has increased, so has the controversy regarding this topic. "Free versus fee" hunting has been well debated among natural resource professionals (Noonan and Zagata 1982, Swenson 1983, Thomas and Adams 1985, Geist 1988). One of the major concerns of those who oppose fee hunting is the exclusion of certain socio-economic groups from the "hunting experience." Additionally, those opposed to fee hunting fear that it will decrease hunter participation, direct people away from land-based outdoor recreation and thus decrease the public's interest in wildlife and wildlife habitat. Proponents of fee hunting argue that it will increase net public benefits by creating an economic incentive for landowners to conserve and protect this valuable resource. Proponents also claim that fee hunting will not exclude hunters from access to the hunting experience, but instead cause a "re-apportionment" of hunting areas among hunters. In other words, as landowners move their land from "free" to "fee" access hunting, some hunters will be displaced by others who are willing to pay for hunting opportunities. It is suggested, however, that these displaced hunters will not abandon their sport, but rather they will seek other free access hunting opportunities (Porter 1982).

The objective of this paper was to examine the structural relationships which exist among the type of land access chosen by the hunter, the hunter's income level, level of commitment to hunting and region of residence.

Methods

Hunter Survey

A 17-page questionnaire was mailed to a disproportionate random sample of residents (N = 3736) and non-resident (N = 1,403) Alabama hunters who purchased a 1986–87 hunting license. Two separate mailings of the questionnaire were used, with a reminder postcard after the first mailing (Babie 1983).

Of the 5,139 questionnaires, 493 were classified as undeliverable. Complete questionnaires totaled 1,856 (1,283 resident hunters and 573 non-resident hunters). The overall response rate was 40 percent.

In order to represent the proportion of non-residents as they occur in the licensed hunter population, a random sample (N = 70) of the non-resident cases was taken and included in the current analysis. These 70 cases represented approximately 7 percent of the total cases in the analysis when cases with missing values were eliminated. This proportion equals that of the 1986–87 proportion of non-resident Alabama licensed hunters (ADCNR 1987).

Log-linear Model

A hierarchical log-liner model (SPSS 1985) was used to identify structural relationships among a hunter's type of land access, income level, commitment to hunting and region of residence. Log-linear models can be designed to predict cell frequencies within a given cross-classification table. The technique is comparable to analysis of variance in that single variable effects are functions of a "grand mean" and interactions are accounted for by the relationship of two or more variables (Fienberg 1981). The objective of hierarchical log-linear modeling is to simplify the interpretation of variable associations by eliminating interactions within the model that do not significantly contribute to the "rebuilding" of the observed counts in the cross-classification table.

Variables Used

1. Primary access type. Hunters were classified into the land access type in which they had spent the most time. Primary access types included: Public land access (PUB) 14.9 percent, other free land access (FREE) 51.5 percent, fee/lease land access (FEE) 28.1 percent, and land owned by the respondent (OWN) 5.5 percent.

2. *Income*. Hunters were grouped into three categories of family income before taxes: Low, \$0 to 25,000 (33.6 percent); Middle, \$25,000 to 40,000 (37.5 percent); and High, \$40,000+ (28.9 percent).

3. Hunter commitment. Hunters classified themselves into one of the following "commitment" categories: Low commitment (28.0 percent), hunting is not as important as other recreation activities; medium commitment (36.2 percent), hunting is more important than most other recreation activities; or high commitment (34.8 percent), hunting is more important than all other recreation activities.

4. Region of residence. Respondents were grouped into "north" (50.1 percent) or "south" (49.9 percent) Alabama categories according to their place of residence. Non-resident hunters were included in the "south" category since most (78 percent) non-resident hunters hunted in south Alabama. The north/south dichotomy divides the state into two regions with approximately equal land area and hunter population.

The northern region contained approximately 62 percent of Alabama's national forest and state wildlife management area acreage. Moreover, public lands in the northern region of Alabama are situated in closer proximity to population centers than are those in the southern region. Therefore, it was hypothesized that a person's region of residence would greatly influence the type of land access "available" to the hunter (i.e., regional supply of land access types).

Results

As the initial step in building the log-linear model, tests of partial association were conducted to determine which terms should be removed from the model and which should be retained. Terms with large partial chi-square values and small observed significance levels were retained in the model. These terms "explain" significant amounts of variation within the contingency table (Fienberg 1981).

The tests of partial association (Table 1) indicated that four 2-way interactions were significant: Access * Commitment, Access * Income, Access * Region, and Commitment * Income. None of the higher order interactions (3-way terms), acting independently, contributed significantly ($P > 0.05$) to the understanding of the relationships existing in the contingency table. The "K-Way" hypothesis test (SPSS 1985), indicated the collective contribution of the higher order terms (i.e., the combined effect of all 3-way and 4-way interactions) was not significantly different from zero ($P = 0.917$). Based on these results, subsequent analyses examined the goodness of fit of the remaining model terms (i.e., the four 2-way interactions shown to be significant).

Lambda parameters derived for the final model associations were used to estimate "expected" cell frequencies within the Access * Commitment * Income * Region contingency table. Analysis of the standardized residuals (observed cell counts − expected cell counts/expected cell counts $^{1/2}$) indicated no major lacks of fit within the model (SPSS 1985). Therefore, the four 2-way interactions included in the final model were adequate in explaining the variance within the multi-variable contingency table.

Table 1. Tests of partial association among all combinations of variable interactions.

Effect Name	DF	Partial Chi-square	Prob.
Access * Commitment * Income	12	9.72	0.6404
Access * Commitment * Region	6	3.33	0.7671
Access * Income * Region	6	1.59	0.9532
Commitment * Income * Region	4	6.37	0.1734
Access * Commitment	6	48.76	0.0000
Access * Income	6	32.48	0.0000
Commitment * Income	4	13.22	0.0102
Access * Region	3	59.59	0.0000
Commitment * Region	2	1.74	0.4192
Income * Region	2	1.18	0.5551

The lambda is a descriptive statistic indicating increments, both in magnitude and direction, away from the contingency table's grand mean (Table 2). For example, FEE access hunting had a strong positive association with high hunter commitment (λ = +0.31) and a strong negative relationship with low hunter commitment (λ = −0.50). Therefore, hunters who had a high commitment to hunting were more likely to be associated with FEE access areas. Conversely, hunters with a low commitment to hunting were not likely to have been associated with FEE access areas. Other findings indicated that low commitment hunters were associated with FREE (λ = +0.29) or OWN access land (λ = +0.30). There was also an indication that a portion of high commitment hunters used PUB access areas (λ = +0.18). This suggests that these individuals were finding a high level of user satisfaction from PUB access areas and/or simply could not afford to pay lease or fee access charges.

Hunter income also had a strong influence in determine the type of land access chosen (Table 2). Individuals in the high income category were positively associated with FEE (λ = +0.27) and OWN (λ = +0.23) access types, and negatively associated with PUB (λ = −0.36) and FREE (λ = −0.14) access types. Undoubtedly, the high income individuals were more likely to own larger tracts of land which they used as a primary hunting access or they were more inclined to spend money to lease hunting lands. As expected, exactly the opposite relationship existed for low income hunters, who were more likely to hunt on PUB (λ = +0.37) or FREE (λ = +0.22) access areas. Lambda's for middle income hunters show no strong tendency to be associated with a particular type of land access.

This analysis also produced a very interesting relationship between income level and hunter commitment (Table 2). The negative lambda for the high income, high commitment hunter (λ = −0.22) may indicate that as income increases, "other activities" may demand the individual's time and therefore do not allow for the

Table 2. Lambda parameters showing the relationships among final model associations.

Access * Commitment	Type of access			
Level of Commitment	PUB	FREE	OWN	FEE
Low Commitment	−0.08	+0.29**	+0.30	−0.50**
Medium commitment	−0.09	−0.14	+0.04	+0.19*
High commitment	+0.18	−0.15	−0.34*	+0.31**
Access * Income	Type of access			
Level of Income	PUB	FREE	OWN	FEE
Low income	+0.37**	+0.22*	−0.26	−0.33**
Middle Income	−0.01	−0.08	+0.03	+0.06
High income	−0.36*	−0.14	+0.23	+0.27*
Commitment * Income	Level of income			
Level of commitment	LOW	MIDDLE	HIGH	
Low commitment	−0.12	+0.08	+0.04	
Medium commitment	−0.10	+0.08	+0.18	
High commitment	+0.22*	0.00	−0.22*	
Access * Region	Type of access			
Region of residence	PUB	FREE	OWN	FEE
Northern region	+0.53**	−0.17*	−0.12	−0.24**
Southern region	−0.53**	+0.17*	+0.12	+0.24**

*Indicates significance at the 0.05 level.
**Indicates significance at the 0.01 level.

development of ''hunter commitment.'' Further, the high income individual may not be as likely to perceive an ''income barrier'' to other forms of recreation which have significant start-up costs. Thus, high income individuals may have other forms of recreation available which detract from their hunting activities. The positive lambda for low income, high commitment hunters ($\lambda = +0.22$) may be viewed in a similar yet opposite manner.

The final association retained in the model, Access * Region, indicates that a different ''supply'' of land access available to the hunter significantly influenced the hunter's choice of land access (Table 2). Most public land in Alabama is situated in the northern region. Hunting areas in the southern region of Alabama are mostly privately owned and the proximity to public land is less convenient (i.e., greater in distance from population centers). The lambda parameters for PUB ($\lambda = \pm 0.53$) and FEE ($\lambda = \pm 0.24$) access reflect the unequal distribution of land access types between north and south Alabama. The lambda for PUB ($\lambda = +0.53$) indicates that when public lands are available, individuals will take advantage of PUB access hunting. However, when public access is in low supply and less convenient, hunters must choose between the remaining access types available.

Finally, it is also important to consider why various interactions were not included in the final log-linear model. For example, Region * Income and Region * Commitment were shown to be insignificant ($P = 0.555$ and $P = 0.419$), respectively) in explaining variation within the contingency table (Table 1). This indicates no significant difference in the income level or the commitment level between hunters in north and south Alabama.

Discussion

Many studies have been conducted in an attempt to explain why people choose to participate in particular forms of recreation (McClaskie et al. 1986). Frequently, recreation researchers look to ''early life experiences'' (Burch 1969, Yoesting and Burkhead 1973, Sofranko and Nolan 1972), ''personal community factors'' (Burch 1969, Field and O'Leary 1973, Buchanan et al. 1981), and 'barriers to participation'' (Christensen and Yoesting 1973, Napier and Maurer 1981, Jackson 1983, Searle and Jackson 1985) to provide insight to outdoor recreation behavior. Collectively, these factors interact with social and economic characteristics to make up what Niepoth (1973) referred to as an individual's ''opportunity framework.'' The opportunity framework guides the individual's psychological orientation, decisions, and, thus, behavior.

In this study, a careful selection of variables for the log-linear model allowed for an adequate representation of the ''opportunity framework'' concept. For example, income was included in the model to represent a socio-economic characteristic of the hunter as well economic barrier influencing land access decisions. A hunter's region of residence was shown to influence land access decisions because of regional land access supply factors (i.e. availability/supply barriers). And ''hunter commitment'' is undoubtedly the outcome of an individual's early life experiences, personal community factors, and perceived barriers to hunting opportunities.

This study showed that income, commitment to hunting, and regional supply factors significantly influenced a hunter's choice of primary land access. However, hunter commitment did not vary across regions, suggesting that fee hunting systems in

Alabama have not decreased the individuals' commitment/interest in hunting. Moreover, a between region comparison of many other hunter background characteristics that could have been correlated with hunter commitment and region of residence was conducted. Hunter background characteristics tested included: age, age started hunting, number of years hunted in Alabama, number of other family members who hunt, income, education, race, marital status, number of children, population of area of residence, population of area of childhood residence, number of game species hunted and reasons for hunting: trophy, meat, challenge and enjoy nature. No significant difference ($P > 0.05$) between regions was found (M. S. Wallace personal files, 1989). Therefore, the hunter population has homogeneous across all variables measured, except for the ''supply'' of land access types available to the hunter; and, that supply difference did not influence the hunter's level of commitment to hunting.

In addition, the 1986–87 Alabama resident hunting license sales data indicate that approximately 7 percent of the general public in northern region of Alabama were licensed hunters and approximately 8 percent of the southern region residents were licensed hunters (ADCNR 1987), further supporting the premise that fee hunting systems in Alabama are not decreasing hunter participation or commitment/interest in wildlife. A review of previous years of Alabama hunting license sales data (1970, 1975, and 1980) yielded similar results.

While it is difficult to project what impact fee hunting systems hold for Alabama's future, the benefits seem to outweigh the costs. During the past decade many large timber companies in the southeastern United States have started leasing land to hunters (Lassiter 1985). Land leasing and fee hunting has encouraged these companies to view wildlife as a ''product of the land'' and hence move toward land-use practices which include wildlife production (McKee et al. 1983). Individuals who own large tracts of income-producing property may also view wildlife in a similar manner. Moreover, it seems logical that lessees who retain ''long-term'' hunting rights on a given parcel of land will have the incentive to protect, conserve, and manage wildlife and wildlife habitat for future benefits.

Study findings support the proponent view of fee hunting systems. During the 1986–87 hunting season, the hunter's income, level of commitment to hunting, and region of residence within Alabama were important in influencing the hunter's primary land access decision. However, as stated, hunter commitment and hunter participation rates were not influenced significantly by a difference in the regional supply of various land access types; leading to the conclusion that, at present, fee hunting system in Alabama are not excluding individuals from the hunting experience not is it decreasing the hunter's commitment to hunting. Instead, a ''re-apportioning'' of hunting areas among Alabama hunters is taking place.

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Overview of Fee Hunting for Deer and Elk on Private Land in Utah

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Introduction

There has been increasing attention given to the availability and potential development of recreation opportunities on private land. For example, the U.S. Forest Service has recently conducted a nationwide study to determine what types of private land recreation opportunities exist and their associated costs and revenues (Driver et al. 1986).

The development of recreation opportunities on private land in states where there is a preponderance of public land is problematical. Public land recreation opportunities are abundant and are either free or are available for very low fees. Landowners have difficulty attracting customers to private land recreation opportunities when substitutes are so abundant and the price they charge must cover their costs, including a return on investment. The only way landowners can successfully market recreation opportunities is to offer a recreational experience that is not available on public land (McDivitt 1987).

Fee hunting, landowners charging for access to their land for hunting, is one example of a diversified recreation experience on private land. Fee hunting not only opens up more land for hunters, it also offers the opportunity for a spectrum of different services and probabilities of hunting success. Fee hunting helps compensate landowners for their contributions to wildlife habitat and for providing hunting opportunities. And by giving a value to wildlife, fee hunting offers an incentive to landowners to use land and livestock management practices that benefit wildlife (Burger and Teer 1981, White 1986).

There have been studies conducted recently in several western states examining the economics and management of fee hunting (for example, Steinbach et al. 1987, Cohen 1988, and Butler 1988 in Texas; Knight et al. 1987 and Morgan 1988 in New Mexico; Fitzhugh 1988 in California; and Bushnell 1988 in Montana). However, none of these have described or compared fee hunting enterprises with respect to marketing strategies such as product differentiation.

This research project was initiated to gain an in-depth understanding of fee hunting in Utah, a public land state. Specific objectives of the research project were (1) to describe currently successful fee-hunting enterprises, including the economics and management practices of the hunting enterprise itself and a description of the types of agricultural enterprises involved in fee hunting and (2) to assess the adequacy of current fee-hunting efforts in addressing the problems of hunter access and wildlife habitat on private land in Utah. This manuscript briefly describes how landowners manage the hunting opportunities they provide and in what ways these opportunities have been differentiated from those available on public land in Utah.

Methods

Telephone and follow-up mail questionnaires were administered using the Dillman (1978) method to Utah landowners who received revenue in 1986 by offering deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) hunting opportunities on their land. Because there was no way of knowing beforehand who or how many people were engaged in fee hunting, and therefore no way to select a representative sample of such people, considerable effort was made to identify all landowners in Utah involved in fee hunting for deer and elk in 1986. Altogether 121 landowners were identified of which 117 (97 percent) completed telephone interviews and 82 percent completed follow-up mail questionnaires. Results reported here are for 114 landowners offering 151 different hunting opportunities.

Results

Hunting opportunities may be differentiated according to the animal to be hunted, number and types of seasons included in the permission to hunt, method of charging (by the acre, season, lease, or permit), services provided, and responsibilities expected of hunters. All of these factors can influence both the fees charged and the costs incurred by landowners offering fee hunting opportunities.

In Utah, about half of fee hunting landowners lease their land to hunt clubs or outfitters and half issue trespass permits directly to individual hunters. In general, these two methods of charging involve different levels of landowner management and different services provided to and responsibilities expected of paying hunters. For example, a permit system usually implies that the landowner is actively managing the hunting enterprise. In that case, the landowner expects to post and patrol the property, guard gates and repair any property damages caused by hunters or wildlife. Because hunters are more directly supervised by the landowner, fewer landowners specify restrictions.

When landowners lease to clubs or outfitters, the club or outfitter is usually expected to post and patrol the property and guard gates. In addition, the club may agree to repair damages to fences, gates, and roads after the hunting season. Landowners often specify where hunters are to camp and warn hunters to be careful of livestock.

Under both lease and permit systems, about two-thirds of the landowners specify road or vehicle restrictions such as using only certain roads or prohibiting off-road vehicles. In addition, some landowners prohibit alcohol use during daylight hours or altogether. More than half of the landowners caution hunters not to leave litter. Figure 1 summarizes the relationship between hunter responsibilities and restrictions and method of charging.

Eleven percent of fee-hunting landowners offer no services to their hunters, 77 percent offer between one and five services, and 12 percent offer more than five services. As shown in Figure 2, when between one and five services are offered, the services are usually a campsite and water and firewood if available on the property. When more than five services are offered, the hunt is usually fully guided and catered and includes services such as guides, lodge or cabins, meals, vehicles or horses, help with dressing game and packing, etc. The average number of services offered

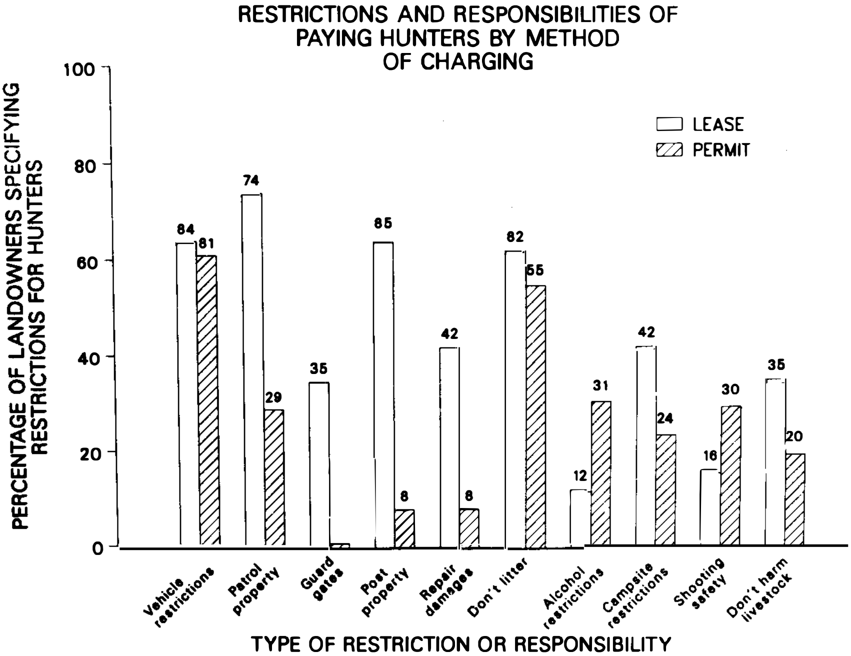

Figure 1. Responsibilities and restrictions expected of paying hunters by method of charging.

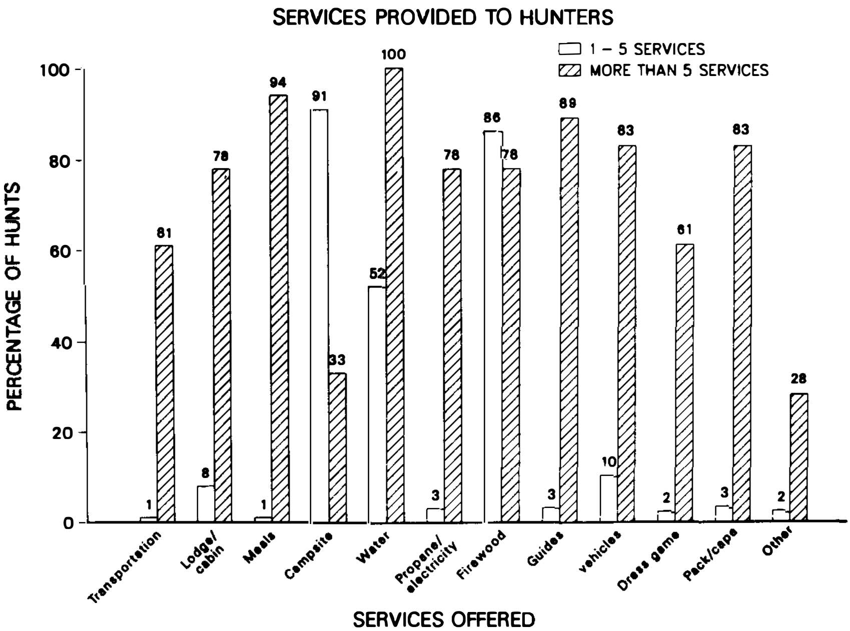

Figure 2. Services provided to hunters.

with guided hunts is six, and for unguided hunts two. All of the hunts offering more than five service are guided.

Because the success of private land recreation opportunities depends on offering a product not available on public land, landowners were asked what they think is the most unique or special opportunity they offer that makes hunters willing to pay to hunt on their property. Table 1 shows their responses.

Most landowners (58 percent) stated that they offer the opportunity to hunt with fewer hunters under less crowded conditions. Many landowners (45 percent) stated that they offer good hunting either because they have more or better quality animals on their land than are available on public land, or because hunters have a better chance of getting an animal because there are fewer hunters relative to the number of game animals and land area available for hunting.

Other important opportunities landowners think they offer hunters include accessible land and animals (either close to urban areas or well-roaded), and plenty of land or (in their words) very beautiful land to hunt on. Note that relatively few landowners (6 percent) stated that providing a trophy hunting opportunity is one of the major reasons hunters are willing to pay to hunt on their property.

Hunting opportunities on public land do not include any services for hunters other than a place to camp and possibly firewood and water. Nor do they require any responsibilities other than obeying hunting regulations. Therefore, another way that private land hunting opportunities may differ from those on public land is the services provided and hunter responsibilities and restrictions. Only 12 percent of landowners offer services that differ greatly from those on public land, and only 10 percent of landowners indicated that they think the services they offer are an important reason why hunters are willing to pay to hunt on their property. Therefore, fee hunting as it is currently practiced in Utah is not concentrating on a differentiation of services as a strategy for success. It appears that the feature that distinguishes most hunting opportunities on private land in Utah from those on public land is crowding. Hunters are paying for the opportunity to enjoy their sport with fewer competitors or where there are more animals per hunter. In a recent survey, hunters stated that some of the most important benefits they receive from fee hunting are more land and more animals per hunter (Jordan and Austin 1987).

The average number of acres available per fee-paying hunter was calculated by dividing the number of acres by the number of hunters allowed on the property at one time. The average number of acres per hunter is 394.

Table 1. Opportunities landowners think they provide to hunters. Numbers add up to more than 100 percent because landowners often gave more than one response.

Opportunity	Percentage
Limited hunters	58
Good hunting	45
Accessible land and animals	19
Plenty of land/beautiful land	15
Services	10
Trophies	6
Other	4

Table 2 shows the frequency distribution of number of acres per hunter. Fifty-four percent of the landowners offer 500 or less acres per hunter. Many landowners do not know how many hunters are allowed on their property at one time because they leave that to the discretion of the club or outfitter to whom they lease their land. In those cases it is not possible to calculate the number of acres per hunter.

To compare these figures with the hunting opportunities on public land, the number of acres of land managed by the Forest Service, Bureau of Land Management, utah Division of State Lands and Forestry and the Utah Division of Wildlife Resources was summed and divided by the number of hunters afield (less those hunting on private land) in 1986. The average number of acres of public land available per hunter calculated in this manner is 213. (This figure is probably high because a good proportion of the land managed by the Bureau of Land Management has no deer or elk on it during the hunting season.) Thus, private land hunting opportunities provide approximately double the acreage per hunter.

Unfortunately, it is not possible to calculate the animal density per hunter on either private or public land. However, if it is assumed that the number of animals per unit land area is the same for both public and private land, then the fact that there are more acres per hunter available on private land also means that there are more animals per hunter. As previously mentioned, many landowners and hunters think that fee hunting provides a better opportunity for hunting success because of the presence of more animals relative to the number of hunters.

Summary and Conclusions

About half of fee-hunting landowners lease to hunting clubs or outfitters. The lease agreement may stipulate that hunters are to post and patrol the property and repair any damages caused by hunters. Typical services provided under a lease system include a place to camp, water and firewood.

Half of the landowners issue trespass permits directly to individual hunters. Under a permit system, landowners expect to post and patrol their property themselves and cover all expenses associated with the hunt. Hunts regulated by permit are more likely to be fully guided and catered.

Fee hunting opportunities for deer and elk in Utah are primarily distinguished from those on public land by hunter density. Private land hunting opportunities provide approximately double the number of acres per hunter (394) than on public land (213). Both hunters and landowners think that animal density is higher on private land as well, but it is not possible to verify those impressions. Only 12 percent of landowners offer services that differ substantially from those available on public land.

Table 2. Frequency distribution of number of acres available per fee paying hunter.

Acres per hunter	Percentage of landowners
Less then 100	14
100–200	24
200–500	16
500–1,000	9
More than 1,000	7
Don't know or no response	30

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Financial Returns to California Landowners for Providing Hunting Access: Analysis and Determinants of Returns and Implications to Wildlife Management

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Introduction

Approximately half of California is privately owned. Most of the critical deer winter ranges are privately owned as well. Habitat in general and winter range in particular have experienced degradation and loss of acreage because of subdivisions and wildland management inimical to wildlife. In an effort to mitigate these problems, the State of California authorized an innovative program named "Wildlife Management on Private Lands" (PLM). The program allows landowners flexibility from standard game regulations in exchange for improved wildlife management practices on their land. The core of the program is the belief that private landowners can accomplish significant wildlife management at their own expense through the profit motive. The combined effect of the new program and declining livestock prices has resulted in 41 of the estimated 200 big game fee hunting enterprises enrolling in this program. However, the lack of information on potential financial returns to such operations hinders existing ranches from starting fee hunting enterprises. In addition, information is lacking on what features of a fee hunting enterprise are profitable and which ones add little to revenue.

The objectives of this study are fourfold: (1) to provide information on financial returns from adding fee hunting to an existing ranch or farm operation; (2) estimate the long run economic returns from starting a new fee hunting enterprise; (3) determine what characteristics add significant revenues to a fee hunting enterprise and (4) determine what wildlife enhancing modifications were made to the ranch and farm operation as a result of the development of a fee hunting enterprise.

Data Collection Methods

The population of interest is California fee hunting enterprises that provided deer, turkey or feral pig hunting in 1986. A sample frame was assembled from lists of licensed enterprises, meetings of fee hunting operators, fee hunting advertisements and county cooperative extension advisors. The list was stratified according to participation in the licensed PLM program. Approximately equal numbers of ranches were selected randomly from each stratum. In total, 73 owners or managers of qualified fee hunting enterprises were selected to receive personal, on-site interviews. Of the 73, 13 could not be reached, even after repeated attempts. Of the remaining 60, 5 ranches refused to participate in the survey. This resulted in 55 completed interviews (of which 28 were in the PLM program and 27 were not). The total response rate of the ranches contacted is 91 percent.

The on-site survey involved asking 59 questions, which were organized into eight areas: (1) geographic and topographic features of the ranch; (2) hunting quality; (3) vegetation and wildlife habitat; (4) type of clientele; (5) marketing information; (6) fixed and variable costs of the hunting enterprise; (7) services offered by the hunting enterprise; and (8) revenues and payments received.

Analysis Methods for Calculating Returns to Fee Hunting Enterprise

For the purposes of computing the returns to the fee hunting enterprises, two viewpoints were adopted that were consistent with our objectives. The first viewpoint involves calculating the short-run financial return associated with adding a fee-hunting operation to an existing ranch or property. In this case gross returns were considered only the financial cash paid; no credit is given for bartered goods or reduction in wildlife damage from the hunting. On the cost side, only variable or out-of-pocket costs directly attributable to the hunting enterprise were included. These items include advertising, actual wages paid to hunting enterprise workers, utilities associated with the hunting enterprise, permits, liability insurance, trash removal, supplemental feed and maintenance costs on equipment and facilities used in the hunting enterprise. We asked ranchers to prorate some of the additional maintenance required due to use by fee hunting enterprise of common facilities such as buildings or trucks. However, business taxes and increased property taxes specific to the fee hunting enterprise were not included. If these added costs occur, they should be deducted from income in both short- and long-run analyses.

The second viewpoint is a long-run economic viewpoint that would be appropriate for a person deciding whether to purchase land or a ranch to go into the fee hunting business. In this case the individual must incur all of the costs described above *plus* cover the land costs (including property taxes) and opportunity costs of family labor as well. However, the economic returns can be expanded to include value of goods received (e.g., barter), reduced damage to crops and facilities by wildlife in addition to cash revenues.

Results for Fee Hunting Enterprise

Table 1 summarizes the financial and economic returns to the fee hunting operation. The cash revenue per acre is $3.82. Subtracting out variable out-of-pocket costs, the short run financial return is $1.02 per acre. while the average return shows a profit, one out of three wildlife enterprises did show a loss. These results are similar to what Jordan and Workman (1988) found in Utah. There, returns were just 66 cents an acre, but 82 percent of the landowners did earn a profit. In our study, there is

Table 1. Economic versus financial returns per acre.

Revenue/cost	Economic view	Financial view
Returns		
Cash revenue	\$3.82	\$3.82
Value of other goods	\$0.34	
Reduction in damages	\$0.07	
Gross return	\$4.23	\$3.82
Costs		
Variable costs	\$2.42	\$2.42
Added maintenance	\$0.38	\$0.38
Short run "financial profit"		\$1.02
Family labor opportunity costs	\$2.33	
Short run economic return	−0.90	
Land purchase (PI)	\$10–\$40	
Long run economic return (*see text*)		

no significant linear relationship between return per acre and number of acres devoted to fee hunting.

The economic returns per acre, which include cash revenues, value of barter "exchanged" for access and wildlife damage reduction is \$4.23 per acre. If just the short-run out-of-pocket costs are subtracted, the overall average return is \$1.43 per acre. The value of barter and reduction in wildlife damage add significantly to the economic returns from the hunting enterprise. Ranchers enrolled in the PLM program had a profit per acre of 30 cents, compared to \$1.62 per acre for landowners not in the PLM program. While PLM landowners had lower costs per acre (\$2.38 instead of \$3.15), their revenues were much lower (\$2.68 instead of \$4.78).

However, a true economic return would account for opportunity costs to the wildlife operation, not just out-of-pocket costs. In the short run, the most important non-cash cost is the family labor devoted to the wildlife operation. In essence, hours worked on the ranch potentially represent wage income foregone. Using the number of hours of family labor time reported in the survey and the average wage rate in California, this labor cost is \$2.33 per acre. The net economic return accounting for opportunity cost of labor is a negative 90 cents per acre.

If a person who is currently not a landowner is considering setting up a new hunting enterprise, the operator must also pay for land. The full land costs when amortized range from \$200–\$400 an acre. However, if the land also is used for cattle ranching or as a permanent home for the owner, only a portion of the land cost might be assigned to the fee hunting enterprise. Nonetheless, inclusion of land costs would make most wildlife enterprises lose money. That is, whether a long-run financial or long-run economic view is taken, most hunting enterprises forced to cover the land costs will lose money.

All of this analysis follows a strict cost-return view of the hunting enterprise for the average landowner. In many cases, landowners objectives for the hunting enterprise will follow the short-run financial view: can a hunting enterprise add more to revenues than it does to cash costs for an existing ranch operation. For many landowners, a fee hunting enterprise is a relatively new endeavor and the full profit potential may not yet be realized. That is, these landowners are still in the experimentation phase of determining what type of fee hunting arrangements work best. As part of this experimentation, some landowners are interested in what characteristics of a hunting enterprise provide the greatest revenue potential. By paying careful attention to the attributes of a hunting enterprise that potential customers find valuable, landowners can significantly improve their economic returns. We now turn to an examination of those factors that contribute additional revenues.

Determining Which Factors Affect Deer Hunting Enterprise Revenues

Analysis Methods

A technique called the hedonic price method (Rosen 1974, Livengood 1983) can be used to decompose the total hunting fee into the amounts attributable to each component of the hunting experience. That is, each ranch offers a different bundle of hunting characteristics and a different price for this bundle. By regressing the fee or total revenue per hunter on each ranch's bundle of characteristics it is possible: (1) to determine if an attribute makes a statistically significant contribution to the price that can be charged to each hunter and (2) if significant, to determine the magnitude of that attribute's contribution to the price. We hypothesize that Revenue per hunter (REV/HTR) is a function of: (1) quality of the hunting experience, (2) other characteristics of the ranch, (3) characteristics of the hunters themselves, (4) services provided by the landowner or ranch and (5) management inputs provided by the hunting enterprise to enhance the hunters experience.

Of course each of these categories had to be operationalized. Each of the variables examined will be defined and the variable names provided in parentheses. The quality of the hunting experience is measured by percent hunter success rate (SUCRATE) and percentage of harvest made up of trophy animals (TROPHY%). Other characteristics of the ranch include its distance from major population centers, elevation, percent wooded (conifers and/or oaks) and modification of livestock grazing (measured in AUMs) associated with the introduction of the fee hunting enterprise. The key characteristic of the hunter is income level. This is quantified as percentage of hunters in the wealthy or high income (HIINC%) range as determined by the landowner's knowledge of the clients. Hunting enterprise services included providing a guide, a vehicle, airport pickup and drop off, cabins, fishing and meals. Management inputs studied included whether the operator attempted to insure compatibility between hunters visiting the ranch (COMPAT) and the amount spent advertising (ADV) the existence of the hunting opportunities. This initial analysis focuses only on deer hunters as this is the largest single species sample.

Consistent with the hedonic approach, returns were expressed as dollars paid per deer hunter. However, analysis also was performed using returns per acre. The basic pattern of the results obtained for returns per deer hunter apply as well as returns per acre and are not presented due to space constraints.

Results

Equation 1 presents the statistically significant contributors to total revenue per deer hunter:

$$(\text{REV/HTR}) = -939 + 13(\text{SUCRATE}) + 10.6(\text{TROPHY\%}) + 5.23(\text{HIINC\%})$$

$$T \text{ values } \quad -2.41 \quad 3.53 \qquad\qquad 3.57 \qquad\qquad 2.37$$

$$+ 8.55(\text{COMPAT}) + .04(\text{ADV})$$

$$1.82 \qquad\qquad 1.31$$

The R^2 is 75 and the F value is 7.34. The R^2 is quite high with 75 percent of the variation in revenue per deer hunter being explained by the included variables. The F statistic indicates the overall equation is statistically significant at the 1 percent level. The t statistics on the two hunting characteristics indicate these are also statistically significant at the 1 percent level. HIINC and COMPAT are significant at the 5 percent and 10 percent level, respectively.

An example of use of the equation to predict revenue changes is as follows: The average revenue per deer hunter is $706. A 10 percent increase in the average deer hunting success rate would increase the revenue per hunter by $130 to $836. Increasing the percentage of the total harvest that are trophy deer by 10 percent would add $106 per hunter. If a landowner had 100 hunters, these two changes would add, $1,300 and $1,060 respectively each season to hunting enterprise revenues. This total increase in revenues could be compared to the habitat and management costs necessary to improve the hunting quality to these levels. If the additional revenue exceeds the costs, landowner profits will rise from improving the proportion of trophies and success rates.

The variables not presented in the equations, such as provision of camping, cabins, guides, transportation, other recreation opportunities, meals, etc., did not have a statistically significant effect (not even at the 10 percent level) on what the landowner could charge deer hunters. This is true whether returns per deer hunter or returns per acre were evaluated. This lack of relationship holds whether the returns are defined as cash returns or total returns including barter exchanged for hunting privileges.

However, the possibility certainly exists that these other services influence the hunters' decision of which (relatively equally priced) ranch to visit. Analysis of this possible path of influence awaits further study and perhaps additional data.

Many landowners modified their previous enterprises to benefit wildlife. While 80 percent of the landowners had livestock grazing, 25 percent of them had eliminated or reduced livestock as a result of adding a fee hunting enterprise. Our survey showed the average reduction was 300 animal unit months. Many ranchers also engaged in other habitat management actions such as manipulating brush to improve habitat.

Conclusion

On average, landowners providing fee hunting in California do make a small financial profit per acre. Adding fee hunting to an existing ranch operation appears to be a profitable venture for two out of three landowners in our sample. The statistical analysis presented in the paper shows that hunter success rates and opportunities to harvest trophy animals are the most important determinants of the amount a landowner can charge.

So far we have focused on the direct monetary returns to the rancher. However, there are two other returns from fee hunting to society. First, much previously closed private land is made accessible to the public for hunting. Secondly, wildlife benefits. Identifiable changes in ranch operations when fee hunting is added include reduction or even elimination of livestock grazing in the acres leased for hunting. More importantly, the addition of fee hunting also seems to change the philosophy of the ranch owner/manager. The rancher now thinks about wildlife in a positive way. It is not longer "look what wildlife has done *to* me," it is now "look what wildlife can do *for* me."

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Recreational Access to Private Lands in Florida[1]

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Introduction

Florida has been gaining about 1,000 new residents per day, making it one of the fastest growing states in the nation (Florida Bureau of Economic and Business Research, pers. comm.). In addition to this direct population growth, over 55 million tourists visit and vacation in Florida each year. In many respects, the state represents a bellwether for other states expected to experience growth in upcoming years. Although there are large federal land holdings (national forests, national parks, military bases and wildlife refuges) in Florida and state agencies have been active in preserving lands, much of the remaining acreage is in jeopardy in the near future. Doig (1986) reported that the losses of wild lands to urban expansion in the United States have been about 1.5 million acres per year; rapidly urbanizing states like Florida are responsible for a disproportionate share of these losses. At the same time that attempts are being made in Florida to manage growth through land use restrictions and comprehensive planning, the economy of the state is heavily dependent upon stimulation through tourism and recreation.

Nationwide, the demand for outdoor recreational opportunities tripled from 1962 to 1983 (Doig 1986) and this trend is expected to continue, particularly in states like Florida. Outdoor recreation is expected to be an increasingly important part of the future quality-of-life for Floridians and millions of tourists. Duda (1987) provided an excellent summary of current and near future relationships that exist between Floridians and wildlife conservation efforts. Much future recreation in the state will depend upon obtaining access to private lands and growing numbers of landowners will be expecting compensation for this access.

Access to Private Lands

Many Americans believe that they should not be required to pay for access to lands for recreation: some consider free access to these lands and the wildlife resources they produce as an "inalienable right" (Teer and Forrest 1968). Access to lands for hunting has been the subject of a number of studies nationwide (Bromley and Hauser 1984, Brown and Dawson 1974, Decker et al. 1979, Franklin and Allen 1985, Holecek 1983, Kleunder 1978, Lassiter 1985, Riggle 1986, Sampson 1986, and Welge 1986). Several of these studies also have reviewed governmental attempts to improve public hunting access to private lands, but these efforts have generally had only limited success. As reported by Sampson (1986), one-quarter to two-thirds of the remaining private rural lands have restrictions on access, and this increases to 80 percent in the northeastern states. The trend toward a reduction in free public

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access to lands for recreation has resulted from continuing losses of rural lands to urbanization, increasing numbers in the recreation-seeking population, increasing property damage caused by trespassers, and a landowner realization that providing access to private properties for recreation has income potential.

Recreational hunting contributes substantially to the economy of Florida, with a projected value of $34 million in 1990 (U.S. Fish and Wildlife Service 1983). Large timber companies have long been aware of the values associated with allowing hunting on their lands and the value of limiting access through hunting leases (Lassiter 1985). Increasingly, other private landowners have become aware of benefits of leasing their property for recreational activities, especially hunting. The benefits range from better guardianship of the land by frequent lessee attendance to increased income for the landowner. It was recently estimated that the use of hunting lease systems in Florida increased by about 20 percent from 1975 to 1985 and that approximately 50 percent of private lands in the state were leased for recreational hunting (Wiggers and Rootes 1987).

Survey of Hunting Lease Arrangements

Hunting lease systems have been developing in Texas since the 1920s and the success of these operations has been repeatedly and well documented (Andrews 1967, Boykin and Forrest 1971, Burger and Teer 1981, Ramsey 1965, Sargent et al. 1958, Teer and Forrest 1968, Ward 1985, and Welge 1986). Private landowners in many states now operate profitable recreational lease programs, but the characteristics of these programs have not been consistently well documented. In a survey of public use of private industry lands in the southeastern U.S., Kleunder (1978) reported that hunting was the most common use, particularly near large, urban areas.

In Florida, private landowners owning 200 or more acres of agricultural or forested lands were identified from county tax records in 5 major regions statewide (labeled Districts 1 (Panhandle) to 5 (South Florida)). In each of these regions, 3 counties were selected that represented a rural county, a rapidly urbanizing county, and a county with at least one large urban area. A total of 1,412 private landowners was initially contacted in these 15 counties and asked if they lease hunting rights on their property. Of these, 690 (49 percent) responded to the presurvey and only 106 (15 percent) returned the postcards indicating that they lease hunting rights and that they would be willing to complete a questionnaire. These landowners were then mailed a questionnaire to obtain information about the extent of involvement in and some characteristics of developing hunting lease systems for the interval October 1983 through September 1984. Several of the 22 questions were directed at the following topics: characteristics of the property, types of leases, fees charged, services provided, agreements and responsibilities, and problems encountered.

Only 45 landowners returned the hunting lease questionnaire; this represented 42 percent of landowners who responded positively to the presurvey, but only 3 percent of large landowners originally identified. The reluctance of landowners to respond to the questionnaire probably was related to several factors, including a general reluctance to share information on the magnitude of ''extra income'' that undoubtedly has tax implications. Because of this, hunting leases represent a good example of an enterprise where survey results must be considered conservative.

The major big game species sought by hunters in Florida is the white-tailed deer, and leases typically also include privileges to hunt wild turkeys and feral hogs. Other wildlife hunted in the state and sometimes specified in lease arrangements were bobwhites, mourning doves, gray squirrels, waterfowl, and American alligators. Average lease prices obtained in this survey ranged from $1.32–2.73 per acre, with a weighted overall mean of $2.29 per acre (Table 1). Although there were no significant differences in per acre lease prices among districts, District 3 (near Orlando in central Florida) seemed to have somewhat higher prices ($2.73 per acre). Currently, the average price is expected to be somewhat higher in the range of $3.00–5.00 per acre. In addition to income on a per-acre basis, some landowners gain additional income by providing other services and/or by charging an extra "trophy" fee (up to $500–600 for a large white-tailed buck) for worthy animals taken on the property.

Several questions in the survey solicited descriptions of the lands being leased for hunting. Four major upland habitat types predominated, including pine plantations (34,000 acres), improved pastures (25,600 acres), natural pine forests (23,500 acres), and open palmetto range (14,000 acres). As expected, the acreages leased for hunting varied statewide by habitat types, with a close association with existing land-use patterns. For example, in Districts 1 and 2 of northern Florida, where industrial forestry is dominant, the greatest proportions (64 percent and 82 percent, respectively) of leased lands were pine plantations. Also, in central Florida (District 3), about 30 percent of the leased acreage was in pine plantations, 30 percent was open palmetto range, and the remaining 40 percent was about equally divided among improved pastures, natural pine forests, and cypress strands. These survey results do not adequately represent wetland habitats, where management for waterfowl and American alligators are gaining in popularity.

Additional questions posed to respondents leasing lands for hunting dealt with the characteristics and logistics of hunting lease arrangements. A high proportion (87 percent) of respondents had written lease agreements (Marion and Hovis 1985) with lessees, while only 11 percent reported verbal agreements. Generally, these hunting rights were leased, in two-thirds of the cases, to a single club or individual. Most (69 percent) leases were established for a period of one year; less than 25 percent had seasonal leases, generally for white-tailed deer or bobwhites. A very small percentage of landowners reported using leases of either a very short (week) or long (five-year) duration. Most landowners (91 percent) responding to this survey accepted only monetary payments for hunting privileges on their property. Also, about 58 percent of respondents said that they did retain hunting privileges on the leased property for themselves, their family and guests.

Table 1. Average prices per acre for leasing access for hunting in Florida. 1984.

District	Returns per acre
1. Florida Panhandle	$1.69
2. North Florida	$1.32
3. Central Florida	$2.73
4. Southcentral Florida	$2.34
5. Southwest Florida	$1.74
Overall weighted mean	$2.29

Probably the biggest concern of landowners considering allowing access to private lands is that of liability. Over 82 percent of respondents indicated that they did include lease provisions intended to protect the landowner from liability and from damage caused by the lessee. Also, a high proportion (64 percent) of landowners neither included provisions for automatic lease renewal in lease agreements nor for resolving disputes (73 percent). Instead, half of the landowner respondents did include provisions for termination of leases, with notice for termination ranging from two weeks to one year. Approximately 40 percent of participating landowners indicated that limitations on the maximum numbers of hunters allowed on the lease property were included in their leases, in 30 percent of the cases the lessee limited the maximum hunter numbers and 24 percent of respondents had no such provisions in their leases. On 62 percent of the sampled leases, vehicles were allowed on all accessible areas, while 38 percent of respondents restricted vehicle use to maintained roads only. Dog hunting for deer remains popular with some rural hunters throughout the South, but 89 percent of participating landowners indicated restrictions against allowing the use of dogs for this purpose.

Private landowners included in this survey were asked about responsibility for practices related to access for hunting. Primary responsibility for many of these practices is negotiable between the landowner and the lessee and, thus, it was difficult to obtain a strong consensus in all cases. In general, road and fence maintenance were more commonly the responsibility of the landowner, while policing against trespass and implementing wildlife enhancement practices were frequently shared between the two parties (Table 2). For obvious reasons, the lessee is very likely to take a more active role in the latter two areas to help both protect and enhance resident game populations. Landowners participating in this survey also were asked to identify specific support services available, including provision of vehicles, hunting dogs, guides, meals, lodging, cleaning and storage of harvested game and other services. Generally, between 80 and 85 percent of landowners did not provide these services to lessees; when they were provided, it was usually at no extra cost to the lessee.

Landowner respondents were asked how they advertised leasing opportunities for their property. Most landowners included in this survey "advertised" by word-of-mouth (75 percent), with only a small percentage of respondents using mailings to previous clients or newspaper advertisements. Also, fewer than 10 percent did not advertise at all. Additional uses of leased property were explored with respondents to this survey as questions were specifically asked about the availability of camping, fishing, trapping, grazing and other activities (collecting firewood and maintaining

Table 2. Responsibilities for practices related to lands leased for recreation (percentage response).

Responsible party	Policing against trespassers	Wildlife enhancement	Road maintenance	Fencing		
				Materials	Labor	Maintenance
Landowner	13	11	49	56	53	53
Lessee	40	49	24	18	20	20
Both parties	42	24	16	9	9	9
Neither party	2	13	7	13	13	13
No response	2	2	4	4	4	4

apiaries). Between 55 and 60 percent of participating landowners indicated that both camping and fishing by the lessee were allowed at no additional cost; some landowners (24 and 13 percent, respectively) did not allow either camping or fishing on their leased property (Table 3). Trapping and grazing of cattle were not allowed by landowners on leased lands in 42 and 44 percent, respectively, of the situations. When asked about any problems associated with leasing land for hunting, fewer than 25 percent of landowners indicated any problems associated with this enterprise, including property damage, difficulty in collecting payments, illegal harvesting of wildlife, trash dumping, equipment vandalism and trespassing.

Other Recreational Ventures

Although tourism and recreation are very important stimuli to the economy in Florida, the establishment of private enterprises to provide recreational experiences for profit is still in an early developmental stage. Several examples exist of large ranches being involved in leasing of lands for hunting, and the average returns per acre to the landowner are generally in the range of $4.00 to $7.00. Some holdings with high game populations and a nearby wealthy clientele have been leased for over $10.00 per acre, but these are the exceptions and not the rule in Florida. The potential appears to be high, but the documented, successful examples are few when searching beyond hunting lease systems. One recreational pursuit that seems to have high potential is fishing, especially for largemouth bass. Although free fishing probably has a longer historical tradition than free hunting, fishermen are beginning to realize that access to quality fishing experiences may be worth paying for. The proposed future implementation of a saltwater fishing license and a required largemouth bass stamp in Florida are indications of increased future expenditures associated with fishing.

Several enterprises are developing in central Florida that are providing fee fishing for native largemouth bass. Florida has a number of areas famous for the productive bass fishery and some entrepreneurs are beginning to take advantage of this situation. For example, one corporate landowner is receiving $10.00 per acre to lease three former phosphate mine pits (totaling 1,400 acres) for bass fishing by the general

Table 3. Additional uses of lands leased for recreation in Florida (percentage response).

Availability	Camping	Fishing	Trapping	Grazing	Other
Not allowed	24	13	42	44	
Allowed, no extra cost	56	60	16	7	
Allowed, at additional cost	4	4	2	7	2[a]
Not available	4	4	2	7	2[a]
Leased separately				4	2[b]
No response	9	11	31	27	—

[a]Obtain firewood at additional cost.
[b]Apiary rights were leased separately.

public; this per acre return is comparable to local grazing leases and two or three times greater than average returns from hunting leases. In another instance, a large ranch leases out a manmade 3,600-acre reservoir to one bass fishing club (about 50 members) for over $70,000 annually. In another study (Milon et al. 1986), it was reported that the sport fishery associated with Orange and Lochloosa lakes (very well-known lakes for bass fishing) resulted in total gross expenditures by resident and non-resident anglers of $5.6 million. Additionally, the multiplier effects due to non-resident expenditures adding into the local economy was estimated to be as much as $10.8 million attributed to just these two lakes. Thus, whether direct or indirect economic benefits accrue from bass fishing, the conclusion is that they are substantial (estimated at $700 million) and show great potential for future growth in Florida.

Other leasing ventures that are developing but not yet well established include American alligator and waterfowl harvest on private wetlands, fee fishing in lakes and ponds, wildlife and nature photography, birdwatching, canoeing, and various other outdoor activities. The potential for these enterprises to further develop and grow seems high, but in some cases there are various land-use, liability or political constraints on their development. For example, a recent and dramatic shift in citrus production from central Florida to locations further south has and will significantly alter vegetation, wildlife habitat, and land use patterns; all of these changes have implications for the future of recreation in the state.

Discussion

The issue of obtaining access to private lands for recreation in a rapidly growing state like Florida has many dimensions. On one level, the public is beginning to demand not only access to, but exclusive use of, a parcel of land and is willing to pay for this use. On another level, the private landowner is certainly ready and willing to accept additional income, but is cautious about questions of liability, concerned about added time commitments, and generally lacking in some of the knowledge, skills and incentives to undertake such ventures. Some landowners in Florida are leasing land for recreational pursuits (especially deer hunting) and they are obtaining an average return per acre of $3.00–5.00. Usually, access to the land is all that is provided by the landowner and the costs associated with this are generally low. At the same time that the costs of initiating a leasing program are minimal, the income per acre also is often not competitive with some other uses of the land (e.g., citrus production, agricultural row crop production and various forms of development). The major benefit for the landowner is that the lease provides an income "cash flow buffer" for times when other sources of income are diminished. A few large enterprises in the state have been known to obtain 20–40 percent of their net annual income from leasing hunting rights to hunting clubs. Because this income may be obtained as "discretionary" money, it is often difficult to obtain accurate and complete information through public surveys.

The liability question on private lands seems to be the major stigma associated with allowing access. Liability insurance to protect either the landowner or the lessee is frequently either unavailable or too expensive to provide any major solution to this dilemma. Sometimes individual hunting clubs are able to obtain liability insurance and/or sign waivers as part of the lease agreement; these tend to allay some associated fears. The high reported use of written lease agreements containing liability disclosures and the acceptance of primarily monetary payments from one group or individual seem to be steps in a positive direction toward legitimizing and simplifying the land access transaction. Additionally, greater use of advertising and/or marketing principles and more provision of additional services for recreationists seem to be areas that could improve the visibility and probably the income obtained from these enterprises.

Although several of the advantages for the landowner of hunting lease systems may appear to outweigh some of the disadvantages, it also is important to consider the wildlife resources on the land. Hunting lease systems may provide the framework for obtaining extra income from the land and public access to the land, but these systems are not necessarily in the best interests of resident wildlife resources. Incentives are generally lacking for private landowners to significantly alter land use practices or to improve habitat conditions for wildlife in any meaningful way. Even though some larger firms may hire a full-time wildlife biologist and develop plantings or clearings for wildlife, these activities are not widespread and frequently are only secondary or tertiary to other income-producing uses of the land. For example, Lassiter (1985) reported that the intensity of wildlife management was low on forest industry lands throughout the Southeast and, of four states surveyed, Florida had the lowest percentage (52 percent) of private forest land acreage where wildlife were included in forest plans and policies.

Summary

Public demand for recreational access to private lands has been increasing in Florida, where the growth rate remains very high and pressures are strong to develop existing wild lands into housing or other uses. A survey was conducted of landowners potentially involved in leasing their lands for recreational hunting and, despite the low response rate, some useful information was obtained. The low response rate apparently reflected a landowner reluctance to reveal details on the magnitude of income obtained from leasing hunting rights, as this has associated tax and competition implications. The survey revealed that Florida landowners generally are not managing the wildlife resources on their lands as a major part of their business operation. Access to the land is often the only thing provided by the landowner and this frequently is done reluctantly due to liability and property damage issues. Liability issues remain as a major area of confusion and concern on the part of landowners. Most hunting lease agreements were established in writing and contained statements about liability of both parties. The hunting lease system in Florida has not developed the sophistication of other states like Texas and Mississippi, nor are the lease prices as high. Hunting leases, primarily for white-tailed deer, ranged in price between \$2.00 and \$8.00 per acre, with a current estimated average of \$3.00–5.00 per acre. Most lease payments are monetary and few landowners provide further services than just allowing access.

In general, incentives are lacking for management of wildlife resources on private lands used primarily for other purposes and the development of these incentives remains as a major challenge. Both the leasing of hunting and fishing rights on private lands are expected to increase in popularity as landowners learn more about these additional sources of income. Some examples were given that illustrated the potential for largemouth bass fishing on private lands to yield higher returns per acre than hunting leases and some other uses. Additional advertising or marketing and provision of services may make future recreational leases substantially more lucrative than at present.

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Special Session 4. *Economic and Other Values of Fish and Wildlife*

Chair
MARK J. REEFF
International Association of Fish and Wildlife Agencies
Washington, D.C.

Cochair
DAVID B. ROCKLAND
Sport Fishing Institute
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Playing the Sorcerer's Apprentice

Mark J. Reeff
International Association of Fish and Wildlife Agencies
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Good morning, ladies and gentlemen, and thank you for getting here at this early hour. With the many activities associated with this conference, it is gratifying to see so many hardy souls willing to sit and listen to something with as onerous a title as "Economics and other Values of Fish and Wildlife."

Let me begin by first saying that I am *not* an economist, unlike my colleague, Dr. David Rockland, Secretary of the Sport Fishing Institute. What I am is essentially an advocate for professional fish and wildlife management. We in fish and wildlife management tend to view economics as something of a necessary tool to accomplish our goal of natural resource management. What I would like to do this morning is make a few remarks about this tool, and why it is featured in a special session at the most prestigious gathering of fish and wildlife professionals in this country.

I have titled my remarks "Economic Values of Fish and Wildlife: Playing the Sorcerer's Apprentice," after the story of the sorcerer's apprentice who, while his master is away, dabbles in the black arts, and is unable to control the spells he unleashes. Most of us were told this story as children, and likely saw the marvelous Disney movie featuring Mickey Mouse as the apprentice. I know that I, for one, have often felt a bit like Mickey Mouse when having to use economics in resource management.

Professionals in natural resource management are all most anxious to employ the dark arts of economics to make their case. For example, the latest figures from the U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting and Wildlife Associated Recreation on the economics of fishing and hunting are all awaited breathlessly, for these figures allow us to go forth and make our case to the Administration, Congress, state legislatures, governors and within our own agencies and organizations. We wait impatiently for any new study which points out how economically important our particular concern is.

With the advent of computer spreadsheets, the ability to crank out a seemingly endless number of studies and updates of studies indicating that, with the correct multipliers, the economic value of fish and wildlife concern is enormous, growing, and will eventually overtake the U.S. Gross National Product.

It is likely that, given a different economist, or one who is more creative than another, a new set of figures will be churned out, giving an even more glowing projection about the economic importance of fish and wildlife. This all may seem a bit odd, to have the chairman of a session on economics poo-pooing the very topic that a number of learned professionals are about to discuss. However, such a session should be provocative and challenging. And I hope you are challenged to look at the use of economics in fish and wildlife management.

I am afraid we may be a bit too anxious to use economics. We wish we too had the skills and secret passwords to employ these spells, which would allow us to prove once and for all how important fish and wildlife are. This has the potential to be a serious and grevious mistake. I believe that the true professional must accept economic concepts, terms and figures, with the realization that they are only a part of the picture. If we allow economics—whether it be economic impacts, values or cost benefit cost ratios—to dominate fish and wildlife management, we will be overlooking other fundamental ecological and social values and concerns. We will have let economics dictate how we manage fish and wildlife, rather than using it at the expense of other tools. ''The sorcerer's apprentice'' will have allowed the spell of economics to get out of control.

Professionals should view all valuations, whether economic, social or political, with healthy skepticism, and remember that economics is one of many tools. We must keep the apprentice working, but only if he heeds the instructions of the ''master'' of professional fish and wildlife management.

I know from what I speak, for we use economics every day in our work here in Washington, and wait with bated breath for every new study. Economics is a powerful and useful tool. But, now that I, a non-economist, have warned caution on the use of economics, it is fitting that I allow our presenters to have their say.

Quantifying The Economic Value of Public Trust Resources Using the Contingent Valuation Method: A Case Study of the Mono Lake Decision

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Defining Public Trust Benefits

The Public Trust Doctrine as reflected in the 1892 United States Supreme Court ruling in *Illinois Central Railroad v. Illinois* established that navigation, commerce and fishing of navigable waters were public uses which the state must protect on behalf of its citizens (Casey 1984). In the mid-1960s California courts expanded the Public Trust uses to include recreational, environmental and ecological values as well as preservation of lands in their natural state (Casey 1984).

Loomis et al. (1984) and Loomis and Walsh (1986) relate the concept of Public Trust values and environmental values to Randall and Stoll's (1983) notion of "total economic value." Total economic value is made up of five components: (1) onsite recreation use of the resource; (2) commercial use of the resource; (3) an option demand to maintain the potential to visit the resource in the future; (4) an existence value derived from simply knowing the resource exists in a preserved state and (5) a bequest value derived by individuals from knowing that future generations will be able to enjoy the existence or use of a resource. As put forth in Loomis and Walsh (1986) these components of value essentially capture the economic value received by society from preservation of a public trust resources such as Mono Lake.

Total economic value can be measured either as an individual's maximum willingness to pay (WTP) for preservation or minimum willingness to accept compensation in lieu of preservation. Which measure to use depends on the who has the property rights to the unaltered resource. For example, in the Mono Lake case, Los Angeles has the valid water right. Hence preservation of Mono Lake at a higher level than is present today can be viewed as an increment in a person's well being or utility. As such, willingness to pay rather than willingness to accept compensation may be viewed as the appropriate measure in this case. In other public cases, individual's minimum willingness to accept may be the correct measure of value. In either case, it is one of these measures of net economic value not recreationists expenditures that is the appropriate measure of value (Loomis et al. 1984).

Mono Lake as a Public Trust Resource

In 1940 the City of Los Angeles was granted a legal water right to divert 100,000 acre feet of water from the major Sierra Nevada streams feeding Mono Lake in eastern California. This diversion rate resulted in a substantial lowering of the lake level, which most biologists feel has created an ecologically stressed condition at the Lake. In 1979 the Audubon Society and Sierra Club filed suit, citing the Public Trust Doctrine as rationale, for requiring Los Angeles to reduce its water diversion rate from streams feeding Mono Lake. In 1983, the California Supreme Court ruled in the case of *Audubon v. Superior Court of Alpine County* that the state, as both public trustee of certain resources for its citizenry and grantor of water rights, must *balance* these two roles. Public Trust resources, such as the ecology of Mono Lake, must be protected whenever *feasible* from avoidable harm associated with water diversion (Casey 1984). The California Supreme Court also ruled the state may modify the allocation of water between those currently having water rights (City of Los Angeles) and Public Trust uses of Mono Lake if existing water right allocations result in avoidable harm (Casey 1984).

As with many precedent-setting court decisions, new questions arise. On what basis can the courts or state water boards determine whether a balance between competing uses of this water had been reached? Was the balance a hydrologic balance or a biological balance necessary to maintain sensitive bird species? A political balancing was tried by the Interagency Task Force, but the solution lacked the support of the Los Angeles Department of Water and Power.

This article develops and economic balancing that incorporates the value California residents place on maintaining Mono Lake as a viable ecosystem versus the replacement cost of the water for the City of Los Angeles (L.A.). The cost of replacement water can be used to measure the foregone benefits to LA residents since alternative, but more expensive, water sources are available to LA. Comparing the incremental benefits in Public Trust resource values at lower water diversion rates with the incremental costs of replacing the lost water will allow for a determination of an optimum balance between the two uses. Viewed in a different manner, quantification of the benefits of preserving Mono Lake's ecosystem at different Lake levels will provide information on (1) how much society should invest in water conservation practices or (2) reallocation of existing supplies form low valued uses to higher valued uses. In this sense the issues surrounding Mono Lake may stand as one more incentive for development of water markets in California. Alternatively, one may interpret the California Supreme Court's ruling that protection of Public Trust resources "whenever feasible" implies purchasing of replacement water whenever the cost of this alternative is less than the values being damaged by continued diversions.

Competing Uses of Water Feeding Mono Lake

Mono Lake is a relatively unique Lake in terms of the mix of Public Trust values provided. The lake is located east of the Sierra Nevada mountains in the Great Basin and has no outlet. Mono Lake is a large hypersaline Lake with natural salinity around 5 percent (50 g/l). The natural salinity of the lake provides a very productive habitat for brine shrimp and brine flies. These food sources, combined with two islands and dozens of islets provide habitat for nearly 100 species of birds. Nesting habitat is provided for 80 percent of the State of California's population of California gulls. Critical migratory habitat is provided for a substantial part of the world populations of eared grebes and Wilson's phalarope. The mineral content of the water, combined with underground springs, has produced a unique landscape with large towers called "tufa" that rise 5–20 feet out of the water and on the nearby shoreline. Mono Lake is a State Reserve and the surrounding land has been designated by Congress as the

Mono Basin National Forest Scenic Area. Approximately 145,000 persons visit Mono Lake each year. The viability of this ecosystem is believed to be at risk if water diversions continue at their current rate.

The Los Angeles Department of Water and Power (LADWP) diverts four of the five freshwater streams that would normally flow into Mono Lake. This diverted water provides L.A. with 17 percent of its water. Outdoor use of water constitutes approximately 25 percent of L.A.'s total water use (Los Angeles Department of Water and Power 1985*a*: 3-17). Preservation of Mono Lake does not necessarily require reducing these water uses as alternative, but more expensive water is available to L.A. from the Metropolitan Water District. To compare the benefits of protecting the Lake to the increased costs of replacement water requires that the Public Trust benefits be measured in commensurate dollars.

The Contingent Valuation Method for Measuring Public Trust Benefits

The Contingent Value Method (CVM) was selected as the technique best able to measure California residents' WTP for preserving Mono Lake. CVM is a widely accepted method for valuing benefits of environmental resources (see Cummings et al. 1986 for a review of CVM). CVM has been recommended twice by the U.S. Water Resources Council (1979, 1983) under two different Administrations as one of two preferred methods for valuing outdoor recreation in federal benefit cost analyses. Recently, the U.S. Department of Interior (1986) endorsed CVM as one of the two preferred methods for valuing natural resource damages. CVM is capable of not only measuring the value of outdoor recreation under alternative lake levels, but is the only method currently available to measure the other Public Trust values such as option, existence and bequest.

The basic notion of CVM is that a realistic but hypothetical market for "buying" use and/or preservation of a nonmarketed natural resource can be described to an individual. Then the individual is told to use the market to express their valuation of the resource. Key features of the market include: (1) means of payment, often called payment vehicle; (2) the value elicitation procedure and (3) description of the resource being preserved.

The means of payment must be realistic and emotionally neutral for the respondent. To improve realism, the payment vehicle should be appropriate for the resource and market constructed. In this study of Mono Lake, one payment vehicle used is an increase in households monthly water bill (or increase in rent for households whose water is include in their rent). The water bill is a very realistic and familiar means of paying for water for most persons. It was particularly appropriate in the Mono Lake case since the water to be replaced is used for municipal and industrial purposes.

The value elicitation procedure chosen is open-ended WTP questions that simply ask the respondent to state their maximum WTP. This was partly due to the choice of a mail survey which makes iterative bidding impractical.

Of course, some people might question the accuracy of answers to simulated markets as compared to real markets where cash actually changes hands. Would people really pay the dollar amounts they state in these surveys? The empirical evidence to date indicates that when asking WTP (rather than willingness to accept), that people would pay approximately what they state in the surveys. This conclusion is based on several comparisons of real cash markets with simulated markets used in contingent valuation (Bishop and Heberlein 1979, Welsh 1986).

Survey Design

Describing the Public Trust Resources at Stake

To allow an accurate description of five Lake characteristics at alternative Lake levels, a variety of hydrology and atmospheric models were employed. To translate diversion rates to lake level, a water balance forecast model developed by Vorster (1985) for Mono Lake was utilized. The same model also translated lake level into the water's salinity level. To predict the effect changes in salinity would have on birds' primary food supply (brine shrimp) the work of Dana and Lenz (1986) was utilized. Changes in severity of dust storms and scenic visibility were related to Lake levels using the air quality model of Kusko and Cahill (1984).

To depict the Public Trust resources at stake, a three color map showing Mono Lake at three different lake levels was included as part of the survey. The visual aid is illustrated (in black and white) in Figure 1. For each Lake level there is a separate boxed-in description of the condition of five lake characteristics printed in the same color as the respective lake level. The arrows connect the boxed descriptions to the appropriate lake level. The five lake characteristics were: (1) equilibrium lake height relative to the 1982 lake level and ease (or difficulty) of recreational access to the lake; (2) salinity of the lake water and its implications for production of brine shrimp (the birds' primary food supply); (3) suitability of Negit Island for gull nesting; (4) likely level of total bird populations and species diversity; and (5) effect of falling lake level on severity of dust storms and the impact on scenic visibility.

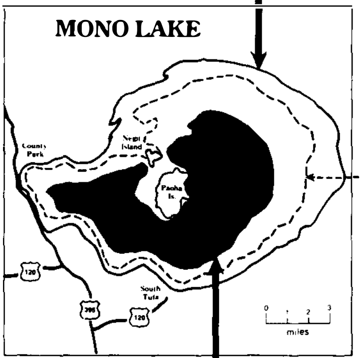
Two of the three lake levels were chosen to reflect the end points of potential legal and political outcomes. Alternative #1 in Figure 1 displays a lake level similar to what was recommended by the Interagency Task Force (6,387 feet), which required a reduction in water diversion from 100,000 acre feet a year to between 25,000 to 35,000 per year depending on a host of meterological conditions during the particular water year (California Department of Water Resources 1979). The lowest lake level is Alternative #3. This level represents continuation of L.A.'s existing 100,000 acre foot diversion rate. Alternative #2 reflects persistence of the Lake's lowest level similar to what occurred in 1982 (6,372 feet) and brought national attention to Mono Lake's plight. This lake level would be maintained with a 50,000 acre foot diversion level (Vorster 1985:225).

Even with all of this scientific research at Mono Lake, direct linkages to bird populations for Alternative #2 could not be precisely quantified by any of the biologists interviewed, and therefore qualitative descriptions had to be employed to describe bird populations at the intermediate lake level. However, the end points associated with Alternatives #1 and #3 are fairly well described in terms of potential populations of birds. Thus the total value for moving from Alternative #3 (current diversion rate) to Alternative #1 (which is the sum of WTP for moving from Alternative #3 to #2 and from Alternative #2 to #1) will be quite accurate.

ALTERNATIVE #1

Minimal Water Diversion from Mono Lake

1. Within 5 years, Lake level would be 15 feet higher than 1982 with most visible tufa towers rising from their reflections in the water. Good access to Lake for recreation.
2. Saltiness of Lake water 2 times that of Ocean (slightly above Mono Lake's natural level) but still acceptable for producing adequate amounts of brine shrimp which are the key food source of the birds.
3. Negit is an island where gull nesting is safe from predators.
4. About one million birds using the Lake and nearly 100 species of birds stopping at the Lake during migration.
5. The occasional dust storms do not severely affect scenic visibility or air quality.



ALTERNATIVE #2

Substantial Water Diversion from Mono Lake
(Conditions similar to Lake's lowest level which occured in 1982)

1. Low Lake level with some tufa towers rising out of water and most on land near the shoreline. Recreational access to Lake difficult.
2. Saltiness of Lake water 3 times that of the Ocean reducing production of birds' food supply.
3. Negit no longer an island but is connected to land such that coyotes and other predators can invade and prevent gulls fom nesting.
4. Bird populations decrease and bird diversity is reduced.
5. The severity of dust storms increase, reducing scenic visibility.

ALTERNATIVE #3

Current Maximum Water Diversion from Mono Lake

1. Lake level drops an additional 30 feet during the next 30 years with exposed shore becoming a white ring of alkali mud and dust with few plants. Recreational access to Lake very difficult. No tufa towers rising out of water, all on land.
2. Saltiness of Lake water increasing to 5 times that of the Ocean resulting in almost complete loss of birds' food supply in 15 years.
3. Both Paoha and Negit are no longer islands making them unavailable for gull nesting.
4. Bird populations at Mono Lake decrease in 15 years to a small fraction of current number, reducing world populations of California Gulls, Eared Grebes and Wilson Phalarope.
5. Severity of dust storms become 2 to 10 times worse than current conditions reducing visibility and creating health hazards.

Figure 1. Alternative lake levels.

Sampling Procedures

The sampling frame was California households in 1985. A random sample of 500 names was drawn from California phone directories. There are some minor drawbacks to using phone directories in that persons who move often are omitted, but Dillman (1978) indicates that telephone ownership is sufficiently high to warrant good representation of the population in the sample.

Mailing Procedures

The development of the mail questionnaire followed the basic outline of Dillman's "total design method" (Dillman 1978). The questionnaire was typeset and put in booklet form, it was accompanied by an individually typed cover letter addressed to the respondent. A pre-addressed, postage paid return envelope was provided to facilitate return mailing of the completed questionnaire. One week after the mailing of the questionnaire, all respondents received a reminder postcard. One month after the postcard a replacement survey and new, more emphatic cover letter was sent to households that had failed to return a survey.

Economic Analysis

Approaches to Expanding Sample Estimates to General Population

These mailing procedures resulted in a response rate of 44 percent, which is about average for general household mail CVM surveys and above the average for a California general population CVM survey. However, the sample had an average education level of 15.62 years compared to the California average (in 1980, however) of 12.24 years. The sample's average age was 47.51 years, whereas the state average was 43 years. The sample income was $5,600 higher than the state population. These differences between sample and state characteristics may be related to the fact that published statistics on the state averages for these variables are several years behind the survey. Nonetheless, the researcher can compute a more accurate estimate of state benefits by adjusting the sample values to account for differences between the sample respondents and the general population.

Schulze et al. (1983) take an ordinary least squares (OLS) regression approach to adjust existence values of visibility at the Grand Canyon for differences in sample and population socioeconomic differences. In particular, Schulze et al. (1983:169) estimate a regression equation which relates household WTP to respondent's socioeconomic variables, such as income, age, race and distance from the Grand Canyon. By substituting state average values for income, age, race and distance ". . . the bid the state's average household would offer to preserve the visibility of the Grand Canyon could be estimated. Aggregate statewide benefits are then determined by multiplying this figure by the number of households in the state" (Schulze et al. 1983:169). This regression approach appears quite defensible and will be more fully developed below.

OLS Regression Approach to Adjusting WTP

The WTP equation for purchasing Lake level #2 instead of #3 (the degradation case) is:

$$\begin{array}{lccccc} \ln(\mathrm{WB23}) = & -4.186 & + 1.8597(\ln\mathrm{ED}) & - .85(\ln\mathrm{AGE}) & + 3.5(\ln[\mathrm{AGREE}+1]) \\ T \text{ Values} & (-1.72) & (2.74) & (-2.39) & (8.78) \\ & & + .62(\ln\mathrm{FEE}) & + .437(\ln[\mathrm{KNOW}+1]) & \\ & & (7.03) & (2.24) & \end{array}$$

Where: WB23 = monthly WTP a higher water bill for Lake level #2 versus #3.

ED = Education level in years

AGE = Age in years

AGREE = Dummy variable, equal to 0 if they would not agree to pay the initial water bill and equal to 1 if they would agree to pay the initial membership fee.

FEE = initial water bill, in dollars

KNOW = number of sources of information a respondent had about Mono Lake.

The number one was added to the value of AGREE and KNOW because taking the natural log of zero is an undefined mathematical operation and the variable was originally coded as zero or one. Adding one simply recodes the variable from zero or one to one or two. Overall this double log equation was highly significant with an F statistic of 23.9 indicating significance beyond the 99 percent level. The equation had an adjusted R^2 of 0.457. All of the slope coefficients in the equation are significant at the 95 percent level or better. The sample size equals 137. The sample WTP and the state average WTP adjusted for state demographics is presented in Table 1.

The WTP in the form of a monthly water bill for Lake Alternative #1 versus #2 (WB12) is given below:

$$\begin{array}{llllll} \ln(WB12) = & -2.54 & +\ 1.54(\ln ED) & -\ 0.924(\ln AGE) & +\ 3.527(\ln[AGREE+1]) \\ T \text{ Values} & (-1.13) & (2.45) & (-2.86) & (10.77) \\ & & +\ 0.54(\ln FEE) & +\ 0.386(\ln[KNOW+1]) & \\ & & (5.96) & (2.16) & \end{array}$$

The double log equation had an adjusted R^2 of 0.515 and an F statistic of 32. The F statistic is significant at the 99 percent level. The slope coefficients are all significant at the 95 percent level or higher. The sample size was 137. The number one was added to each variable for the same reason described above.

Willingness to Pay Results

Table 1 summarizes the value per household and the total State of California benefits. Total state benefits are the adjusted state average value per household multiplied by the 9,888,060 households in California.

Table 1. Annual benefits to California households.

Alternative	Sample estimate	Sample adjusted WTP equation	Total state benefits
#2 vs. #3	\$65.04	\$51.36	\$507,850,700
#1 vs. #2	\$48.72	\$43.32	\$428,350,700
Total	\$113.76	\$94.68	\$936,201,400

About 20 percent of all the respondents refused to use the hypothetical market to value preservation of Mono Lake. There were also many people who had a legitimate zero WTP to protect Mono Lake. These people indicated they either could not afford to pay a higher water bill or they did not value protection of Mono Lake. These zero bids count as real indicators of these households' economic value and are included in all computations and analysis.

Most of the other bids were generally conservative and represent a very small fraction of the respondents' income (on average about one-tenth of one percent of their income). Geographically, respondents living in the L.A. Department of Water and Power service area had WTP amounts above the state average. While we did get a few bids in the hundreds of dollars range, it is worth noting that an environmental group specializing solely in efforts to preserve Mono Lake (the Mono Lake Committee) has a fair number of their contributions in these dollar ranges. About 9 percent of the members actually make contributions of $100 or more, with 0.5% making contributions of $500 or more (Martha Davis, pers. comm. 1986).

Reasons Why People Would Pay to Protect Mono Lake

Most of survey respondents' WTP was for "knowing Mono Lake exists as a habitat for birds," followed by protecting Mono Lake for future generations. Protecting Mono Lake for your own future use and current recreation value were much less important. The relative importance of the four reasons is shown in Figure 2.

Cost of Replacing Water and Hydropower from Mono Lake

To maintain the Lake level described in Alternative #1, water diversions by LADWP would have to be cut from the current average of 100,000 acre feet per year to 25,000 acre feet per year (Vorster 1985:225). More expensive replacement water is available to L.A. from the Metropolitan Water District. The marginal cost of this replacement water is $224 per acre foot. Of course if water markets were to

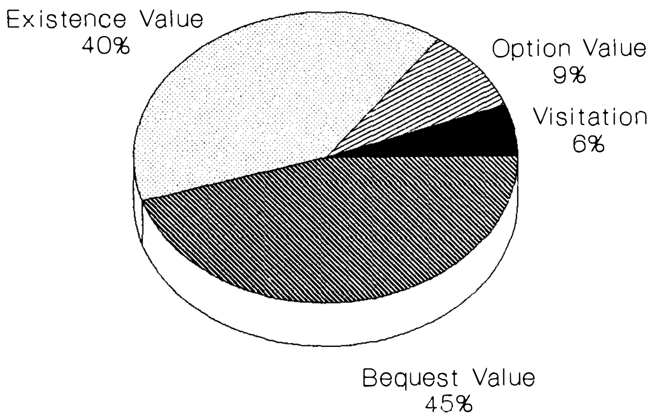


Figure 2. Reasons for valuing Mono Lake.

develop more fully, it is likely that L.A. could be supplied surplus water from agriculture at costs of $50 an acre foot (Gibbons 1986:38). In this sense, the $224 per acre foot thus represents an upper bound on the cost. This figure is also likely to be an upper bound on costs because there may be investments in water conservation or water management efficiencies that can provide several thousand acre feet of water at a marginal cost less than $224. Nonetheless using the $224 per acre foot figure, the water replacement cost to maintain Mono Lake at the level in Alternative #1 is $15.7 million each year.

The water diverted from the Sierra Nevada streams drops from an elevation of approximately 7,000 feet to approximately sea level at L.A. To capitalize on the energy potential of this elevation drop, LADWP has constructed several facilities to generate hydroelectricity. The annual replacement cost of the electricity associated with maintenance of Mono Lake as described in Alternative #1 would be $10.5 million annually (L.A. Department of Water and Power 1985*b*). Thus, the total costs of preserving Mono Lake as described in Alternative #1 would be $26.2 million annually.

Perspective can be gained on the cost estimate by expressing it on a per household basis. If the higher cost of replacement water and power were spread equally among all households in the state the average cost would be $2.64 per household per year. This amounts to 22 cents per month to a typical household in California.

Comparison of Benefits and Costs of Preserving Mono Lake

While the average cost per household of preserving Mono Lake is $2.64 a year or 22 cents per month, the average household would pay $95 per year or $7.90 more per month to have Mono lake as described in Alternative #1 rather than #3. Therefore it is economically feasible to preserve Mono Lake. Recognizing there is a confidence interval around our point estimates, the probability is very high that households would certainly pay the $2.64 per year necessary to purchase alternative water sources. From the standpoint of economic efficiency analysis (which compares overall benefits and costs to state households in the aggregate), it is economically feasible to purchase replacement water so as to maintain Mono Lake as described in Alternative #1 regardless of whether the costs are spread or borne by just LADWP ratepayers. Specifically, the amount of gain to state households greatly exceeds the losses in the form of higher water bills. The exact distribution of the costs within the State of California will of course influence the political feasibility of any solution.

This study did not quantify the ecological effects replacing Mono Lake water has on other resources elsewhere in the state. In part this is due to belief that investments in water conservation and recycling can make up part of the replacement needed. In addition, vigorous use of marginal cost pricing of water (i.e., pricing water at its replacement cost rather than average cost) can result in the needed 10 percent reduction in water demanded. This reduction would occur in just the same manner as the price increases for electricity and gasoline reduced consumption of these goods. In the long run, the most economical and environmentally sound new supplies of municipal water will likely be obtained form transfers of water from irrigated agriculture in and around the Kesterson area. In these cases, this transfer may even result in a net environmental gain to the state.

Conclusion

This study was successful in measuring the Public Trust values of preserving Mono Lake at alternative Lake levels. In a methodological sense, contingent valuation stands as useful tool for evaluating the economic balancing of traditional water demands with protection of Public Trust resources. In the door opened by California Supreme Court regarding challenges to water rights, contingent valuation may prove to be a valuable tool for providing evidence as to the extent of balance between water uses. CVM can also be used to assess the economic feasibility of replacing the foregone water via investments in water conservation or purchase of water from competing users, including agriculture.

The empirical results show that state residents total social benefits of preserving Mono Lake exceed the costs of such preservation. Based on these figures, Mono Lake is valued by state residents not solely for recreation but primarily for preservation of a relatively unique ecosystem that provides critical habitat for several migratory birds. As such, the benefits received principle would imply costs of maintaining this ecosystem should be shared by all state residents.

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The Changing Role of Subsistence in Rural Alaska

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Introduction

Traditionally, subsistence referred to activities that were undertaken to provide sustenance for physical survival, and often inferred survival by the barest of means. Harvesting of fish, wildlife and other natural resources were essentially the sole source of support, and inputs to the production process were obtained from closed systems that existed within isolated communities. Group participation in resource harvesting activities reduced the risk of failure, and failure meant doom. The traditional sharing and distribution system increased the certainty of survival in the face of naturally fluctuating resource availability.

Today, rural Alaska is a far cry from the isolated, primitive situation that existed a relatively short time ago. Communities may be geographically isolated, but benefit from many of the same services common to more developed, urban areas. Air transportation is available in almost all communities and many have regularly scheduled air service—some even by jet. Centralized electric service is available in most communities and their households have many electrical appliances, including televisions and washers. Centralized water supply and sewage disposal systems are common. Education through high school is generally available locally as are college-level courses through the University of Alaska. Telephone and satellite communications are also available in many localities (Alonso and Rust 1976, Glass and Muth 1988).

In much of rural Alaska, the economy is a mix of three sectors—the public, private, and subsistence (Glass 1987). Monetary income and other benefits are derived through the market as well as the public sector, but subsistence activities also make a major contribution to overall well-being. Annual incomes of many rural residents, whether derived from employment or resource harvesting for sale (both usually seasonal), or public transfer payments, are relatively low in many communities, especially when compared to the high costs of food, fuel, lodging, and other basic needs. In many rural areas, subsistence activities are important as supplements to monetary income. However, subsistence activities still seem to be practiced widely even in the most affluent rural communities (Glass and Muth 1988).

The public sector is also very much involved in the economy of rural Alaska. The same programs that are available to other Alaskans and United States citizens are available to rural Alaskan residents. The public sector provides employment both directly and indirectly through capital investments. Furthermore, unemployment compensation is available for those out of work who qualify. Other programs provide a safety net to assure survival during the worst of times. Educational, medical and other services are provided through the public budget. Airports and seaports are also provided through public investment. In fact, the commercial and subsistence fish and wildlife are publicly owned resources until harvested.

Contemporary rural Alaska has undergone profound changes due to modernization. In this paper, we will examine some of these changes and assess their impact on the traditional subsistence lifestyle. Particular reference will be given to the implications toward the socioeconomic assessment of alternative resource development.

Production Process

As with commercial activities, subsistence harvesting can be visualized as a production function, the physical relationship between inputs and outputs. In both cases, various factors of production are combined to produce goods and services. Historically, subsistence activities were largely dependent on labor, with limited capital, but this has changed dramatically. As capital investments increased over time, subsistence and harvesting became physically more efficient, but more dependent on the market economy.

The changes that have occurred are demonstrated by an historical examination of trapping. Before the coming of the white man, Native trappers relied on rather crude implements such as babiche snares and deadfalls, traveled primarily by foot or canoe, and utilized seasonal dwellings along their traplines. When dog teams were used, they were fed food caught and processed by the trappers or members of their working circle. The implements utilized in trapping were also produced by the trappers, their families or members of their own small groups or communities. Although trade existed with other communities, no monetary-oriented market existed.

With the coming of the white man, steel traps were introduced and furs were sold to foreign traders. While the market made some inroads into the subsistence lifestyle, it was still a relatively minor component.

Today, subsistence is substantially more intertwined with the public and market sectors. For the 1982–83 trapping season, a survey conducted by the Alaska Department of Fish and Game for the Interior Region indicated that 81 percent of the trappers responding used snowmobiles to check their traplines. In fact, 12 percent of the respondents utilized aircraft in their trapping operations. While 18 percent used dog teams, this was often done for nostalgic reasons, or for a desire to work with dogs, rather than as a result of harvest efficiency.

Trapping and other subsistence activities have become more and more market dependent and are requiring greater capital investment. While subsistence was once perceived as isolated from the market economy, there is considerable interaction between monetary income and both capital and operating expenses in many subsistence activities.

As with the physical production process, the cost of subsistence can be examined in a manner similar to more traditional market-oriented activities. Equipment, fuel, and other material goods are purchased largely through the market, although this has been the case only in the present. For example, the snowmobiles that are used widely to run traplines require an initial investment plus operating costs for fuel, repair and maintenance. Other subsistence activities utilize metal or fiberglass boats, outboard motors, guns, ammunition and sonar devices. Although smoking and drying are still practiced, home canning equipment and electric freezers have replaced many of the traditional preservation techniques. Furs, handicrafts, and other items are sold through formal market channels. The market and public sectors of the economy have become intertwined with almost every facet of the subsistence lifestyle.

The cost structure of subsistence activities differs from the neoclassical market model in several significant ways. For example, labor is not generally priced, so it is difficult to determine the cost related to one of the primary factors of production. This is also often the case with sole proprietorships in the market economy. In the latter case, the opportunity cost of time may be an appropriate proxy for labor costs, but this approach is more difficult to apply to subsistence activities. To be sure, there are instances where individuals forego income-generating opportunities in order to pursue subsistence activities; and, in these cases, the opportunity cost concept may have applicability. However, income-producing alternatives often are not available in rural Alaska; many of its inhabitants do not possess the kinds of skills that would make them competitive in the labor market even if they were to migrate to new locations. If it were possible to calculate opportunity costs, this approach also has conceptual limitations that should be considered (Glass and Muth 1987).

Quantifying the labor costs of participation in subsistence activities is further complicated because the participation itself often provides a payoff beyond the dollars or material product. In other words, psychologically, participation reaps its own rewards. However, it should be noted that such benefits may also be accrued in other walks of life.

Making matters even more complicated, some subsistence activities are closely associated with market-oriented enterprises. An individual may use the same fishing gear to satisfy family and community subsistence needs for salmon that is used to harvest salmon for commercial outlets. In this case, only the additional costs incurred for the subsistence harvest can be charged appropriately to that activity.

Another consideration is that much of the production process which provides fish, wildlife and other natural resources is likely to be exogenous to the subsistence system. Ownership rights of fish and wildlife are not limited to specific human populations although some specific harvesting rights may be transmitted to them by governing bodies. Even so, subsistence users contribute little to the production process before they actually engage in the pursuit and harvest of fish, wildlife and the other resources upon which they depend.

All in all, the familiar neoclassical, microeconomic models are not particularly useful in explaining subsistence behavior. Any model, whether dealing with subsistence or the market, which does not consider behavior in the face of risk and uncertainty has limited applicability to real-world problems. Concern for the uncertainty of the future with respect to sources of monetary income may explain why those traditionally pursuing this lifestyle often continue to maintain or enhance their capabilities even during periods of relative affluence. Members of subsistence societies most often participated in group activities not only to increase efficiency, but also as a means of reducing individual risk of an inadequate provision for critical needs (Scott 1976). Other models—such as the optimal foraging theory—have arisen in an attempt to explain subsistence behaviors more adequately. (Smith 1983, Winterhalder 1981). Nonetheless, extensions of microeconomic theory which consider risk and uncertainty have the potential to provide valuable insights into the supply side of subsistence behavior.

Changing Dependency

While there are structural similarities between the production of goods and services in the market and traditional subsistence systems, disparities seem to prevail with respect to the distribution of goods and services. In the market, the pricing system is the primary allocation mechanism, but it does not play a major role with respect to the distribution of subsistence goods. Harvests of fish and wildlife are shared among family members or even larger groups. Group members may have specific roles to fill for the overall good, but the existence of medium of exchange is not apparent. Subsistence distribution and exchange are based on norms of reciprocity and mutual obligation (Scott 1976, Oberg 1973, Muth 1986, 1989, Landgon and Worl 1981), rather than on monetary exchange.

While one might argue that a broad definition of the economy would include the allocation processes that occur within primitive societies, this is more a matter of semantics without relevance to the current subsistence situation in Alaska. As previously recognized, Alaskan villages have become immersed to varying degrees, in mixed economic systems, and the traditional subsistence lifestyle has been influenced severely. In view of this situation, Dalton (1971) concludes:

> *Modernization and development inevitably restructure the economy and society of village communities because the principal innovations that comprise modernization are new economic, cultural, and political transactions, activities, and institutions which connect the village to the outside world, thereby undoing local dependence, autonomy, and isolation. What anthropologists sometimes call the increase in scale that accompanies modernization means new mobility and alternatives, new activities and occupations, new transactional flows. These integrate local communities with the nation, economically, and eventually create a new common cultural identify—shared values and attitudes—as well as new equipment and diversified lines of production.*

While total dependence of subsistence does not exist to the extent that it has in the past, traditional food gathering and related activities still fill a vital role in rural Alaskan survival. For example, Kruse (1982) reported that opportunities for wage income were not sufficient to provide the sole economic base in the North Slope. He concluded that the value subsistence production added to household income from public and market sources enabled most North Slope households to enjoy moderate lifestyles.

Dependency on subsistence outputs also varies with the season of the year. During the summer months, salmon or other fish, berries and other edible plants, and a host of subsistence products are abundant in most rural localities, and sources of monetary income are also most readily available. By contrast, many sources of monetary income, as well as subsistence opportunities, tend to become very scarce in much of rural Alaska during winter. Thus, an activity like trapping, while usually not a major component of average annual income, can become critical for survival on a short-run, seasonal basis.

Trapping provides a source of additional income and also food for human consumption. While, strictly speaking, income from trapping may be considered commercial in nature, it violates neither the state nor federal definition of subsistence. Trappers receive revenues through the sale of raw furs to local buyers, regional fur dealers or fur auctions in the lower 48 states and Canada. Furs are also manufactured into handcrafted products for sale, barter or distribution through informal community channels.

The importance of subsistence products to supplement monetary income in remote areas of Alaska cannot be denied, but the contribution that participation in subsistence activities makes to other facets of social well-being may exceed these material returns. For instance, trapping is not only a source of cash income and supplement for the family's food supply, but also a form of recreation. With Alaskan Natives, trapping can have an important cultural component. An activity such as trapping provides a means for Native people to maintain touch with the traditional ways of life (Daley 1982). The willingness of trappers—both Native and non-native—to spend long periods in the bush, even when fur prices are low, may be partially explained by the desire to participate in this traditional activity.

Participation in subsistence activities reinforces a variety of cultural and subcultural values and institutions for both Natives and non-natives. For example, the harvesting of fish and wildlife contributes to self-reliance, independence, and the ability to provide for one's self and family—values that recent empirical evidence suggests as reasons people migrate to or remain in Alaska (Alves 1980). In addition, subsistence activities are a primary component of traditional Alaskan Native heritage, a heritage that many people desire to preserve (Berger 1985).

From this perspective, it is obvious that subsistence involves much more than physical dependence on the production and allocation of goods and services in the traditional economic sense. Subsistence involves patterns or networks of production, processing, distribution, exchange and consumption that help maintain a complex web of institutional relationships involving authority, respect, wealth, obligation, status, power and other components of social structure (Dowling 1968, Berger 1985, J. E. Hannah Associates 1981). Thus, it may not be significant whether salmon are taken by primitive gear such as a fish wheel, or by modern, sophisticated commercial equipment. The salient factor from a subsistence perspective is that salmon, taken by whatever means, enter the community distribution and exchange network and, consequently support the existing sociocultural configuration of institutional structures (Muth et al. 1985).

For example, within Alaska's subsistence-based communities, several studies indicate that hunting and fishing ". . . commonly occur within cooperative and extended kinship groups linking several households. Fish and game products are distributed and exchanged along community-wide, non-market networks. The community is dependent socially and economically on the productive activities in the non-market fishing and hunting sector. These traditional and customary modes of production, distribution, and exchange provide the social and economic integration of entire communities" (Wolfe and Ellanna 1983).

Surveys conducted in rural Alaskan communities demonstrate the extent of subsistence participation even though monetary income is also available (Kruse 1982, Smythe 1988). In such cases, individuals are likely to adjust the times in which they participate, that is, weekends, vacations, and slack periods for employment. Nonetheless, high proportions of those surveyed indicated that they continued to participate in hunting, fishing and other traditional subsistence activities.

These surveys also provide empirical evidence with respect to the level of community involvement in the subsistence production and distribution system. Very high proportions of rural households continue to give or receive food from other households.

While neoclassical, microeconomic theory, modified to consider risk and uncertainty, can provide some useful insights into the supply side of subsistence activities, its tenets bear little resemblance to traditional subsistence distribution patterns. The driving force behind theoretical market behavior can be expressed simply as greed, but this term has no place in traditional subsistence societies. In fact, greed in abhorred, while social status is based largely upon generosity and sharing (Spencer 1959). One of the most serious adverse effects attributable to modernization has been the social stress related to the abandonment of these traditional distribution systems. Local economies become more and more immersed in the market and public sectors.

Discussion

Clearly, the economic base of most rural Alaskan communities represents an integrated market-public-subsistence mix. The market operates to provide monetary income as well as goods and services. The public sector provides employment and transfer payments, levies taxes, stimulates employment in the market sector, and provides services. Subsistence activities serve critical roles of both supplementing income and providing a source of support during periods when sources of monetary income are limited or nonexistent. Subsistence activities, in addition to their economic role, contribute to overall social well-being through a variety of social, cultural, and psychological functions. The interactions between these sectors of the economic base must be considered when assessing the impact of proposed natural resource allocation decisions on social well-being.

The complexity of the interactions among these economic sectors and other institutional domains adds to the difficulty of conducting meaningful impact analyses of alternative resource allocation strategies. Assessing the socioeconomic impact of subsistence in isolation of the market and public sectors offers little opportunity to determine the likely changes in social well-being attributable to a proposed action. Hence, the interactions among these three sectors must be considered in light of their relationship to overall well-being.

For example, a resource development project in the vicinity of a rurual community in Alaska can have a myriad of effects, both positive and negative. Resource development can have undesirable effects on the availability of some of the most critical subsistence fish and wildlife species such as salmon, berries, moose, deer, and caribou. However, depending on the magnitude of fish and wildlife losses, it is not clear that such an occurrence will actually diminish the subsistence harvest or overall standard of living of local residents. Fewer moose may mean only that more time must be spent hunting in order to reach a desired level of harvest rather than a reduced harvest. Furthermore, increased accessibility to previously difficult-to-reach hunting and fishing areas can provide a wider range of opportunities. By the same token, more accessibility may increase competition for subsistence resources by people from other areas.

The impact of resource development is likely to go far beyond these rather direct effects on fish and wildlife. If the introduced activity provides employment and other income-generating opportunities to local residents, it may have a profound effect on subsistence activities as well as the other economic sectors. Those receiving monetary income can avail themselves of the commercial market for goods and services and thus reduce both their dependence and the associated risks of the subsistence lifestyle. There may be less time to pursue subsistence activities for those steadily employed, but the level of harvest and availability of subsistence products are not necessarily diminished proportionately as a result. Subsistence efforts may be concentrated during periods when not working, and those who are not employed may increase their level of participation, sharing the harvest with the wage earners. Furthermore, the availability of monies for capital investments in subsistence and related equipment can increase efficiency and mobility to the extent that desired harvest levels are realized with less effort.

Modernization, resource development and structural differentiation into previously-remote, rural Alaskan communities can also have its negative aspects. With more people frequenting the community, new residents and visitors, demands for public services usually increase. A loss of community cohesiveness may result. Levels of stress and social pathology may rise. While a nearby resource development project might well increase the tax base to support public services in the short run, such operations are usually temporary in nature. After the project is completed, and the firm, and most of its employees, moves elsewhere, small rural communities can be burdened with substantial public debt brought about by capital investments to satisfy the wants of a population that has, to a large extent, departed. Thus, the permanent residents may be saddled with a continuing tax burden, limited employment opportunities, and greater dependence on a subsistence base that may have been diminished, both in terms of the availability of natural resources as well as the removal of specialized knowledge from the community's social repertoire.

There are, of course, situations where changes in the allocation of resources virtually eliminate subsistence activities. For example, the loss of specific areas to trapping may not be replaceable in many localities in the interior of Alaska. On public lands throughout rural Alaska, there exists an informal registration of traplines which, in fact, convey limited property rights. Transfer occurs only when a trapper becomes inactive, dies, or disposes of the trapline in some other manner. If a trapper loses his area to competing uses, he may not be able to find another that is not already claimed. In such a case, the trapper incurs some critical losses. Fur revenues will no longer be available. Those furbearer carcasses that are consumed as food will no longer be available, affecting not only the trapper and his family but also other community members with whom these resources are shared. The furs that were used in handicraft production would no longer be available unless purchased from other trappers or fur dealers, which may reduce the profitability of such an enterprise. There would also be a loss of the psychological values to the trapper of participation in a traditional subsistence activity. Furthermore, running a trapline can also enhance hunting success by providing opportunities to discover new areas, observe the location and behavior of game, and conduct complementary harvests. Varying with the degree of annual and seasonal dependence, the loss of a trapline can be critical.

Conclusions

The examples cited above not only demonstrate some of the complex interactions associated with resource management decisions that might occur in the mixed private-public-subsistence economies that typify rural Alaskan communities, but also suggest where mitigation measures may or may not be effective. When examining material well-being alone, there do appear to be opportunities to mitigate the loss of subsistence opportunities. A reduction in the population of a subsistence species or a diminishing of one of the factors of production does not necessarily mean that total output will decrease. Other inputs can be substituted to reach the same level or even a greater harvest. Thus, a decline in local salmon stocks may not result in a corresponding reduction in the subsistence harvest of salmon; since fishermen can compensate by spending more time fishing, utilize more efficient fishing gear, or travel to areas where they can harvest other stocks. Thus, money accrued through the cash economy used to invest in better fishing gear may compensate for reduced stocks, at least for subsistence users. Substitution among the factors of production can enable an adequate harvest to satisfy physical well-being so long as the subsistence allotment is not reduced below the level of community needs. Of course, a reduction in the salmon subsistence allotment could have serious consequences unless substitute species were available. However, it should also be considered that the loss in the commercial or sport harvest in deference to the subsistence priority can also have a detrimental impact on the community.

There may be alternatives within the input mix to harvest subsistence products and, at least, imperfect substitutes for many of these products in the market; but it appears much more difficult to compensate for the loss of the opportunity to participate in subsistence activities in an intrinsic sense. While the willingness to substitute one subsistence activity for another may vary with the individual, complete withdrawal from this lifestyle can be deleterious. There may be suitable substitutes with respect to some activities outside of the realm of subsistence, but it is often very difficult for individuals raised in such a culture to make this kind of adjustment. Determining just compensation for such a loss may be beyond the state of the art. Fortunately, few resource allocation decisions are likely to remove people involuntarily and completely from the subsistence lifestyle, and there are substitutes for many of its material components.

In addition to the legal definitions of subsistence, a variety of social science and popular definitions exists. The lack of a commonly-accepted definition, the on-going judicial interpretation, and the variety of social, psychological, economic and cultural functions of subsistence increase the difficulty of conducting meaningful socioeconomic impact assessments of subsistence user-groups. In order for the social consequences to be identified comprehensively, it is our view that subsistence studies should be conducted within a broader sociocultural context than that occasioned by traditional economics or other social sciences in isolation. Models which attempt to identify socioeconomic changes in remote rural communities must take into consideration the unique mix of the private, public and subsistence sectors that characterizes local economies.

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Economic Values of Arkansas' Sport Fisheries

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Introduction

For the past decade or so, natural resource managers have been attempting to place monetary values on fish and wildlife resources, largely in response to stiff competition for limited funds. Scientifically designed, highly quantitative economic surveys are the norm and do provide much needed information for the estimate of fish and wildlife values for resource use/cost comparisons and other major policy decisions. Such studies are generally expensive and yield results tomorrow, while the decisions concerning dollar allocation are being made today.

Once the economics of a state's game and fish and related human activities are defined, are we, as resource managers, prepared to get the most out of the information with which we have been supplied? Are we to be satisfied with being able to state the worth of our state's wildlife resources, or can we gather information to help us to market this valuable product and thus increase its value as well?

With questions such as these in mind, the Arkansas Game and Fish Commission contracted Area Marketing/Research Associates (AMRA) of Little Rock to design a study. The goals of the study were to define:

- The impact of fishing on the state's economy.
- The potential impact of improved fishing conditions upon the inclination of the public to fish or to take up fishing.
- The demographics of the fishing and non-fishing publics.

Methods

The Economic Impact Study, hereafter referred to as the Arkansas Study, consisted of a telephone survey of 210 licensed Arkansas fishermen and 203 resident non-fishermen, selected at random from local telephone directories throughout the state. Of these 413 residents, approximately 50 fishermen and 50 non-fishermen from each of the state's four congressional districts were interviewed.

One hundred nonresident fishermen also were interviewed as part of this study. These respondents were randomly selected from a list compiled from the 15 locations in the state where the greatest numbers of nonresident fishing licenses are sold.

Interviews were conducted on November 28 and 29, 1987, using a 42-item survey instrument which included seven demographics indicators.

The Arkansas Study spawned a further analysis by AMRA,which proposed to provide a measure of the possible economic impact of increased fishing activity in Arkansas. *Measuring the Value of Increased Fishing in Arkansas* is, in essence, a further development of the data provided by the Arkansas Study. The questions addressed in this analysis were:

- What is the relationship between the public's catching more and/or larger fish and its willingness to go fishing more often (the marginal propensity to fish)?

- How much more would be spent on fishing in Arkansas by those for whom this relationship is positive (the marginal propensity to spend on fishing)?
- What would be the economic impact on the Arkansas economy if these marginal propensities could be realized?

Study Results

Current Spending, Resident and Nonresident Fishermen

The weighted mean annual expenditure reported by fishermen in pursuit of their sport was $391.00. This figure is probably somewhat conservative, for two reasons. First, people are likely to underestimate the amounts they spend on recreational activities, particularly the indirect costs (Charles Venus, Venns and Assoc., pers. comm., 1988). Secondly, in order to calculate the weighted mean expenditure, the highest spending category ($700.00 plus, open-ended) was capped with an estimate of $800.00 total expenditures, thus decreasing that weighted mean value (Table 1).

Since there were 636,963 Arkansas fishing license holders in the year preceding June, 1987, and the weighted mean annual spending estimate was $391.00, the total spending by licensed fishermen would be approximately $250 million. If, as predicted, this estimate is low by 25 percent, the total spending for the year would have been around $311 million, and with the multiplier effect, $569.6 million in total economic impact.

Marginal Propensity to Fish/Spend

Respondents to our survey universally demonstrated what can be called the "marginal propensity to fish." Individuals, in adherence to this theory, can be expected to fish in direct correlation to the likelihood of catching fish, with number and size of fish being equally important as factors in the success of a fishing trip. Similarly,

Table 1. Estimated annual expenditures by fishermen.

Amount spent/yr.	Number of fishermen		Percentage of total
Less than $100	63		21.1
$100–199	48		16.1
$200–299	31		10.4
$300–399	22		7.4
$400–499	23		7.7
$500–599	16		5.4
$600–699	14		4.7
$700 and over	75		
Refused	6		2.0
Total	298		100.0
Median		$322	
Weighted mean		$391	
Modal group		$700 and over	

the amount of money spent on fishing is influenced by the success of previous fishing trips, or the expected success of future trips.

The propensity to fish is strongly influenced by the time available to fish. Respondents demonstrated a likelihood to fish more frequently when provided the opportunity to catch more or larger fish than they usually catch. However, since a basic tenet of both human nature and economics is that human wants always exceed the resources available to satisfy them, the finding that the propensity to fish is greater than the propensity to spend is not surprising. While 71 percent of those surveyed indicated that they would be likely to fish more if they could expect greater fishing success, 40 percent said they would not spend more money than they do currently. Nonetheless, the weighted mean of additional spending by those respondents who said they would spend more was \$144.00 annually, about 37 percent more than the present \$391.00 weighted mean.

Estimating the additional spending expected to occur if the marginal propensity to fish is activated requires several steps. These steps include arriving at increased spending estimates for both those who do not currently fish and those who do, and the multiplier effects of those spending increases on the general economy.

Potential spending by non-fishermen. Study results show that about 1,181,000 Arkansans age 18 and over are not buying fishing licenses and are assumed to be non-fishermen. Of the non-fishermen surveyed, 41 percent said they would probably go fishing if they could be sure of good fishing success. This adds up to 484,000 additional fishing licenses, and with fishing expenditures expected to increase accordingly, about \$159 million in economic impact on the state's economy. Note that, even with this increase, there would still be about 700,000 Arkansans age 18 and over (38 percent of the population) not licensed to fish.

Potential additional spending by fishermen. When asked how much more they would spend per year if they could catch more or larger fish, only 49.3 percent of the fishermen surveyed gave definite answers (Table 2).

Using a cap of \$250,00 on the open-ended \$200.00 plus category, a weighted mean of the groups yields a figure of \$144.00 in addition annual spending per angler. Since we have no way of knowing the percentage of fishermen who might spend

Table 2. Potential additional annual fishing expenditures by fishermen expecting increased fishing success.

Additional spending	Percentage of fishermen
Less than \$25	6.5
\$25–49	5.2
\$50–74	5.8
\$75–99	2.9
\$100–124	6.5
\$125–149	0.6
\$150–174	0.6
\$175–199	0.6
\$200 +	20.6
Total	49.3

considerably more than $250.00 per annum', we must accept the $144.00 weighted mean, although it may reasonably be considered a very conservative figure.

Even though only 49.3 percent of the responding fishermen offered actual dollar figures, 60 percent indicated they would spend more money if fishing success improved. This 60 percent (382,000 fishermen) is therefore the potential base for increased spending. If these fishermen could be inspired to activate their marginal propensities to spend, the result would be an addition $55 million.

Multiplier effects. Of the approximately 210,000 licensed nonresident fishermen who visited Arkansas last year, around 60 percent would be willing to spend additionally an average of $194.00 each on fishing, with the guarantee of better results. With the resulting multiplier effect, this additional spending of $24,444,000.00 would generate about $61 million in total new spending and income in Arkansas. Regarding resident fishermen, the assumption was made that additional fishing-related spending would logically have been spent anyway on other goods and services, resulting in a negligible net multiplier effect.

Summary of Results

If the marginal propensity to spend for fishing can be activated as indicated by the survey respondents, the results would be as shown in Table 3.

Discussion

The purpose of this paper is not to deliver an economic review of the methods or subsequent results of the Arkansas Study, but rather to report the findings of that study and to weigh its disadvantages and advantages when compared to a more quantitative approach.

The Economic Impact of Sport Fishing in the State of Arkansas, hereafter referred to as the SFI Study, prepared by the Sport Fishing Institute (SFI) using data collected by the U.S. Fish and Wildlife Service for the *1985 National Survey of Fishing, Hunting and Wildlife Associated Recreation* resulted in findings similar to those of the Arkansas Study (Table 4).

Although the methodologies employed by these two studies are very different, their results are remarkably similar. While the SFI Study is a quantitative economic study, the approach of the Arkansas Study is marketing in nature. The theory of the marginal propensity to fish lends itself well to just such an approach. As fisheries management agencies, we must be as concerned with marketing our resources as we are with establishing set values on them. As has been proven in the private sector, there is no better way to increase sales, or in our case increase our constituency and thus our funding base, than to market a product effectively.

Table 3. Potential economic impact of fishing in Arkansas.

Additional spending—New fishermen	$159,000,000
Additional spending—Current fishermen	55,000,000
Multiplier effect—Nonresident fishermen	61,000,000
Current spending—All fishermen	311,000,000
Total potential economic impact	$586,000,000

Table 4. Comparison of estimated economic impact of fishing on Arkansas as determined by two studies

	Spending	Economic impact
Arkansas study	$372,300,000	$681,900,000
SFI study	$311,000,000	$569,600,000

The greatest advantage of approaching fishing economics from a marketing viewpoint lies in the types of information gathered about your constituency. The demographics and attitudes of the fishing public are extremely important in identifying problem areas and in determining how to approach and combat particular problems. The major marketing problems identified by the Arkansas Study had to do with the public's criteria for activating their marginal propensities to fish and spend, those being the assurances of catching more or bigger fish. Unfortunately, we cannot control the quality of fishing, as too many variables exist. We can, however, influence the public's perception of what constitutes "fishing success." For example, our study revealed that the idea of a successful fishing trip varies greatly among fishermen. Catching fish is important to nearly all fishermen, but keeping fish is considerably less important to many. By directing, through education, the public's perception of fishing success toward catching and away from keeping more and larger fish, we may be able to satisfy more fishermen while at the same time decreasing actual harvest pressure on our fisheries. This in turn would afford our expanding constituency (new fishermen) a better chance at successful fishing than they would otherwise have had.

The marketing orientation of the Arkansas Study offers other advantages as well, especially for state or local resource managers who usually experience shortages of time, money and manpower. From the time AMRA was contracted to perform the Arkansas Study to the day it was completed was about three months. The study therefore supplied us with very timely information, especially when considering that the SFI Study results were not available until four years after the study was conducted. Furthermore, AMRA contends that any subsequent studies using the same format can be conducted, processed and analyzed in as short a period as three days.

The entire Arkansas Study cost approximately $17,000.00. Subsequent studies would, of course, be even less costly, as preparation of the questionnaire and study design accounted for much of the initial cost. The Arkansas Study could be conducted annually, accumulating valuable information on trends in fishing expenditures and attitudes, reflecting our relative successive activating the public's marginal propensity to fish.

State game and fish agencies face a constant struggle for limited funds and traditionally have been at a disadvantage when money allocation time rolls around, due to the problems associated with placing monetary values on fish and wildlife and related recreational activities. Methods like the Arkansas Study offer state agencies the opportunity to place dollar values in front of financial decision makers, backed by the statements and opinions of those who use fish and game resources, the hunter and fisherman.

Results obtained by the Arkansas Study match up favorably with those of much more expensive, lengthy and detailed studies. More importantly, this method allows us to estimate the incredible monetary value of our wildlife resources nearly as quickly as the need arises. When questions arise concerning land or water resource use, time can be of the utmost importance.

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The Economic Value of Hunting and Fishing in Montana

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Introduction

In the past the primary indicator of economic value of fish and wildlife in Montana has been dollars spent by sportsmen. Although economists recognize that expenditures are important to local and state economies, they also know that expenditures do not reflect the total recreational value of the resource, which includes the personal benefits one receives from sport fishing and hunting. By measuring these additional benefits, economists can determine the total recreational value of the state's fish and wildlife resource by estimating what sportsmen would be willing to pay to fish and hunt in different locations across Montana. Traditionally, values that have been assigned to fishing and hunting opportunities have been low, and are often generated without site-specific data. The more individual states that have site specific information on net economic values, the better chance there is for influencing federal policy decisions regarding fish and wildlife. In 1985, the Montana department initiated the Montana fishing and hunting economic values study to provide site-specific data for Montana and because of a concern that fish and wildlife values be put on a more competitive basis with marketed commodities. The two-year, $270,000 project was funded primarily by state fishing and hunting license fees and federal sport fish and wildlife restoration dollars. An additional $29,000 was donated by the Bureau of Land Management. The U.S. Forest Service provided inkind services and staff time. The primary objectives of the study were to (1) provide accurate and current net economic values and expenditures for sport fishing and hunting in Montana to federal and state land and water management agencies, (2) to develop a base of qualitative value and attitude information to correlate with economic value data for use in making internal management decisions regarding quality and quantity of resource allocation and (3) to communicate this information in a way that would be widely understood and utilized. There are many important values other than recreation and expenditure values related to wildlife resources that were not evaluated in this study (Walsh et al. 1985). There was no attempt to value the animal itself, only the recreational experience associated with it. The evaluations were designed and studies were conducted by Rob Brooks, Montana Department of Fish, Wildlife and Parks economist, Dr. John Loomis, University of California at Davis, Dr. John Duffield, University of Montana and Dr. Stuart Allen, University of Idaho. Pat Graham, fisheries division administrator for the department deserves considerable credit for providing the initiative for the study and providing management guidance through its completion.

Travel Cost Method

The methods used in the Montana study (i.e., the travel cost method and the contingent evaluation method) have been preferred and sanctioned by the U.S. Water

Resources Council since 1978 and employed by the U.S. Fish and Wildlife Service since 1980. The U.S. Forest Service and Bureau of Land Management are now using the same methods in their planning. The travel cost method is based on actual behavior patterns of individuals and determines willingness to pay above necessary expenditures. Specific visits can be measured to particular fishing and hunting sites. These visits drop off as travel costs increase, which put out a demand curve of dollar values which can then be compared to commodity values. The resulting first stage, or per capita demand equation, allows the analyst to calculate the additional amount recreationists would pay over and above their travel costs to have access to a site for hunting or fishing. In this sense the average value is like an average market price, looking at the full range of possible prices one could get from various individuals for a particular recreation experience. For a more detailed discussion of methods and data sources refer to Brooks (1988), Duffield (1988), Duffield et al. (1987) and Loomis and Cooper (1988).

Data Sources

The main source of information on hunters origin and site destination was obtained from a telephone survey of license hunters performed by Montana Department of Fish, Wildlife and Parks in 1986. Hunters were asked to indicate sites visited, species hunted, travel distance, trip expenditures, vehicles driven and hunter demographics such as age, income and years hunted. The other data source used was the annual hunting pressure and harvest survey administered by the department. These data were aggregated to develop measures of hunting success by site and total recreational values by site.

Elk Hunting Values

Expenditures

Total expenditures per elk hunting trip for the complete sample were $285. Total expenditures per hunting day per individual were $102. Total statewide annual expenditures were $58.4 million. Resident expenditures per trip averaged $81.14, while nonresident expenditures averaged $1,399.12.

Net Economic Values

For the random sampling of license hunters, the state average net economic value for elk hunting was $185 per trip. This means a hunter would be willing to pay $185 more per trip on average to have the opportunity to hunt elk in a given area. On a per day basis, based on an average of 2.8 days per trip, the net economic value for elk hunting was $66. Utilizing the sample average of 6.3 hours of hunting per day, the U.S. Forest Service 12-hour recreational visitor day (RVD) for Montana elk hunting would be $125. (Currently the U.S. Forest Service uses $13.60 in 1982 dollars as the value of a big game outing). The annual aggregate value of Montana's elk hunting areas was $38 million. The most similar study using a travel costs method model was the work done in Idaho by Sorg and Nelson (1985). The Montana values are approximately double those reported in the Idaho study.

Qualitative Dimensions

Methods. Loomis et al. (1988) used contingent value methodology (CVM) and 1986 Montana hunting data, and calculated net economic values which provided a comparison with the Duffield (1988) baseline. They also measured changes in elk hunter benefits of reduced congestion to hunters in various hunting areas in Montana. An estimation of benefits of elk hunting stratified by the type of hunter and motivation for elk hunting was also provided (Allen 1988*a*). The basic notion of CVM is that a realistic but hypothetical market for buying use and/or preservation of nonmarketed natural resource can be described to an individual. The individual is then told to use the market to express their valuation of the resource. Key features of the market include (1) description of the resource being preserved, (2) means of payment and (3) the value elicitation procedure.

Data Sources. The sampling frame for the analysis was a list of residents and nonresidents who had purchased elk hunting licenses for the fall 1986 season. The elk hunter was asked to value his most recent elk hunting trip. Questions were also asked regarding the value of having double the chance to harvest a six-point or better bull elk. The last scenario described to the elk hunter related to reduction in crowding or congestion. The goal was to obtain an estimate of net willingness to pay to reduce the number of other hunters they encountered.

Results. The net economic value based on the CVM survey per elk hunting trip was $262.31. Values per hunter day were $39.90 and values per 12-hour RVD were $62.18. These values are similar in magnitude to what Duffield (1988) calculated for the Montana net economic elk hunting baseline study. Elk hunters were willing to pay more for doubling chances to harvest a six-point or larger bull elk. The mean value calculated was $345.44 compared to the $262 value for the elk hunting experience. Montana elk hunters were not willing to any significantly additional amounts for reducing in half the number of elk hunters they encountered. The mean net economic value for reducing elk hunter competition was $258.69. These results are likely due to the fact that Montana elk hunters see very few other hunters during their nearly week long hunting trips.

Hunter Preferences

The primary purpose of this portion of the study was to provide information on how economic values varied across different types of hunters. The average values calculated reflected different levels of benefits that varied systematically between different types of hunters. Hunters with similar ratings had fairly homogeneous preferences and, therefore, were grouped together. Allen (1988a) described four different categories for Montana hunters, which were (1) multiple experience hunters, (2) meat hunters, (3) trophy hunters and (4) outdoorsmen. Results indicated that trophy hunters have the highest net economic values for elk hunting and meat hunters have the lowest net economic values. All four types of hunters valued the opportunity to double chances of harvesting a six-point bull elk. The trophy hunters and the outdoorsmen had the highest increase in willingness to pay for doubling chances of harvesting a six-point bull elk. When evaluating willingness to pay for reducing the number of hunters seen by one-half or reducing hunter congestion, the outdoorsmen (who ranked solitude as their second most important trip attribute) had a small but positive willingness to pay for reduction in crowding. Meat hunters had the highest additional willingness to pay for reduction in crowding. However, most elk hunters did not seem to derive significant benefits from reducing crowding in the hunt areas analyzed in Montana. Refer to Allen (1988b) for more details regarding this elk hunter preference investigation.

Deer and Antelope Hunting Values

Brooks (1988) and Loomis and Cooper (1988) provided net economic values for deer hunting and antelope hunting in Montana. Expenditure data from the survey indicated that resident deer hunters spent $55 per trip or $31 per day and nonresidents in contrast spent $542 per trip or $86 per day. The total annual expenditure for deer hunting was $63.8 million. The state average net economic value for deer hunting was $108 per trip. This means hunters would be willing to pay $108 more per trip than they actually did to be able to hunt at a given site. The net economic values across sites varied considerably due to a large number of factors both actual and perceived. The net willingness to pay per hunter day for deer hunting was $55. Converting this value to a Forest Serve RVD yields $102. The total annual net economic value for deer hunting was $51 million. Expenditure values for antelope hunting were $114 per trip and $50 per day for a total of $4.5 million dollars annually. This represents spending $108 per 12-hour visitor recreation day. In a departure from the usual TCM method which estimates the average value per trip, the average value per antelope hunting permit was estimated instead. For Montana antelope hunting the state's average net economic value was $143 per permit. This means a hunter would be willing to pay on an average $143 more per permit to have the opportunity to hunt a specific antelope hunting unit. The net willingness to pay per hunter day was $62. The value per U.S. Forest Service 12-hour recreation visitor day was $135. The net economic value of antelope hunting under the existing permit system was $6 million annually. Values varied, per department administrative region, from $112 per permit to $171 per permit.

Fishing Values

Data Sources. Angler expenditures and net economic values for stream fishing and lake fishing were determined based on a regional travel cost model using 1985 data (Duffield et al. 1987). The data used to calculate net willingness to pay was collected from two separate surveys designed and administered by the Montana Department of Fish, Wildlife and Parks. The fisheries survey is designed to estimate fishing pressure on Montana's sport fishing waters. In addition to the annual fisheries survey, a supplemental angler telephone survey was administered in September and October of 1985. This survey provided detailed socio-economic data on both resident and nonresident fishermen.

Expenditures

For stream fishing, expenditures calculated during this study were $48 per day and $97 per trip for a total annual expenditure of $52.4 million. For lake fishing expenditures, values were $38 per day and $91 per trip for a total annual expenditure of $47.3 million. The state average for all waters was $48.13 for residents and

$360.24 for nonresidents per trip. Ranges in daily expenditures were $22.13 per day for resident stream anglers to $116.37 per day for nonresident stream anglers.

Net Economic Values

The state average net economic value for lake fishing was $89 per trip. For streams the value was $113 per trip. This means an angler was willing pay $89 and $113 more per trip to have the opportunity to fish lakes or streams respectively. On a per day basis, the net economic value for lake fishing was $70 and $102 for stream fishing. Converting these values to a U.S. Forest Service RVD would yield a value or $280 for stream fishing and $342 for lake fishing, (currently the U.S. Forest Service uses a value of $3.22 per outing for lake and stream fishing for resident fish in 1982 dollars). The annual aggregate value of Montana stream and lake fishing was $122 million and $93 million respectively. Net economics values were also derived on a site-specific basis (Duffield et al. 1987). Values for stream fishing were higher in Montana than those reported in Idaho in a similar study (Sorg et al. 1985).

Qualitative Dimensions

The contingent evaluation methodology (CVM) was utilized to estimate net economic values for trout fishing on 19 Montana rivers. This provided a comparison between the TCM method of estimating values done by Duffield et al. (1987). This portion of the study (Duffield et al. 1988) had as a secondary objective to estimate the net value associated with changes in fishery quality. Specifically, angler net willingness to pay was estimated from improved chances to catch larger trout and improved chances to catch more trout. A third objective was to explore the issue of market definition, in this case the types of recreation experiences. By defining different angler types, it is possible to show how net economic values vary across user groups. Allen (1988*b*) completed a companion survey to this bioeconomics evaluation and described and analyzed findings with respect to angler characteristics, preferences, behavior and attitudes.

Data Sources. The sample used for this evaluation was a list of residents and nonresidents who purchased Montana fishing licenses and were contacted in Montana Department of Fish, Wildlife and Parks annual pressure surveys of 1985.

Results. The net economic value per trip based on CVM methods was $90.74 based on a sample of 1751 responses. This value correlates well with the $97 amount reported by Duffield et al. (1987) using the TCM methodology.

The mean value for doubling the catch of large trout was $101.77 which was about $11 above current conditions. The net economic value for doubling the catch of fish irrespective of size was $97.52.

Angler Preferences

Allen (1988*b*) defined four subgroupings of angler types. The groups included two generalists types and an occasional angler group and a specialist group. The two generalists types differed mainly in that one was geared more towards the outdoors and solitude while the other was more oriented toward the fishing itself. Members of the specialists groups were twice as likely to be fly fishermen compared to the other three groups. Occasional fishermen were twice as likely to catch no fish as the other groups and fished one-third as much. Net economic values varied dramatically across the various angler type groupings. As one might expect, mean value per trip increased with specialization and commitment to the sport. For example, regarding mean values for the current trip or baseline, the occasional user had a net economic value per trip of only $7.56 while the generalists groups were at $91.03 and $117.07. The specialist group had a value of $1470.78. Values varied greatly across rivers as well from $58 per trip on the Bitterroot to $228 per trip on the Madison. The mean net economic value per trip averaged across 17 rivers was $117. Anglers were willing to pay significantly more for double chances of catching large trout on only 60 percent of the sampled rivers. By contrast anglers were willing to pay significantly more for doubled catch on only 15 percent of the rivers. Occasional users were willing to pay $7.56 for the current trip but $67.51 for doubling chances for large trout and $45.26 for doubling overall catch. All user groups had a considerably higher willingness to pay for increased catch of large trout. Only the occasional user group also was willing to pay considerably more for doubling overall catch. The complete results of the trout stream angler preference survey (Allen 1988*b*) provide a more thorough description of angler preferences.

Discussion

It is important to understand that bioeconomics is not meant to be used to stimulate, create or undermine local economies. Neither is it meant to dominate fish and wildlife management policy that will ultimately decide the fate of fish and wildlife resources. While fish and wildlife alone are not the answer, they are symbolic of what is necessary to maintain a stable and diverse economy. As Aldo Leopold once said, "there are components of the land community that lack commercial value but are essential to its healthy functioning." We must be flexible and willing to adapt our attitudes from commodity-based economics to recreation-based economics. Entities and communities that do so in Montana will likely succeed in the future as traditional market commodities continue to decline. We must take the offensive and be prepared to provide alternatives to federal management agencies faced with tough resource decisions and not just react defensively to their actions. For the most part decision-makers and the public have a difficult time understanding the concept of net economic values. They have been referred to in comments to the department as "phantom or voodoo values." The perception is that if we do not pay hard cash for an experience, then it cannot have a dollar value. Expenditures are important to local communities and businesses. To them the money spent by anglers and hunters represents the benefit in the form of direct income or taxes. Because they represent real dollars it is also much easier for people to relate to expenditure values. However, using net economic values is one of the few ways we have in attempting to put market and nonmarket resources on a common ground. Attitude and preference data enhance decision making related to quantitative net economic values by allowing reflection on what it is people value about fishing and hunting experiences.

The department recognizes that there is a potential for adverse reaction to the studies and potential for misuse of the results. Several development interest groups viewed the results as a threat and have tried to discredit the studies and their results. Most people still misunderstand the concept of net economic values. Because economists define net economic value as a willingness to pay above what people already have spent, some view the net economic value simply as the amount of money that could be captured from anglers and hunters in the travel and tourism industry. Many sportsmen felt that this was an attempt by the department to use the results to justify higher license fees to use up the economic surplus. Those who place a relatively low value on fishing and hunting seem to have the most difficulties with the concepts of net economic values probably because their own willingness to pay is low or nonexistent. To reduce the confusion about willingness to pay we began referring to net economic values as a measure of benefits to anglers and hunters and expenditures as a measure of costs. We redefined willingness to pay as the worth of the experience above actual expenditures. One must remember that the studies only value the recreational opportunity at a point in time. The values reflect the quality of that opportunity and its scarcity relative to similar opportunities. It is hoped that our studies broaden the debate about fishing and hunting into a part of the policy process that traditionally has excluded fish and wildlife. We are not sure what all the uses of this information will be, but it is hoped that the information in our studies will be used to influence policy decisions regarding resource use. More studies are needed of this type throughout the country to provide comprehensive site-specific data to decision-makers. These types of data are also seldom, if ever, used by state fish and wildlife agencies in assessing their own decisions. When they are used, they are used primarily in an advocacy role in opposition to a particular action. Anticipated uses for the information could include federal land and water planning, developing mitigation projects, Superfund reclamation projects and state water reservation. Potential uses within our own department include management plan direction, evaluating access, acquisition and habitat enhancement priorities, and influencing fish stocking programs. Ultimately, we need to communicate more effectively values of fish and wildlife in terms that people understand. We need to focus on the value of long-term stability and growth over short-term profit and uncertainty. We must articulate and provide diverse and quality opportunities for the public or risk losing support. When conveying the role of fish and wildlife in the economy, we must not unwittingly advocate expanding that role without first considering how it will affect fish and wildlife and people's perception about them over the long run. In moving fish and wildlife values closer to the top of the pile in the decision-making process, we acquire new responsibility and we must provide reasonable alternatives. We have tried to put fishing and hunting on more common ground with market activities and ultimately to affect the quantity and quality of these recreational opportunities. Only the future will indicate if we have been successful.

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Effects of Participant Skill on the Value of Alternative Fishery Management Practices

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Introduction

Freshwater fishing is the most important wildlife-related recreation activity in the United States. In 1985, for example, the 33.1 million warmwater participants spent $8.9 billion and the 13.5 million coldwater participants $3.8 billion (U.S. Fish and Wildlife Service 1988). While warmwater was most popular in the past, coldwater may become increasingly important in the future. Long-run statistical forecasts of fishing and hunting indicate that coldwater will be the fastest growing activity, more than double warmwater. With compound annual growth of 1.4 percent, coldwater fishing is expected to increase 39 percent by the year 2000 (Walsh et al. 1988).

This means that improved coldwater fishery management programs will need to be developed to provide more opportunities for the growing number of participants and to maintain quality of the experience. With future prospects for continued budgetary restrictions, managers increasingly will face the problem of producing more with less. Managers need information on how the unique characteristics of coldwater fishing affect angler benefits in order to improve the cost-effectiveness of fishery management programs. Driver and Cooksey (1977) and Bryan (1977) introduced the idea that overall anglers are heterogeneous, but that within group types, preferences homogeneous. Bryan defined a typology of anglers ranging as follows: (1) occasional anglers who participate infrequently, (2) generalists who use a variety of methods, (3) two groups of technique specialists who usually fly fish. The studies suggest that skill level may be related to the demand for various types of fishing opportunities produced by management programs.

The purpose of this paper is to explore some important differences in the economic value of alternative practices to distinct user groups of low, medium, and high skill. Empirical comparisons of benefit per fishing day to each of the three groups are developed for changes in the following variables: number and size of fish caught, hatchery and wild trout programs, catch and release regulations, and preservation of rare native species. The contingent valuation method (CVM) is the most important tool that we have to address such questions. The U.S. Water Resources Council (1983) recommended net willingness to pay (consumer surplus) as an acceptable economic measure of the benefits of public recreation programs.

Survey of Skill Groups

The data were obtained from onsite interviews with a sample of 150 anglers on the Cache la Poudre river, Colorado, during the summers of 1985–87. The stratified random sample included 60 anglers classified in the low skill group, 58 medium, and 32 high. Respondent-reported skill level were adjusted by the interviewer after observing their fishing practices. The skill rating was determined by the total daily catch, whether browns or rainbows, and the observed skill in handling fishing tackle. Wild brown trout were more difficult to catch than either wild or hatcher rainbow trout.

Table 1 illustrates how coldwater fishing values were related to the level of participant skill. Low skill anglers often caught no trout, were unlikely to catch more than four, and brown rarely entered their catch. They caught only 0.12 browns on the day interviewed and averaged 2.02 total trout per day at the site. Their catch was generally made up of 0–4 hatchery rainbows. They exhibited a beginner's level of knowledge about fishing tackle and the sport. If using fly tackle, they had difficulty casting.

Medium skill anglers generally caught at least one or two trout and occasionally as many as eight or ten. Browns entered their catch but not on a daily basis. They caught 0.45 browns on the day interviewed and averaged 5.57 total trout per day at the site. They exhibited an intermediate level of knowledge about the sport, where to fish and handling tackle. They had the ability to cast a fly with some accuracy out to 30 feet.

High skill anglers almost always caught some trout, generally six or more on the day interviewed, and browns were typically part of their catch. They caught 7.22 browns and averaged 12.91 total trout per day at the site. They exhibited an advanced level of knowledge about fishing tackle and the sport. They were accurate on fly casts up to 40 feet or more.

Regression Statistics

Table 2 shows the statistical effect of skill on net willingness to pay for fishing at the study site and for several important characteristics of quality. The interviewer asked participants to report their maximum willingness to pay costs of the current trip. Subtracting direct travel costs from total willingness to pay and dividing by number of days resulted in consumer surplus of \$13 per day, with an average catch reported as 5.7 fish 10 inches in length. From this starting point, respondents were asked to report changes in net willingness to pay contingent on changes in the quality of fishing. With 150 cases, the five equations explained 15 to 49 percent of the variation in willingness to pay. The F-statistics indicate that the overall equations were significant at the 0.05 level. The coefficients for the independent variables were significant at the 0.10 level or better based on the t-statistics shown in parentheses. Blanks indicate that variables were not significant.

The first equation shows that the low skill group was willing to pay \$2.41 per angler day less and the high skill group \$2.55 more than the medium skill group. The catch rate function shows that the medium and high skill groups were willing to pay \$0.90 and \$0.76 per day less, respectively, than the low skill group to catch an additional fish. The function for size of fish shows that the low and medium skill groups were willing to pay \$0.72 and \$0.66 per day less, respectively, than the high skill group for an additional inch in length. The wild trout function shows that the low skill group was willing to pay \$1.20 per day less and the high skill group \$1.38 more than the medium skill group to catch wild trout rather than hatchery trout. The last equation shown in Table 2 indicates that the medium and high skill groups were

Table 1. Descriptive statistics for participant skill levels, Cache la Poudre River, Colorado, 1987.

	Skill level			
	Low	Medium	High	Total
Cases	60	58	32	150
Total trout caught on day of interview	0.88*[a]	3.12*	11.59*	4.03
Brown trout caught on day of interview	0.12*	0.45*	7.22*	1.76
Total trout caught on average day	2.02*	5.57*	12.91*	5.71
Average size caught at the site (inches)	10.05	10.07	10.19	10.09
Hours fished on day of interview	4.77	4.35	4.53	4.55
Annual days fished at study site	4.90*	10.33	11.00*	8.03
Annual days fished at all areas	17.78*	30.72*	42.41*	28.04
Bait fishing (percent)	53.48*	30.60*	2.34*	33.73
Lure fishing (percent)	27.47	32.67*	16.56**	27.15
Fly fishing (percent)	19.05*	36.72*	81.09*	39.12
Important preference measures				
Number caught (1 = low, 5 = high)	2.42	2.66*	3.09*	2.65
Size caught (1 = low, 5 = high)	2.57	2.72*	3.75*	2.88
Method (1 = low, 5 = high)	1.80*	2.45*	4.09*	2.54
Variety of species (1 = low, 5 = high)	1.68*	2.29*	2.91*	2.18
Crowding (1 = low, 5 ≈ high)	2.54	2.89*	3.65*	2.91
Catch and release (1 = anti, 2 = neutral, 3 = pro)	2.12*	2.40*	2.94*	2.41
Member of a sportsmen organization (2 = yes, 1 = no)	1.08*	1.26*	1.59*	1.26
Consumer surplus per day	$10.44*	$13.50*	$17.35*	$13.10
Percent of trip benefits attributed to fishing	59.92*	77.24*	87.81*	72.57
Investment in equipment	$195.00*	$443.02*	$1448.44*	$558.67
Income	$29,233	$35,086	$42.125*	$34,247
Education (years)	13.53	14.45**	15.63*	14.33
Age	42.68	44.29	40.91	42.93

[a]An * indicates that the means are significantly different at the 0.05 level or above. An ** indicates that the means are significantly different at the 0.10 level or above.

Table 2. Least squares equations for the value of an angler day, additional fish, additional inch, wild trout, and preservation of native cutthroat trout, Cache la Poudre River, Colorado, 1987.

Variable[a]	Description of variable	Angler day	Additional fish	Additional inch	Wild trout	Preservation of cutthroat trout
Mean value		\$13.10	\$0.78	\$1.36	\$1.35	\$4.82
Constant		3.9624 (0.48)	0.2637 (0.98)	0.4781 (0.96)	0.0982 (0.12)	3.9952 (1.91)
Low skill	1 = yes 0 = no	−2.4124 (−2.31)	—	−0.7204 (−2.22)	−1.1993 (−2.33)	—
Medium skill	1 = yes 0 = no	—	−0.8999 (−4.69)	−0.6631 (−2.10)	—	2.3492 (1.80)
High skill	1 = yes 0 = no	2.5534 (2.09)	−0.7645 (−3.21)	—	1.3783 (2.19)	3.4122 (2.31)
Days	Days per year at study site	−0.1311 (−2.42)	—	—	—	—
Income	Dollars per year (\$1,000)	−0.1018 (−1.30)	0.0182 (4.40)	0.0213 (3.88)	0.0874 (2.36)	0.0640 (2.35)
Income squared	Dollars per year^2 (\$1,000)	0.0032 (4.02)	—	—	−0.0007 (−1.73)	—

Table 2. (continued).

Variable[a]	Description of variable	Angler day	Additional fish	Additional inch	Wild trout	Preservation of cutthroat trout
Education	Years	1.3325				
		(1.79)	—	—	—	—
Education squared	Years^2	−0.0527				
		(−2.16)	—	—	—	—
Total days	Days at all					0.0568
	sites	—	—	—	—	(1.86)
Vacation		0.0506			−0.0192	
	Days per year	(2.64)	—	—	(−1.95)	—
Age						−0.1096
	Years	—	—	—	—	(−2.83)
Importance	Preference scale					
	1 = low;		0.1501	0.2411		
	5 = high	—	(1.80)	(2.23)	—	—
R^2		0.49	0.19	0.21	0.15	0.17
F-Statistic		18.67	9.73	10.79	6.25	7.13

[a]T-statistics are shown in parentheses below the coefficients.

willing to pay $2.35 and $3.41 per year more, respectively, than the low skill group to preserve native cutthroat trout (Greenback, Rio Grande, and Colorado River cutthroats).

In addition, benefits (Bradford bid curves) were estimated for the economic value of catch rate and size with and without catch and release regulations (Walsh 1986). The functions were based on values obtained from each individual for several changes in the number and size of fish caught. These observations trace out the representative individual anglers' marginal benefit function. The results indicate that low and middle skill groups were affected adversely by catch and release management. High skill anglers, on the other hand, considered catch and release management an acceptable tool to improve the quality of fishing.

For the total sample, the value of catching and keeping an additional trout was $0.80–0.017 (fish)^2 with both variables significant at the 0.01 level. For the low skill group, the value of an additional trout was $1.08, also significant at the 0.01 level. However, the value of an extra trout was not significantly different from zero for the medium and high skill groups. With catch and release regulations, the value to the total sample of catching additional trout fell to $0.26, significant at the 0.01 level. For the low and high skill groups, the value of an additional trout was not significantly different from zero and it was −$0.81 for medium skill group, significant at the 0.01 level.

The value of an additional inch was $1.48 for the entire sample. $1.17 for low skill, $1.32 for medium skill, and $1.98 for high skill, significant at the 0.01 level. The value of an extra inch under catch and release management was not significantly different from zero for the low and medium skill groups. It was $1.74, significant at the 0.01 level, for the high skill group.

Comparative Studies

Few previous studies have estimated the economic value of catch rate—number and size—wild trout, or angler skill. Adamowicz and Phillips (1983) reported the marginal value of catching an additional fish ranged from $1.69 to $2.69 in Alberta (1976 Canadian dollars). Sorg et al. (1985) reported a value of $2.00 per additional fish and $1.80 per additional inch in Idaho. Johnson and Walsh (1987) reported a value of $0.95 per additional fish and $1.25 per additional inch at Blue Mesa reservoir in Colorado.

Vaughan and Russell (1982) estimated a value of $15.60 for managed fisheries where stocking costs were incurred and $24.09 for unmanaged, self-stocking fisheries at private fee sites in the United States. It is possible that there were other quality differences between the two types of fisheries. King and Walka (1980) reported that net benefits of older, highly experienced, fly, lure, and well educated fishermen with higher income were nearly twice as much as all other anglers. Duffield et al. (1988) reported that casual anglers had substantially lower net values per trip than generalists or specialists in Montana. Specialists fished more often with flies and had higher income than the other groups.

The value of catching an additional fish on the Poudre river was somewhat less than estimated elsewhere, particularly for participants with medium and high skill were already were catching large numbers of trout. However, with regard to the value of catching larger trout, the results from the Poudre river were consistent with earlier studies, and increased with the level of angler skill. Although the increase in value per day for wild trout fishing was well below the estimate by Vaughan and Russell (1982), their value was for different sites, and other quality changes were not controlled. The breakdown of anglers by skill group provided results consistent with those of the Arizona and Montana studies. The high skill group on the Poudre river fished more often with flies and had higher income, as did the specialist group in the Arizona and Montana studies. In addition, the Poudre study showed that values for different aspects of the angling experience varied among angler groups.

Conclusions

This paper addressed the problem of estimating the effect of participant skill on the benefits of alternative cold water fishing programs. The contingent valuation method was applied to determine the economic value of important aspects of the fishing experience to three distinct angler groups. It was shown that they had distinctly different preferences and values. The results suggest that the lower skill groups preferred higher catch rates based on hatchery fish stocking programs, while the high skill group preferred larger wild trout resulting from catch and release regulations. Low and medium skill anglers were willing to pay more for additional trout and less for larger wild trout than the high skill group.

Understanding the value of alternative fishery management practices can help managers improve the efficiency of state programs. Since quality to one angler group may mean something completely different to another, an acceptable regulation to one may be unacceptable to another. The difference among angler groups implies that managers need to provide a variety of experience rather than catchable hatchery trout, for example, that provide one type of experience. Sections of a single body of water might have several management strategies to provide the desired experience for different angler groups.

The results presented here should be viewed as first approximations subject to improvement with further work. Much more research is needed before all of the relevant economic and noneconomic questions concerning the value of fishery management services will be understood. The significant differences among the skill groups suggest that future research on the value of site quality could include participant skill as a proxy for tastes and preferences. The effect of participant skill can be held constant in fishing demand functions to estimate the benefits of programs to produce a particular type of fishing experience.

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Wildlife Habitat Enhancement on Corporate Lands: Social, Economic and Corporate Benefits

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Introduction

North Americans are continually searching for new and more efficient sources of energy and raw materials. Demands for increased production of timber and other construction materials, medicinal supplies, and agricultural practices, all have immense implications for the wildlife resource. Development activities can contribute to environmental disruption. Those disturbances often result in a loss of habitat and displacement of wild populations, ultimately contributing to reduced wildlife numbers and sometimes to species extinctions.

Today, the environment remains a vital issue to both the public and private sectors. Development interests and corporations increasingly have demonstrated a growing consciousness for the need to improve environmental safeguards on their lands. This concept of responsible land stewardship by private landowners has been gaining momentum in recent years, culminating in new wildlife initiatives throughout much of corporate America.

While the ''bottom-line'' must prevail in free-market systems, benefits, other than those of a financial nature, are being realized through corporate wildlife enhancement programs. These programs produce ecologic, societal (educational and recreational), corporate and scientific values, in addition to possible financial benefits and incentives for participating companies. Let us examine each of these briefly.

Values

Ecologic

Some of the most obvious benefits derived from wildlife habitat enhancement activities on corporate lands are those which relate directly to habitat protection and enhancement. Continued encroachment upon remaining wildlife habitat may make corporate lands a much needed stronghold for diminishing populations. Additionally, habitat enhancement activities often provide opportunities for species reintroductions, as well as an increase in the diversity and richness of existing species. These programs may contribute, in some cases, to decreasing threats of sensitive species, and an overall decline in species extinctions.

Societal (Educational & Recreational)

Corporate wildlife habitat programs often involve the local community. By providing limited access to their lands or involvement with the projects, corporations make recreational and educational opportunities available to the general public. Such opportunities may include nature and hiking trails, wildlife photography and observation, hunting and fishing. With over 55 million Americans participating in non-consumptive wildlife activities alone in 1980 (Shaw 1987), these growing benefits are significant.

Direct community involvement in corporate wildlife programs often involves hands-on participation by various groups and organizations. For example, some companies provide opportunities for local conservation and youth groups, such as Boy Scouts and Girl Scouts, to contribute to the construction and monitoring of bird nesting boxes. Others assist in planting of food plots for wildlife.

By involving the community in wildlife projects, corporations are providing useful educational experiences and learning opportunities, as well as building environmental awareness and understanding. They are creating a partnership in responsible land stewardship. Other educational initiatives related to corporate wildlife programs include the construction and operation of nature centers on corporate lands, and company supported natural resource research through grants, graduate fellowships, undergraduate internships, and high school assistantships.

Because wildlife belongs to the entire community, and not only to those fortunate to have wildlife residing on their land, an ecumenical societal benefit of wildlife-related activities and programs is the improvement of corporate stewardship of private lands for the benefit of wildlife and people.

Corporate

Direct benefits to corporations involved in wildlife habitat enhancement projects are varied in nature and extent. Improved communication between industry and the conservation community is a significant benefit. By demonstrating responsible wildlife management, companies also are able to improve employee relations and morale, as well as provide opportunities for public recognition of individual and company-wide achievements. The projects create heightened awareness among industry groups and the general public, and demonstrate the value of enhancement projects to others in the corporate community. Positive results invite imitation.

During the formulation and implementation of site-specific wildlife management plans, corporations can form partnerships with key state and federal agencies. An additional corporate benefit of many wildlife habitat programs is an enhanced appearance of participating plants and facilities.

Scientific

Scientific advantages of corporate wildlife enhancement programs are manifold. The opportunity to conduct floral and faunal inventories prior to assembling a wildlife management plan for a particular site may provide federal, state, and local fish and wildlife agencies with valuable information. Similarly, some corporate wildlife programs provide the opportunity to work with government agencies toward the successful implementation of the North American Waterfowl Management Plan.

Access to corporate lands as ecological study areas for universities and public schools is a valuable contribution to the science of wildlife management. These protected areas provide unique opportunities for controlled studies.

Economic

While cost benefit analyses regularly determine whether or not companies undertake certain projects, we have already noted a variety of largely non-financial benefits of wildlife habitat projects. These do not, however, preclude monetary benefits to corporations.

For example, because many habitat enhancement programs include vegetative management practices, such as reduced mowing of grasses to create new habitat, decreased land maintenance costs can provide savings to participating companies.

Integration of wildlife projects with timber management plans allow some companies to provide additional revenues from timber sales to sustain their habitat programs—a very desirable benefit if sound forest management practices are implemented. Further, companies interested in providing fee hunting opportunities on their lands have an additional financial incentive to provide land management practices that will be sensitive to the needs of the game species residing there. Thus, these companies benefit directly by participating in projects that may improve wildlife habitat and attractiveness of their property.

Lastly, some company projects have helped generate income for local communities by enhancing public recreational opportunities.

Wildlife Habitat Enhancement Council

This brief review of the benefits of wildlife enhancement on corporate lands suggests the potential for productive partnerships between the corporate and conservation communities. Established in 1988, the Wildlife Habitat Enhancement Council (WHEC) is a new cooperative venture designed to bring members of these sometimes adversarial groups closer together for the common goal of enhancing undeveloped corporate lands for the benefit of wildlife, fish and plant life.

The Council is a nonprofit organization whose membership is comprised of large and small corporations, public interest groups and individuals. The Council's primary contribution is to offer a process for structuring a successful wildlife management program.

Beyond the Balance Sheet

Preliminary information supplied to the Council by a sample of its member companies supports the premise that the benefits and values accruing to companies participating in wildlife habitat programs tend to outweigh the costs of implementing those programs. These values include employee and community relations, and the forging of partnerships with key state and federal agencies and local conservation groups.

Delmarva Power And Light. A typical example is Delmarva Power and Light Company. The company installed a striped bass (*Morone saxatilis*) brood pond at a one-time construction cost of approximately $55,000 at its power plant on the Nanticoke River in Vienna, Maryland. The company pays an additional yearly consulting fee of $25,000 to the Delmarva Ecological Laboratories for their services and technical expertise (i.e., assist with netting and freeze branding). The monetary cost incurred by the company was stated by a company spokesperson as ". . . a small price to pay for public relations benefits."

Because Delmarva's fish hatchery project was originally conceived by an employee (later used in their media campaigns), Delmarva also derived positive employee relations benefits by demonstrating a willingness to implement employee suggestions. Ecologically, the local striped bass population also benefited, as the hatchery-raised fish were found to have a better survival rate than the natural population.

By contributing to the overall health and vitality of the Chesapeake Bay, Delmarva also received positive community recognition.

General Electric Corporation. The General Electric Corporation currently has 150 acres (60.73 ha) dedicated to plant and wildlife preservation at its Medical Systems Manufacturing Plant in Waukesha, Wisconsin. This site includes a 5-acre (2.02 ha) pond used by various wildlife species, that was already in existence for use as an emergency water source and for fire protection. Thus, there were no costs incurred for the pond in regard to wildlife habitat enhancement. In addition, the plant site leases part of its land to a farmer, whose lease agreement includes a provision requiring the farmer to leave a stated amount of corn for use by migratory waterfowl. This arrangement generates income from farming, which can be used to offset other associated program costs.

This General Electric plant also maintains a prairie grass restoration project that was initiated in 1974. While the company invested money for prairie grass seed and seeding equipment, these expenses were less than what it would have cost for sodding and traditional landscaping and maintenance. In addition, the company saved thousands of dollars per year in maintenance (i.e., water, fertilizer, and mowing) expenses.

This particular wildlife habitat and prairie restoration project also serves to increase privacy to the plant by providing a "green space" buffer zone. Improved community relations, and pleasant, work-conducive surroundings, were cited as associated benefits of the projects. As concluded by an employee regarding the plant's habitat projects, "there are lots of intangibles to the quality of life benefits."

DuPont. At a DuPont textile fiber plant in Kinston, North Carolina, a five-year plan, initiated in 1984, revolves around 450 acres (182.19 ha) of mixed habitat comprised of open fields, woodlands, marsh, hardwood river bottoms and a bald cypress swamp. Wildlife-related activities at this site include wildlife plantings, erection of bluebird and wood duck nest boxes, and construction and stocking of a fish pond.

Wildlife program costs at this site include $7,000 to $8,000 for plant materials and associated labor, and costs for the nest box building materials. Labor for the box construction was donated by local scout troops and high schools. Local federal and state agency officials (i.e., Soil Conservation Service and state department of natural resources) also donated time to the plan's design and implementation.

As part of the site's vegetation management, hedges were planted, the state forestry department and department of natural resources donated trees, and mowing was reduced to every other year. Previous costs to mow the several hundred acres of lawn on the site cost between $2,000 and $5,000 annually. During non-mowing years, this is a direct savings to the company. Further, a timber harvest on an unused portion of the property generated between $7,000 and $10,000 in revenues. These monies then were earmarked for the wildlife program to offset project costs.

Delmarva, General Electric and DuPont are three examples of companies that realize that the values of wildlife extend far beyond the balance sheet. Hopefully, the number of companies sharing this understanding will continue to grow.

Conclusion

The year 1988 marked the passage of a Congressional Resolution, honoring the 100th birthday of Aldo Leopold, recognizing his outstanding dedication and contributions to the field of natural resource management. Perhaps it is in the continued spirit of Leopold's "land ethic," that corporate landowners are becoming increasingly aware of their stewardship responsibilities. As more and more company lands are managed for the benefit of wildlife, environmental ethics may be gaining a stronghold in corporate board rooms. Companies with active wildlife management and enhancement programs recognize the value of improved employee and community relations, and realize that the satisfaction derived from preserving our natural heritage far outweighs the economics.

In the proceedings from the symposium on "Economic and Social Values of the Wildlife Resource," titled *Valuing Wildlife* (1987), Stephen Kellert, stated that "the most important incentives for conserving wildlife, in other words, will not be bribes of material enhancement, public spiritedness, or the acceptance of scientific theory but a personal conviction that land managed for wildlife is land ultimately more satisfying, attractive, and enjoyable for people."

Management and employee commitment are essential ingredients for successful corporate wildlife programs. It is with great hope and anticipation that conservationists and natural resource managers observe the progress of the corporate community in enhancing their properties for wildlife. With continued cooperation from both the public and private sectors, the possibilities are endless.

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Special Session 5. *Partnerships for Conservation: Accomplishments and Opportunities*

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A Marketing Approach to Fish and Wildlife Program Management

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The purpose of a business is to create and keep a customer.
Theodore Levitt (1986)

Introduction

A simple yet pervasive principle guides many successful businesses. It is a focus on customers: their welfare, satisfaction, and sense of having received value for their investment. Natural resource management programs, such as fish and wildlife conservation, should also have such a focus. After all, conservation happens because many people—our customers—demand its products, by they elk, trout, raptors, waterfowl, grizzly bears or watchable wildlife. Protection, restoration and enhancement of basic resources—habitats and populations—is the foundation for conservation programs. But taken to the extreme, a focus on resources leads to the notion that people's needs for different goods and services from fish and wildlife populations are secondary. It also causes biologists to think their highest priorities are resource protection, the search for biological truth, and saving nature from people. They would be more effective if they sought ways to secure a sustainable balance between people and a healthy, productive environment.

Biologists must be concerned with what laws, regulations, and policies require, but not to the point where meeting customer needs is neglected. Laws and regulations are reflections of what people want and expect. They control much of the priorities and approaches in fish and wildlife management. But they are not all there is, and market forces will become more important in future programs. In this paper we offer a few thoughts on the role of marketing as a factor in fish and wildlife management. Space precludes a comprehensive treatment of the subject, so the reader is referred to the excellent text by Levitt (1986) and a set of readings by Hoel (1987).

We discuss the general nature of a customer orientation in fish and wildlife programs and compare trends in budgets and personnel for the USDA Forest Service Wildlife and Fisheries Program with the history of laws, regulations, scientific knowledge, and use of marketing concepts. Our theses are (1) that laws and scientific knowledge, while important in fish and wildlife conservation, are not the ultimate forces for change, and (2) that increased attention to customers may be the most important factor in making fish and wildlife conservation more competitive with other uses of lands and waters.

Marketing: A Focus on Customers

In a typical business customers are obvious—they are the people who use or purchase what you have to offer. Measures of success are relatively easy to discern. Trends in profit and number of customers or share of a particular market are commonly used to determine business strategies. In fish and wildlife conservation it is not always easy to identify customers or what constitutes a successful strategy. Difficulties arise from the nature of the products, diverse public goods and services for the most part, and the nature of those for whom they are protected or produced. The public is not a typical customer. It is a diverse collection of individuals and groups, each holding different attitudes and values about the resource, few of whom ever directly compensate the producer or deliverer for the goods and services. Lack of a clear producer-seller-customer relationship causes many conservationists to discount the applicability of business principles. This is commonly expressed by such notions as "We're not in this to make a profit, only to serve the public"; or "Our mission is to take care of the resource," followed by some statement to the effect that, therefore, "business principles do not apply."

It is not necessary for wildlife and fisheries management to be motivated by profit to use marketing concepts. Fish and wildlife resources are defined by the people who find value in them—customers. Those customers are not an amorphous body of constant and unvarying attitudes and universal commitment to whatever resource managers propose to do. They are segmented into groups with special interests looking for specific kinds of products.

Most biologists are motivated by the drive to please their customers, whether they be turkey hunters, salmon anglers, bird watchers, nature photographers, readers of scientific papers or reviewers of environmental assessments. Thus, biologists tend to measure success by how many people, i.e., customers, want or read their products. They think and act in marketing terms.

The long-term ability of fish and wildlife managers to stay in business and their short-term latitude to conserve more, produce more, or shift program emphasis depends on customers. If the attitudes and values of customers shift, priorities must shift—if managers want to stay in business. That should be obvious from the recent increased emphasis on watchable wildlife programs. If the numbers or influence of customers wax or wane, programs will follow. Witness the effects of larger numbers of anglers or the increasing influence of those in California who do not favor hunting of mountain lions. If managers want to boost a particular program, say protection of endangered plants, they must work with a set of customers that probably does not include bear hunters who use hounds. If they choose not to respond to new or potential customers for fish, wildlife or native plants, they must be prepared for others to capitalize on the lost opportunity. If they want to move aggressively into serving a new set of customers for aspects of the fish and wildlife resource, they may need to work the demand side of the demand-supply relationship. That means advertising, which agencies bureaucratize by calling information and education.

Fish and wildlife resources are highly valued by Americans. And people have moved beyond the notion of fish and game for subsistence and sport only. They now see wild flora and fauna as integral parts of an environment that is healthy for all life. They are willing to pay more and sacrifice short-run economic opportunities for long term stewardship of fish and wildlife. Translated, that means fish and wildlife are more competitive in the market for access to land, water and capital resources. Biologists and resource managers who recognize this and use marketing effectively can enhance their competitive advantage.

The authors are beginning to use marketing approaches to turn the custodial and reactive program for management of fish and wildlife habitats in the National Forest System into a customer-oriented, proactive program. We are early in what we hope is a long process of change. We are not professionals in marketing. We will probably stumble a bit along he way. If we succeed it will be because we used market forces and customer relationships effectively. If we fail, meaning fish and wildlife habitat management continues to be guided by the minimum needed to meet laws and regulations, it will be because we did not. No more, no less. New scientific knowledge, new laws or new regulations, by themselves, can only yield better custodial management. Perhaps for some that is good enough. We believe our customers deserve more.

Two Marketing Principles of Use to Fish and Wildlife Programs

We are working with two marketing principles: (1) Differentiate basic resources, i.e., products, to serve specific market segments and enhance total value of fish and wildlife, and (2) manage relations for long-term partnership. There is much more marketing, but this is where we chose to start.

Differentiate the Products

"There is no such thing as a commodity. All goods and services can be differentiated and usually are" (Levitt 1986). A product is a complex cluster of things. In our business it starts with the generic resource, such as a deer herd or trout population. But the total product also includes all the values that customers see in a deer herd in a particular setting, and all the things people do to add value to that generic resource (Figure 1). Value added might include books and magazine articles that augment the customer's knowledge and appreciation of the resource. It might include guiding services that enhance experience, photos or taxidermy that capture the moment, or even the memory of sharing in the work of improving the resource. The total product in fish and wildlife management is not the basic resource that laws and scientific knowledge are concerned with. And the total value of fish and wildlife resources is not just the value of the generic resource.

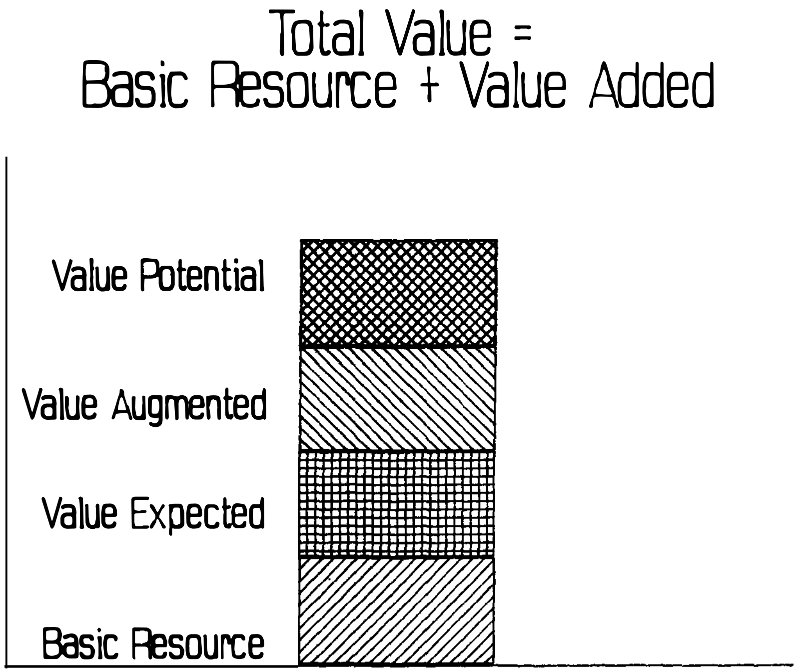

Figure 1. The total product concept: differentiation and value added. The basic resource of fish and wildlife management is the population, herd or flock. Customer expectations and extra services or experiences provided for hunters, anglers, birdwatchers or nature lovers differentiate generic resources and add total value. The ability to attract customers to fish and wildlife depends in part on producing healthy basic resources and in part on differentiating that resource and providing value beyond expectations.

Of course, there are limits to how much of a generic resource can be produced in a particular place, carrying capacity if you will. Without product differentiation, those biological limits constrain how many people can use a resource in the same way without jeopardizing quality of experience or sustainability. Thus, perceiving that protection or production of the generic resource is all there is to fish and wildlife conservation severely limits the number of customers that can be served. The marketplace has recognized this and the reaction is all around us. Instead of one open deer season there are special seasons for archery, black powder, either sex, and trophy bucks. Ice fishing serves a set of customers who once waiting all winter until spring thaw. A herd of bighorn sheep that once served a few hunters now also serves thousands of sheep watchers. There are even guiding services to take people hummingbird watching.

Marketing operates on this total product concept (Figure 1). The value of generic fish or wildlife resources is expanded as customers add value through expectations and knowledge, and providers add value through services and special opportunities to serve different sets of customers. More customers are served in more ways with higher overall value to society and greater total benefits from the basic resource. For managers of particular populations or habitats, this is a way to get more people wanting to do business with you. Handled creatively that can mean more support for management programs—something like a profit in the public sector.

Product differentiation and value added are not just commercialism, beneath the dignity of a professional biologist with a pure heart and only the good of critters in mind. They are crucial to long-term success. Biologists care for wild animals and their habitats. To do a better job of protecting or producing wildlife they need more research, more technology, more people to inventory, plan, evaluate, and carry out projects; i.e., they need bigger budgets. How do biologists get bigger budgets? They create more happy customers; a simple positive feedback loop.

Manage Relationships for the Long-term

The second marketing principle is partnership. Relationships between producer, seller, and customer in conservation may not be unique but they are certainly different than a typical retail operation. For one thing many of us are at different times all three. For example, each of the authors has done research, planned and carried out management projects, written articles and given popular talks to "sell" fish and wildlife, and hunted, fished, and watched birds. Many a sportsman or citizen conservationist has joined in planting willows, building guzzlers or lobbying for budget support. The customer who only pays for a license and fishes is rare. The result is that our business does not have traditional seller-customer relationships. It has complex and long-standing relationships with customers and suppliers that tend toward partnerships. Trust and interdependence are as important as efficient and effective delivery of products to such customers.

Relationships must be managed to build bonds of support based on valid expectations of how everyone involved in fish and wildlife conservation contributes to common goals. Part of this comes from knowing who the customers are and how we can best meet their needs, or having the ability to know when people are functioning as customers, when as partners, and when as suppliers. This is made even more complicated by the fact that some people are alternately suppliers of budget resources, customers for certain fish or wildlife products, partners on some projects, and litigants on others.

A foundation for good relationships starts with the idea that biologists have a variety of partnerships with people. The strongest and longest standing partnership is between state fish and wildlife agencies and the people who own or manage habitats. One of the most important partnerships is with colleagues who have responsibilities for different resources and different sets of customers. Bill Zeedyk (pers. comm.) has four simple rules for effective partnerships: (1) No junior partners, (2) support one another's goals, (3) share the pain and the glory and (4) participate in one another's activities.

The Forest Service has formalized partnerships through memoranda of understanding with 43 state fish and wildlife agencies and participating agreements with national and local conservation groups. Partnerships don't all have to be formal. The idea is that more progress on mutual goals results from positive working relationships than from antagonistic "gottcha" relationships. The traditional "full partner" relationship between the states on population management and the Forest Service on habitat management remains the strongest aspect of long-term relationships in fish and wildlife conservation. Nelson and Raml (1989) describe some of the early results of partnerships with various conservation groups.

Trends in the Forest Service Wildlife and Fisheries Program

Perhaps the central question at this point should be, is marketing just a fad or does it make a real difference in fish and wildlife programs? There are probably many ways to measure difference and get an answer. We offer historical trends in total budget and professional workforce as indicators. Keep in mind these are indicators, the ultimate difference is customer satisfaction and health of basic resources. The rationale for using budget and workforce to indicate success is as follows. Caring for basic resources and carrying out inventories, plans, and projects to enhance their productivity or availability depends on having skilled people in place, on the production line so to speak. That is reflected by workforce trends. The ability of those people to get things done depends on having operating budgets.

If laws, regulations, or scientific knowledge are the driving forces for emphasis on fish and wildlife, trends in budgets and workforce should respond directly to changes in legal mandates or pulses in the state of knowledge. If attention to customer needs are the driving forces, trends in budgets and workforce should be independent of laws and knowledge and be more reflective of political and market forces.

Historically, the Forest Service Wildlife and Fisheries Program has emphasized protection of wildlife and fish habitats through coordination with other resource management programs, such as timber, range, and harvest objectives of state wildlife agencies. Often these roles were carried out by generally-trained foresters and range conservationists. Prior to 1970, the Forest Service employed fewer than 100 professionally trained biologists in the entire workforce (Figure 2). There are 155 national

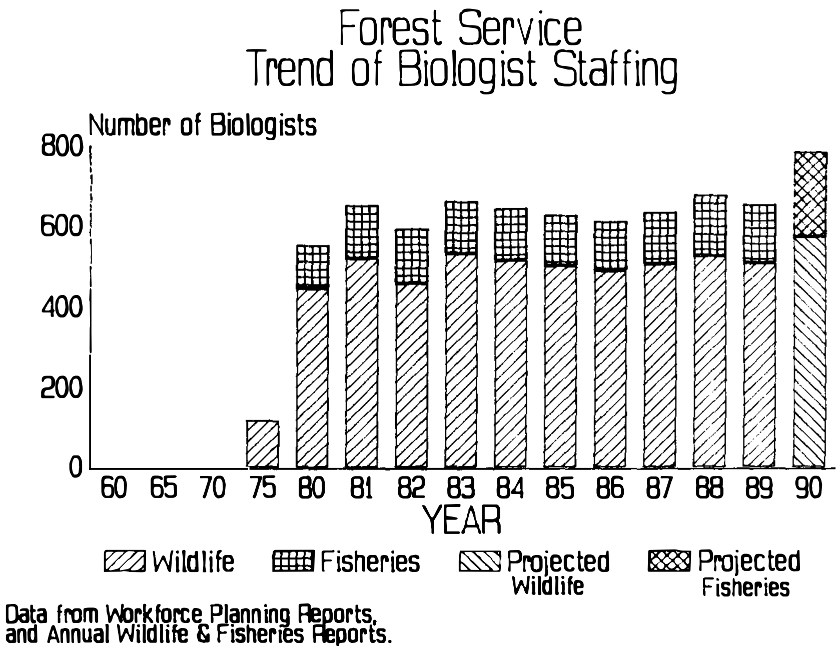

Figure 2. Annual trends in number of professional biologists employed by the USDA Forest Service to carry out wildlife and fisheries work.

forests and national grasslands where overall planning and budget development work occurs. There are 654 ranger districts where the actual work of managing lands, resources and people's activities occurs. There are slightly over 191,000,000 acres of land in the National Forest System. Thus, prior to the 1970s the workforce was less than one biologist per national forest and less than one biologist per 1.9 million acres. The job of coordination and custodial habitat management was handled by state agency biologists. Often it wasn't handled at all. Primary emphasis was on game and fish production and development of hunting and fishing access.

The National Environmental Policy Act of 1969 created a need for more biologists to prepare environmental assessments. Growing concern for the effects of other resource management programs on fish and wildlife resources also boosted the need for more biologists. The Endangered Species Act of 1973 created a need for biologists to conduct work specific to threatened or endangered species. And the National Forest Management Act of 1976 eventually created a need for detailed planning and evaluation of fish and wildlife habitats. These laws and their implementing regulations have had profound effects on the urgency and priorities for fish and wildlife work on the national forests and national grasslands. But their effects on actual budgets and workforce to accomplish that work were indirect at best.

The biologist workforce of the Forest Service grew dramatically in the late 1970s, as did the annual budget (Figure 3). This may have been a lag response to the aforementioned legislation. More likely it was in direct response to a political ad-

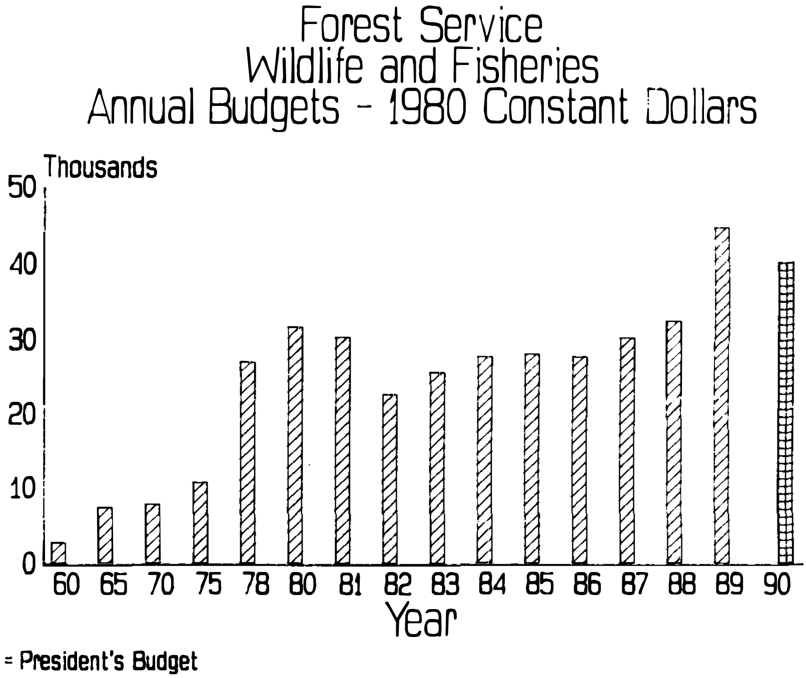

Figure 3. Annual trend, in constant 1980 dollars, in budgets for the Forest Service Wildlife and Fisheries Program.

ministration that favored attention to environmental quality and to a Director of Forest Service Wildlife and Fisheries, Merrill ''Pete'' Petoskey, whose positive attitude changed the way the agency viewed its responsibilities and opportunities in fish and wildlife programs.

The political climate changed during the 1980s and both budget and workforce stabilized. The need for biological work did not diminish; it actually grew as forest planning under the National Forest Management Act increased and more species were listed as endangered or threatened. Scientific knowledge was dramatically improved during this period through publication of such landmark books as Thomas (1979) and Harris (1984). Yet, budget and workforce from 1982 to 1989 were stable at slightly over 600 people and $30,000,000 respectively. In constant 1980 dollars, that was about $195,000 per forest. There were no major new laws or regulations on behalf of fish and wildlife in the 1980s and concern for federal budget deficits may have contributed to the lack of workforce and budget response to increasing demand and workload.

The federal budget deficit did not improve during the late 1980s. The scientific knowledge base grew only in small increments since the pioneering work in habitat relationships of the late 1970s. And there were no new laws compelling more attention to fish and wildlife. Yet in 1989 the wildlife and fisheries budget and workforce made a dramatic increase and the workforce began to grow. The President's budget proposal to Congress for fiscal year 1990 is $15 million higher than ever before. What stimulated the change and what does it portend for the future?

We believe attention to customers and the many values of fish and wildlife are the reasons for renewed attention. In 1986, the Forest Service and interested conservationists initiated a Challenge Cost-Share Program in wildlife and fisheries habitat management. The intent was to provide federal funds to be matched by state and/or private funds to accomplish habitat work. An initial outlay of $923,000 was matched by nearly $1,500,000 from about 70 cooperating groups (USDA Forest Service 1989). In 1987, the Forest Service offered $1,500,000 in Challenge Cost-Share and nearly 200 groups contributed over $2,600,000 toward habitat work. In 1988, the Forest Service program of $2,500,000 attracted $4,600,000 from more than 400 conservation groups. With a 1989 program of $3,000,000, the Forest Service expects to draw more than $6,000,000 for matching habitat improvement work. There is no stronger indicator of demand than the willingness of customers to pay for what they want, and the Challenge Cost-Share Program has shown the strength of demand for fish and wildlife in the National Forest System. The President's proposed budget for fiscal year 1990 would offer $6,000,000 for fish and wildlife Challenge Cost-Share projects.

In 1987, the Forest Service and its partners in the American Fisheries Society, state fisheries agencies and fishing interest groups initiated a program called Rise to the Future—Fish Your National Forests. The intent was to increase attention to the values benefits of fisheries in the National Forest System. Nearly 50 percent of the anadromous fishery of the Pacific Northwest and 50 percent of the cold water fishery of the nation depend on National Forest System waters. More than 2,200,000 acres of ponds, reservoirs and lakes, and 128,000 miles of fishable streams and rivers exist in the National Forest System. The resource supports over 50 million angler days and 110 million pounds of commercial salmon caught per year at an estimated economic value of $123,000,000. Yet, until 1988 the Forest Service employed fewer than 130 professional fisheries biologists who operated on a habitat management budget of less than $3,000,000 annually. Rise to the Future emphasized partnerships and attention to customer needs. By 1989 there were 168 professional fisheries biologists administering a $16,000,000 habitat improvement program.

In 1988 and 1989, the Forest Service restructured its wildlife habitat management program into nine major "product lines": elk, waterfowl, deer, wild turkey, bighorn sheep, quail, grouse, snag dependent species and watchable wildlife. Each has a program manager from the field and a team of "managing partners" from state agencies and conservation groups. Under the banner of *Get Wild*, we expect a response for wildlife habitat similar to what is now occurring for fisheries. Already the historically flat budget of $5,000,000 per year has inched up to $7,000,000 in 1989. The National Forest System is home to the richest diversity of wildlife in the country. It provides habitat for 75 percent of the big game animals of the West. Such a resource deserves better attention.

Our next effort is in threatened, endangered and sensitive species, including rare plants. Preliminary work is complete and partnerships are now formed to take the emphasis on these resources and their customers to a higher level. National Forest System habitats sustain 30 percent of all the listed species in the country. The goal is to make the National Forest System a place where endangered species can flourish, probably the best hope for biological diversity in the nation.

Thoughts on the Future

Where the emphasis on marketing leads is hard to say. The generic resource of fish, wildlife and endangered species positions the National Forest System to conserve more of the variety of life and serve more people in more ways than any wildlands in the country. By combining strong, positive, customer-oriented programs in fisheries, wildlife and endangered species as integral parts of multiple-use conservation, the Forest Service and its state and conservation group partners can safeguard much of the nation's biological diversity while simultaneously contributing to the vitality of local, regional, and national economies. Capitalizing on this potential will not require new laws or regulations. It will not require, nor need it wait for, major increases in scientific knowledge. What is needs is the magic of a marketing imagination and the close attention to customer satisfaction that implies. The infrastructure of existing laws, policies and scientific institutions ensure that the zeal to satisfy more customers is balanced by protection of the long-term health and productivity of basic resources.

To give a hint of what is possible we offer a vision. It is conceivable that every ranger district could employ a professional, journey-level wildlife and fisheries biologist, one of each on average. There could be on average one botanist for every two districts and one invertebrate zoologist on each forest. They could each supervise a trainee, technician, or cooperative education student. They could each administer a $20,000 Challenge Cost-Share habitat improvement program on average. Each supervisor's office could have a planning and marketing staff of a senior wildlife, fisheries and endangered species biologist, one of each. And each regional office could have a program management staff of 8 to 10 senior management biologists. The Washington Office would employ about 20 to 25 people to administer the entire program. There could be 200 research biologists in support roles on science and technology development. This vision is not in any plans or programs at this time. It is, however, possible if people interested in fish and wildlife in the National Forest System want to make it a reality.

Compared to the 1989 program of 800 professional biologists and a $65,000,000 annual budget ($44,800,000 in constant 1980 dollars) the possibilities show a growth potential for perhaps 2,500 professional biologists in the workforce, about 1,000 technicians and trainees, and a $50,000,000 Challenge Cost-Share Program in habitat and access management. The resource and its customers could conceivably support a $250,000,000 annual program in fish and wildlife conservation on the national forests and national grasslands: about $100,000,000 in salaries, the rest in stewardship and enhancement of basic resources to better serve customers. We've seen the limited effects that new knowledge, laws, and regulations have in stimulating change. Now its time to see what a marketing imagination can do to make knowledge and the intent of legal mandates come alive to create more happy customers for fish and wildlife.

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Interorganizational Cooperation for Natural Resource Management: New Approaches to a Key Problem Area

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Introduction

Successful natural resource management goes far beyond the performance of employees in responsible government agencies. Rather, it involves the actions of private citizens, commercial firms, voluntary organizations and other public or private bodies whose activities can assist or constrain the actions of the core agency.

Often, technical plans succeed or fail less as a result of technical soundness than as a result of the ability of natural resource managers to orchestrate the necessary cooperation among such organizations. This has become quite apparent in third-world settings where wildlife conservation, coastal resource protection, and social forestry have encountered extremely difficult institutional barriers to effective action. Moving mountains sometimes seems easier than moving organizations.

Adding to the difficulty is the fact that managerial responsibility is often held by people with interests and training in technical fields of natural science rather than applied fields of social science. This situation is further compounded when problems require solutions that transcend organizational boundaries. And since natural boundaries do not follow organizational boundaries, this is the norm.

In response to this experience, a method called "stakeholder analysis and coordination action planning" has been developed to help program managers analyze their institutional environments and obtain cooperation from key organizations. It has registered success in Africa, Asia and Latin America and it could prove useful in North America as well. This paper describes key elements of this approach to interorganizational cooperation for natural resource management and illustrates it with a social forestry application.

Management by Influence

Social forestry is not simply the growing of trees by foresters. Quite the contrary—"social" comes before "forestry." That is, the impact on trees, soil and animal life is only obtained through the behavior of people. Conserving woodlands, planting and nurturing woodlots, improving livestock fodder, and more efficient consumption of wood energy and forest products result from actions by farmers, bureaucrats and entrepreneurs outside the forestry department.

Thus, a social forestry program achieves its objectives by working with and through various individuals, social groups and formal organizations rather than by controlling the performance of forestry technicians. Indeed, cooperation from the courts, the police, the tobacco industry, researchers, agricultural extension people , local leaders, educators, villagers, shopkeepers and many others will characterize successful social forestry.

The foresters responsible for implementing social forestry are usually experienced in commercial forestry and skilled at plantation and nursery management. They recognize that this new emphasis will require cooperation from people outside the forestry department in order to be successful. However, they also recognize that they are technicians with no training in organization or extension methods and they do not know how to get these people involved and supporting the program. For them, social forestry lies in uncharted terrain where they cannot control program performance but instead they must be able to influence the actions of others. Thus strengthening interorganizational cooperation requires an approach that stresses management by influence.

Analytical Basis

The analytical basis for the approach noted here has three elements. They are represented by the terms stakeholder, coordination and influence. A stakeholder is defined as an individual or a group that can have an impact, either positive or negative on a given situation. That is, stakeholders have access to resources that either are needed to carry out an activity, or they have resources that can be mobilized to prevent the activity from being performed.

To conduct a stakeholder analysis, staff first list the problems they face in achieving a specific objective, then they list all the stakeholders who can help to resolve the problems. These two lists then become the two axes for a matrix, in which the vertical axis displays the problems, while the horizontal one arrays the stakeholders. For each problem listed, staff indicate with an X in the appropriate cell which stakeholder(s) can help to resolve that problem. Figure 1 illustrates a simplified stakeholder analysis based on social forestry programs in two African countries.

In discussing the outcome of stakeholder analyses in field situations, the staff are often struck by the large number of stakeholders they identify and by the small number of problems over which they, as stakeholders, have control. Their task is literally out of their control.

Recognition of the lack of control invariably leads to discussion of coordination. But this term contains too many disparate elements to offer useful guidance. Its components must be specified if it is to contribute to an understanding of management options.

Coordination can be disaggregated into three behavior types. The first is INFORMATION SHARING. This is communication. Organizational actors do or do not let others know what they are doing, or planning to do, and this either helps to smooth relations or its lack leads to bad feelings and management breakdowns that are faulted for poor coordination.

The second dimension of coordination-related behavior is RESOURCE SHARING. Resources controlled by one actor may be needed for the job of another to be done properly. For instance, a training center under the aegis of one ministry may be needed for work being done by another, or access to vehicles may make the difference between a successful or failed effort.

The third type of coordination behavior is JOINT ACTION. This involves two separate actors or organizations actually doing something together. Each may be

Objective = Promote wood saving technologies and practices

Problems / Stakeholders	Forestry department	Forest research institute	Ministry of fianance	District councils	Ministry of agriculture	Police	Ministry of education	Natural resources college	Business council
1. Technology development	X	X						X	
2. Transport	X				X	X			
3. Data on practices		X						X	
4. Pricing policy			X						
5. Marketing				X			X		X
6. Extension of technology	X			X	X				
7. Publicity	X				X				
8. Production									X
9. Fuel source	X			X					
10. Tax policy			X						

Figure 1. Stakeholder analysis.

using its own resources, but they have synchronized their actions so that they complement, enhance and reinforce each other. They may be physically together, such as a mixed-ministry team visiting a village, or they may be separate, such as a forestry presentation in the morning and an agricultural presentation in the afternoon of a training session: simultaneously or sequentially a set of planned, related activities is being undertaken by different actors. (Honadle and VanSant 1985).

Coordination, then, is not synonymous with control. Rather, it goes beyond directive behavior to include influence and communication practices which result in cooperative behaviors, improved use of limited resources, and higher organizational performance.

Conceptually, the realm of *control* held by a manager can be seen as a small circle in the center of a manager's world. Beyond that small circle is a larger area where the manager might *influence* what is going on, but is unable to control it because others had resources they could use, independent of the manager, to effect action in that arena. This influence arena is embedded in a still larger area where the manager can not influence what is happening, but since events here could influence the other arenas it is necessary to keep abreast of developments. This is called the area of *appreciation* (Smith et al. 1980).

When this view is applied to the results of a stakeholder analysis it shows the variety faced by managers. Where a problem shows only an X in the manager's column, it is a control situation. Where Xs appear in the manager's column and in other columns, it is a situation requiring influence strategies. And where Xs appear in other actor's columns but not in the manager's column, then it is a situation of appreciation.

In Figure 2 the three management arenas are used as the horizontal axis of a matrix, with the dimensions of coordination supplying the labels for the vertical axis. In

Circumstances

Coordination types	Need to appreciate	Need to influence	Ability to control
Information sharing	Seminars Meetings/committees Report distribution Liasion Common location Common language Third party contract	Workshops Meetings/committees Report distribution Common Location Common language Enabling policy Incentives	Restricting policy Procedures Supervision Audit/monitoring Unilateral planning Penalties
Resource sharing		Contracts & agreements Incentives Meetings/committees Workshops Loans & grants Joint budgeting Enabling policy	Restricing policy Procedures Unilateral budgeting Audit/monitoring Penalties Supervision
Joint action		Contracts & agreements Incentives Meetings/committees Workshops Personnel loan Joint supervision Joint planning Enabling Policy Task Forces Joint Training	Restricting policy Procedures Supervision Penalties Merge organizations Audit/monitoring

Figure 2. Coordination mechanisms for varying circumstances.

each cell appropriate management mechanisms are displayed. Thus, for example, a manager in a situation of influence can find in the matrix a number of mechanisms to use to influence others by sharing information, sharing resources or acting in concert. It also shows that there are many non-control mechanisms available, but they will require management initiative, rather than waiting for normal administrative procedures to generate appropriate action. Influence-based leadership demands a much more active operating style than that offered by control mechanisms. The process of applying these perspectives in field settings is introduced below.

Application Process

Organizational assistance has three phases—reconnaissance, workshop and follow-up. It begins with a reconnaissance study (*see* Honadle 1982) to determine the appropriate design of a workshop series. At the end of this study, an outline for the workshop(s) has been created and a list of key participants has been developed. This participant list is based on an initial assessment of likely stakeholders. The reconnaissance is essential for ensuring the quality of the process and the data base for the workshop.

A workshop method (Silverman et al. 1986) is used to begin coordination and action planning efforts. The workshop involves bringing together some of the actual stakeholders for a period of three to six days. Workshop participants, working in small groups, go through a series of structured exercises, each one building on the previous one, resulting in the development of coordination strategies and action plans for the participants to implement when the workshop is over. During the final stages of the workshops, workgroups composed of real operating units negotiate and contract with each other.

The exact configuration of workshop participants, groups and exercises depends on the objectives and phase of the program and the circumstances in the field. In some cases, a series of workshops is held. For example, a first workshop may involve a national level coordination planning effort with people from numerous ministries, which is followed by action planning workshops of national, regional and local staff from the agency implementing the program. In other cases, it may be a series that alternates between national and other levels of government staff, or it may consist of a shifting mix of ministry, non-ministry and private sector participants. The sequencing of the workshops and participant mix is designed so that each workshop builds on the outcome of the previous one.

The process used in these workshops is flexible and capable of being adapted to fit a wide range of circumstances and conflict levels. At the same time it is rigorous—it follows a strict general sequence (see Honadle and Cooper, forthcoming). The sequential rigor keeps it effective in circumstances of extreme bureaucratic and political conflict. The use of groups enhances its ability to deal with controversial topics by protecting individuals from exposure to political risk. But this method requires skilled and experienced organizers to work. It is not a tool for neophytes.

A follow-up is conducted after the participants have had time to put their plans into action. This reinforces the coalition building that began during the workshop, refocuses attention on priority issues, and promotes adjustment to changing circumstances.

Conclusion

Influencing human behavior is key to conserving and renewing resources, and giving resource managers and protectors institutional knowledge and tools is as crucial as giving them technical know-how. Natural resource management demands the complementary application of natural science and social science knowledge to real problems (Heberlein 1988).

Unfortunately, natural scientists seldom are exposed to state of the art social science and management methods and perspectives. This is especially unfortunate given the wide range of observers who have identified both the need for effective interorganizational management in future efforts (Sampson 1988, Kelly 1988, Wellman 1987, Clark and McCool 1985) and the weakness of interorganizational cooperation as an important contributor to past difficulties (Moore 1987, Dunlap 1988, Baden and Stroup 1981).

The introduction of social science perspectives has begun in the area of wildlife management (Decker and Purdey 1988), but it needs to be expanded to other natural resource concerns and to build upon the methods and insights of the applied behavioral sciences. The stakeholder analysis coordination action planning approach presented here is just one of many tested methods for institutional analysis and performance promotion. Although it was developed in response to institutional inertia in third-world settings, it is applicable to domestic North American programs.

Much innovative social science has evolved based on social and institutional issues surrounding international development programs (*see* Ickis et al. 1986, Cernea 1985, Honadle and VanSant 1985, Yaeger and Miller 1986) and the bulk of these programs are agriculture or natural resource based. This largely untapped reservoir of experience should be brought to bear on natural resource management in North America as well. Programs such as the Critical Areas approach to the Chesapeake Bay (see Therres et al. 1988) could perhaps benefit from such application.

Interorganizational cooperation is a key problem area in natural resource management. Experience with rural development in the third world is a promising source of approaches to this problem and a technique derived from that experience is stakeholder analysis and coordination action planning. But this is just one approach to a larger issue—the need to merge social science and natural science knowledge in the service of natural resource management. This is the real challenge.

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"Join Us": Challenge Cost-Share for Wildlife and Fisheries on National Forests

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Congress initiated the Forest Service Challenge Cost-Share Program in 1986. Its mission is to improve habitat through partnerships for wildlife and fisheries on 191 million acres of national forests and national grasslands. This program provides a unique opportunity for the public to directly influence wildlife and fishery management on public lands. By putting their labor and/or money to work on the ground, they can improve the situation for fish, wildlife and endangered species.

Wildlife and fish are important to the public. The American people have demonstrated their interest loudly and clearly through the land management planning process, increased legislation, and increased litigation and public debate on wildlife and fishery issues. Four pieces of legislation affecting the Forest Service has given the public a forum to voice their support for wildlife and fisheries: the National Environmental Policy Act of 1969 (NEPA), the National Forest Management Act of 1976 (NFMA), the Sikes Act of September 1960 and the Forest and Rangeland Renewable Planning Act of 1974 (RPA).

NEPA directed federal agencies to use an interdisciplinary approach toward planning that considered amenities and social values along with economic and technical considerations. It also required that a detailed statement of the effects of federal actions on the environment be disclosed to the public. Six years later, NFMA went one step further. It directed the Forest Service to prepare Forest Land and Resource Management Plans, detailed documents that outline management objectives and practices for the national forests. The NFMA also provided for public participation in land management planning, an opportunity that many segments of the public have utilized. Since 1976, the public has provided an estimated 300,000 to 400,000 comments to draft land and resource management plans. They have also filed approximately 670 appeals on forest land and resource management plans. A large majority of the comments and appeals express concerns regarding wildlife and fishery issues. The public questions whether adequate provisions have been made in forest plans to protect and enhance wildlife and fishery resources.

The state fish and wildlife agencies have long been the strongest advocate for wildlife and fishery management on the national forests. The Sikes Act of September 1960 provides for cooperative planning with state fish and wildlife agencies. The Forest Service has cooperative plans with all states that contain National Forest System lands. Projects from these plans are being incorporated into the forest land and resource management plans. The Forest Service has and will continue to maintain a strong partnership with state fish and wildlife agencies.

The fourth piece of legislation previously mentioned is the RPA. The RPA directs the Forest Service to prepare an assessment of present and projected future uses of the nation's renewable resources. Resource programs are to be designed considering the supply and demand for them. The 1985 RPA assessment shows several things. Wildlife and fish based recreation is expected to increase overall. Nonconsumptive activities (photography, birdwatching and nature study), are expected to increase at the greatest rate, followed by cold water fishing. If we are to meet the public's demand for these resources, we must provide for an increase in wildlife and fish populations. Comparing projected resource demands across all ownerships shows that national forests and grasslands will become much more important for providing opportunities to hunt or fish, and to view photograph or study wildlife.

As stated previously, fish and wildlife management on national forests has long been a cooperative venture with state fish and wildlife agencies, but recently several new partners have joined in our efforts. In the past few years, we have signed 10 national agreements with fish and wildlife organizations.

In December 1988, the Chief signed an agreement with the Sport Fishing Institute (SFI), a non-profit scientific and educational organization. The SFI represents the interests of anglers and serves as a liaison between the sport fishing industry, the public and the government. Together SFI, with its network of 15,000 fishery professionals, and the Forest Service will produce educational material as part of the "Rise to the Future" program.

In November 1988, we signed agreements with the Foundation for North American Wild Sheep. The Forest Service manages seasonal or year-long habitats for about 80 percent of the wildsheep in the United States. As partners, we will cooperate to meet the growing public demand for wild sheep viewing and hunting opportunities on the national forests.

Last year, an agreement was signed with the Rocky Mountain Elk Foundation. Under this agreement, the Elk Foundation, with over 30,000 members provided money and volunteers to improve elk habitat on the national forests. Thus far, the Foundation has provided $231,000, with much more planned for the future.

Trout Unlimited and the Forest Service have signed an agreement to improve fishery resources on national forests through specific habitat improvement projects. Local Trout Unlimited Chapters and Forest Service Ranger Districts have accomplished hundreds of projects which were facilitated by this national agreement.

Since 1984, the Forest Service has been partners with Ducks Unlimited and the U.S. Fish and Wildlife Service to accelerate improvement of the 12 million acres of waterfowl habitat on national forests. These efforts will be coordinated with the North American Waterfowl Plan.

We also have agreements with Quail Unlimited, Federation of Fly Fishers, Ruffed Grouse Society, and National Wild Turkey Federation. These national memoranda of understanding provide a written framework to build partnerships at the local level.

In 1986, at the urging of leaders in the conservation community, headed by Lonnie Williamson of the Wildlife Management Institute, Congress initiated the Challenge Cost-Share Program in the Forest Service. This program is aimed at capitalizing upon the strong public interest and support for wildlife habitat improvement work. High priority jobs are accomplished utilizing the support of many groups, including conservation organizations, civic clubs, businesses, private individuals and other federal and state agencies. Partners step forward with their money or labor to accomplish on-the-ground projects. Their contribution is matched by federal dollars. In 1986, 57 partners contributed $1.6 million and accomplished over 30,000 acres of habitat improvement and completed over 1,800 structures, such as water developments, bird houses and fish ladders for wildlife and fish. In 1988, 429 partners came forward with over $4.0 million and accomplished nearly 47,000 acres of habitat improvement and completed over 4,500 structures. The public, who own the fish and wildlife on the national forests, has really come forward to help us meet their demands.

Numbers of acres and structured do not begin to describe the on-the-ground accomplishments through challenge cost-share projects. Following are a series of projects we have completed with our partners.

- In cooperation with faculty and students at Idaho State University, the Idaho Panhandle Forest conducted surveys for Townsends big-eared bats. Data from these surveys will help forest managers understand he habitat requirements of bats and provide needed management information.
- Challenge Cost-Share combines benefit for human as well as natural resources. The Boys Ranch in Arizona provided the labor of young men to rehabilitate trout habitat in Christopher Creek on the Tonto National Forest. The Boys Ranch, in return, got a forest setting in which to rehabilitate the young men in their program.
- In the Tahoe National Forest, meadow improvement projects were completed in cooperation with the California Department of Fish and Game, which provided $18,000 to augment the Forest Service's $2,500. Meadow improvements increase carrying capacity for a variety of wildlife species. Improvements included: (1) willow planting; (2) fencing; (3) installation of check dams; and (4) access controls. Sixty four acres in four meadows were treated.
- The Forest Service joined California Department of Fish and Game to accomplish an instream improvement project for the threatened Lahontan Cutthroat Trout in the Portuguese Drainage of the Sierra National Forest. The project included armoring streambanks to reduce sediment movement into the creek, and willow planting to increase shading of the stream.
- Two projects at Oregon Dunes national Recreation Area in the Siuslaw National Forest benefited threatened and endangered species. Silverspot butterfly habitat was enhanced through burning and mowing dense vegetation following guidelines in the recovery plan. The other project enhanced Aleutian Canada goose habitat by digging potholes, building nesting platforms, and seeding areas with cereal grains.
- The Siuslaw National Forest is improving elk forage through meadow rehabilitation. This is an ongoing program that began in 1987. The project consists of seeding and fertilizing clearings at old homesteads. Partners include the Rocky Mountain Elk Foundation, Forest Service and Oregon Department of Fish and Wildlife.
- The George Washington National Forest is cooperating with Virginia Department of Game and Inland Fisheries to reintroduce the peregrine falcon in the George Washington National Forest. The birds had vanished from the Shenandoah Valley of Virginia in the early 1950s. In June 1986, the Peregrine Fund supplied 12 young birds for release in the Forest. The young birds were released last fall, with high hopes for re-establishment of the population.
- Volunteer Kathy Phillips of the Laurel Lake Wildlife Club helped with osprey handling in the reintroduction "hacking" project on Laurel River Lake in Kentucky. Five osprey chicks from Delaware were placed in a 20-foot high protected

roost. They were detained and fed in the roost for 6 weeks, then released. They should stay in the area to become the start of an osprey population in Eastern Kentucky.

- In cooperation with Michigan Conservation Foundation and Consumers Power Company, the Huron-Manistee National Forests installed 50 bluebird boxes.
- A project in the Hoosier National Forest surveyed federally-listed and state-listed threatened and endangered plant species and their habitats in cooperation with the Indiana Department of Natural Resources. This resulted in several management recommendations.
- The Chugach National Forest in Alaska developed a cooperative action plan for recovery of the Dusky Canada goose on the Cooper River Delta. Their partners include the Alaska Department of Fish and Game, Oregon Department of Wildlife and the Washington Department of Game.

Cooperation with our partners extends farther than numbers of elk, turkey, ducks and bluebirds. The Challenge Cost-Share Program improves management of the National Forests in many ways. For example, it can ease conflicts with our many publics by promoting cooperation in goal setting for wildlife and fisheries. We and our partners approach resource challenges as equals. Priorities for habitat improvement work may shift within the framework of the Land Resource Management Plans.

Challenge Cost-Share projects often benefit species that are not hunted or fished, such as threatened and endangered species, nongame birds or "watchable wildlife," and sensitive plants. Work for these species is often not adequately funded by federal or state dollars. Badly needed administrative studies and monitoring plans can be funded through Challenge Cost-Share.

The Challenge Cost-Share Program also provides opportunities for people to get involved in national forest management in a positive way. People who may not typically hunt or fish on public lands, such as the handicapped, urban youths, and civic groups such as garden clubs, become involved in projects to benefit fish and wildlife. These people become better informed about forest management and are some of our strong advocates for proactive fish and wildlife programs on public lands.

The Challenge Cost-Share Program also provides both direct and indirect services to the public, whether through promoting outdoor education opportunities for our nation's school children or promoting strong work ethics for troubled youths as in the Arizona Project's Boys Ranch. Partnerships for fish and wildlife can often benefit community health and stability. We face a few challenges along with the success of this program. The biggest challenge is keeping up with our partners.

On some forests and grasslands, were are not quite ready to start on-the-ground work. As stated previously, some of the Land and Resource Management Plan do not reflect a strong commitment to wildlife and fisheries. Therefore, they do not contain a backlog of improvement projects ready to meet public demands. Those plans may need amendments to reflect the public's interest in wildlife and fish values. In some areas, we do not have the necessary staff to do project planning and supervision. We continue to look to the state fish and wildlife agencies as important partners for us in this area.

We are ready for the challenge of meeting public demand for wildlife and fish resources. Challenge Cost-Share has strengthened partnerships with forest users by improving understanding of overall Forest Service goals and reducing misunderstandings among users. As Chief F. Dale Robertson says, ''I believe this new wave of conservation partnership and cooperation can and should eventually dominate the confrontational approach toward natural resource management.'' Challenge Cost-Share projects offer unique opportunities for the Forest Service and our share holders to work side-by-side and hand-in-hand to accomplish projects for wildlife and fish. *Join Us!*

Expanding BLM Partnerships through Challenge Cost-Sharing

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I appreciate the chance to be here today to provide some insight into how the Bureau of Land Management (BLM) is expanding cooperation and partnerships in its wildlife and fisheries program. I am very proud of the fish and wildlife program in BLM. Over the years we have developed many innovative and creative methods of working within a multiple-use agency to protect and enhance fish and wildlife resources. We have a cadre of professional biologists and botanists second to no other agency, and we have a record of accomplishments that can hold their own anywhere.

The Bureau of Land Management manages about one-third of a billion acres in the Western United States and Alaska that provide habitat for over 3,000 species of fish and wildlife, including 140 federally listed plant and animal threatened and endangered species, and 870 species that are candidates for federal listing. In fact, no single federal or state agency manages more fish and wildlife habitat than the BLM. Millions of Americans visit BLM lands each year to hunt, fish, observe wildlife and to otherwise pursue fish- and wildlife-related activities. Conservatively, we estimate wildlife viewing alone to be worth $200 million in primary benefits.

In FY 1989, the budget for the wildlife and fisheries program was a little over $20 million. Obviously, managing the wide array of economically, recreationally, and scientifically important species over these vast habitats at this funding level is challenging, to say the least.

In FY 1985, when our budget was in the $15 million range, the Congress stimulated new thinking in our approach to funding fish and wildlife habitat management on BLM lands. It did this by appropriating $300,000 to BLM to be used for matching funds, now called Challenge Cost-Share, for improving habitat for desert bighorn sheep. Desert bighorns were targeted because BLM manages 80 percent of the habitat for this species.

We feel that the Challenge Cost-Sharing initiative has been a landslide success. Not only has it been a shot in the arm in a budge sense, it has provided congressional encouragement and direction to develop a series of partnerships with various private organizations. While BLM has long been cooperating and working closely with state fish and wildlife agencies, it has until recent years done relatively little with the private sector. The Challenge Cost-Share funds and associated congressional guidance in FY 1985 ignited new thinking and approaches to working with outside groups.

The initial $300,000 appropriated in FY 1985 was more than doubled through matching contributions of money, materials and labor provided by state agencies and private organizations. With this extra money and help, we were able to develop 18 water sources in three states (Arizona, Nevada, New Mexico); establish four new herds in Arizona and analyze four other habitats there in preparation for reintroduction; and initiate studies on disease mortality. The benefits of this approach were recognized by the Congress, who again appropriated $300,000 in FY 1986 for sheep. Completion of our rangewide plan for managing desert bighorns in 1988, together with continued cost-sharing efforts, will enable us to expand desert bighorn herds on BLM land from 32 to 114. This is something about which the BLM and cooperating conservationists, sportsmen and agencies can be rightfully proud.

In FY 1987, the Congress increased the matching fund account to $450,000 and removed the restriction that the money only be spent on bighorn sheep related work. This enabled us to begin formulating a whole new range of partnerships involving all sorts of organizations—waterfowl, fisheries, T/E species, other big game oriented groups, and so on. In that year, state and private contributions totaled a whopping $1,860,000. Any way you slice the cake, this is a significant expression of the public interest in BLM's fish and wildlife program.

An example of a multi-benefit project using the Challenge Cost-Share capability is how our Spokane, Washington, District is using the Challenge Cost-Share to foster cooperative habitat management in riparian zones in the arid Columbia Basin. In FY 1987, Spokane began to work more closely with the state wildlife agency, and a consortium of sportsmen's clubs, the Inland Northwest Wildlife Council. This partnership is now implementing a broad-based riparian enhancement plan to improve overall habitat quality, protection for the riparian system, and rehabilitation of both aquatic and adjacent upland habitats. The Inland NW Wildlife Council is providing labor, materials and equipment for habitat improvements. The results of this effort are apparent already. On four separate tracts in the project area, bank cover has increased, erosion has slowed, water quality and quantity have increased, nesting cover for waterfowl has increased and resident trout habitat has been expanded and improved. A section of land and a mile of trout stream that had previously been closed have now become available for public use and recreation. This has all been accomplished through a Challenge Cost-Share capability of less than $40,000 over the past two years—truly an example of what cooperation can accomplish at the local level.

In FY 1988, $900,000 was appropriated to the BLM for Challenge Cost-Sharing. This was matched by some $1.5 million in outside funds. In addition, we had $3 million worth of pledges that we were unable to match. Total Challenge Cost-Share opportunities identified by BLM State Offices during our Annual Work Plan process totaled $3.7 million in BLM funds and $4.5 million in contributed funds, materials and labor for that year.

In FY 1989, the Congress increased Challenge Cost-Share funds to $1.5 million. Unfortunately, at this level we still could only match less than half the opportunities identified at the field level. We anticipate these $1.5 million cost share funds will be matched by at lest $2 million in state and private contributions this year.

Most of the work done under Challenge Cost Sharing is designed to enhance the habitat for an array of fish and wildlife species. But we do no limit our cooperation just to those types of activities. For example, we have some projects that are geared to inventory of key resources, monitoring the effectiveness of ongoing management and the conduct of studies to resolve on-the-ground management problems.

We feel that the landslide success of the Challenge Cost-Share approach is due to several factors. First, there is growing public interest and concern about BLM's fish and wildlife program. Second, there is increased awareness of the social and economic importance of fish and wildlife to local communities and the people of this nation. And, third, we believe that at least part of the expansion and increased support is a result of an historic milestone achieved in May 1987 for the wildlife and fisheries program when the BLM director approved our strategic plan, *Fish and Wildlife 2000*. This plan describes goals and objectives for efficient management of fish and wildlife resources on BLM lands. it was completed following extensive consultation with our field offices, state fish and wildlife agency officials, representatives of various conservation organizations, and internal work sessions. It is a product of deep and prolonged thought by most of our managers and biologists.

Fish and wildlife resource management, as practiced by BLM, is a three-step process of fact-finding, planning and action. We realize that none of these steps can be effective without the cooperation of others. Thus, one of the significant elements of the plan concerns external consultation and partnerships.

Given our limited budget capabilities and the outpouring of public interest shown for our program and the Challenge Cost-Share initiative, we clearly realize that we needed to intensify our proactive efforts with potential cooperators to get the on-the-ground management work planned, implemented and completed. These expanded partnership opportunities are, in short, essential to the efficient operation of a viable fish and wildlife habitat management program throughout the BLM.

One of the things we did to implement the partnership component of our strategic plan was to form a special team to identify opportunities and strategies for increasing outside interest and investments in fish- and wildlife-related work. This team identified a comprehensive set of strategies for expanding outside investments and partnerships, ranging from better internal planning and more effective outreach with potential contributors to more efficient coordination and the tracking of accomplishments. Implementation of these strategies has helped to bring greater internal awareness to the importance of developing partnerships with a host of different organizations. Investments from conservation organizations and others have more than doubled in three years, largely due to a greater effort on the part of our field people and the tremendous initiative and potential afforded by the Challenge Cost-Share approach. Since February of 1988, for example, we have signed memoranda of understanding at the national level with the Rocky Mountain Elk Foundation, Quail Unlimited, National Wild Turkey Federation, the Foundation for North American Wild Sheep, and Trout Unlimited.

The list of cooperators at the field level is too numerous to list here, but some examples include local chapters of Ducks Unlimited, Trout Unlimited, National Wild Turkey Federation, Isaak Walton League, local affiliates of the National Wildlife Federation, Audubon chapters, Nature Conservancy, bighorn sheep organizations, and the various state fish and wildlife agencies.

In summary, there is no doubt that the Challenge Cost-Sharing funds have provided a vital boost to BLM efforts to implement on-the-ground management of fish and wildlife on BLM lands. This support and involvement by outside contributors has resulted in the improvement of thousands of acres of habitat for an untold variety of wildlife and fish species. Also, it has helped us to make many new friends at all levels, thus enriching our agency. This is resulting in a more dynamic effort by the BLM as the steward of lands and resources on behalf of the American people.

Our thanks to all who have joined with us to make Challenge Cost-Share a vital and growing addition to the BLM and to our fish and wildlife program.

Challenge Grants: An Evolutionary Step in Volunteer Programs

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The U.S. Fish and Wildlife Service (Service) was authorized to implement a volunteer program in Fiscal year (FY) 1978 through the enactment of the Fish and Wildlife Improvement Act. This act opened the door for people from all walks of life to donate their time, talents, labor and enthusiasm to help the Service carry out its responsibilities for fish and wildlife conservation and wildlife-oriented public recreation. In FY 1982, when the Service began keeping records of its volunteer activities there were 4,200 people contributing 128,400 hours. Today the program has 12,400 people contributing 478,600 hours. This is considered equivalent to approximately $3,871,000 of contributed services. Since its implementation, the volunteer program has functioned in a supportive role to ongoing Service programs. Volunteers have assisted in animal care, bird banding, wildlife surveys, environmental education, trail development, maintenance, and other resource needs, all of which are part of station[1] operations. Funding to support volunteers comes directly from the participating station's operational and maintenance base funding, no special funding is provided. This fact is the primary reason why the new Challenge Grant program is considered, by many, to be the next step in volunteer agreements.

The Challenge Grant (CG) program was introduced in 1985 as a Forest Service initiative, and has now been expended by Congress to other agencies. The backbone of the CG program is that it builds on the strength of today's volunteer activism by providing matching funds to support associated activities. The program is designed to allow individuals, conservation groups, public agencies (such as state agencies) or other non-federal sources an opportunity to assist in or conduct natural resource-oriented projects on federal lands.[2] The CG program provides a direct mechanism through which the federal government will furnish up to 50 percent of the project costs in either money, materials or some combination of both. The Cooperator then matches the federal share with donations of money, material, volunteer labor[3] or some combination of the three. In FY 1988 the U.S. Congress appropriated $200,000 to the Service's budget to initiate a CG program. The program is being supported in FY 1989 at the same funding level.

The goal of the Service's CG program is to enhance overall operation and maintenance of Service lands by completing projects through cost-sharing with Cooperators. Challenge Grant partnerships are started in one of two ways. First, station

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[1]The term "station" for the purpose of this report refers to field offices for wildlife refuges, fish hatcheries, research facilities or other Service facilities on which a volunteer may work.

[2]For the purpose of this report, the term "Cooperator(s)" will refer collectively to the following: private individual(s), conservation group(s), public agencies (such as state agencies) or any other nonfederal entities.

[3]Cooperator(s) are allowed, under the guidelines of the CG program, to use volunteer labor as payment toward their share of the CG project. One hour of volunteer labor is considered equivalent to the pay rate of a GS-5 step 1.

managers identify high priority projects needing additional resources ($/people) to complete and then seek matching support for these projects from Cooperators. Second, public interest is sparked in a resource need and a Cooperator's offer to conduct a CG project is received by the Service. If the project supports the primary purpose for which the station was established, it can be accepted as a CG project. The ability of cooperators to propose compatible CG projects is an attractive feature of the program. Many individuals and organizations wish to volunteer their resources to achieve particular personal interests or club goals. The CG program allows them to do this and to increase the fruits of their efforts by receiving matching funding from the government.

In the Service's first year of administering the CG program there were 55 approved project proposals submitted that would have resulted in $572,000 in matching Cooperator funds. With an appropriation of $200,000 in the CG program to fund these projects there was a shortfall in available federal matching funding of $372,000. Of the 55 projects that were submitted, 31 were funded for FY 1988. An analysis of the CG projects conducted at the end of FY 1988 shows that the total cost for the 31 projects was $504,000. Subtracting the initial $200,000 supplied by the government, the amount donated or services volunteered by the Cooperators totaled $304,000. The ratio of government-supplied funds to contributed funds is $1.00 : $1.52 a higher return of the taxpayer's investment than the $1.00 : $1.00 required.

Two representative examples of CG projects undertaken in FY 1988 were conducted in Missouri and California. In Missouri, the Neosho Chamber of Commerce matched Service funds in order to develop a public use facility at Neosho National Fish Hatchery. In California, members of he Westmoreland gun club donated their time, labor, and materials to reconstruct one-quarter of dike at Salton Sea National Wildlife Refuge. As a result, an estimated 120 acres of marshlands were restored for waterfowl and shore bird use. (See Appendix A for a synopsis of CG projects.)

In FY 1989 the Service received 89 CG project proposals that would have totaled $647,000 in matching Cooperator funds. With the appropriations remaining at the FY 1988 level, there was a $447,000 shortfall in available funding. Of the 89 projects proposed for FY 1989, 27 received Service funding. Initial projections reveal that the cost of these 27 projects will be approximately $500,000. The expected ratio of government funds to Cooperator funds will be approximately $1.00 : $1.50.

After one complete year of operation the Service has found the CG program to be a highly useful, fiscally sound program in helping to accomplish its goals. The positive response of the Cooperators to enter into CG agreements has been documented. The success of the program revolves around several key points. First, the program operates with special appropriated funding. If a project becomes a CG project it receives its own funding. Managers need not worry that a CG project will affect funding for other station programs. Therefore, managers are generally very receptive to a CG program. Second, the program draws upon the already established volunteer program. The fact that people can contribute themselves (time, talents, labor and enthusiasm) as payment for their share of a CG project makes it possible for anyone to get involved, no matter what their economic status. Third, the fact that individuals or groups can suggest a CG project that interests them and then if accepted by the Service, receive matching funds to complete it, is a real incentive to participate.

To date, the Service has initiated or receive 144 project proposals that would have resulted in more than $1,220,000 in matching private sector funds. The Service has been able to effectively utilize approximately $604,000 or 50 percent of this funding to enhance the overall management of its lands. As information concerning the CG program is disseminated, the Service expects to receive an increasing number of requests to initiate projects. Therefore, this will produce two benefits for the Service. First, the Service will accomplish an increased number of management activities on its lands at a reduced fiscal outlay, and second, the CG program will help build strong community support for Service programs while providing for lasting public awareness and understanding of the Service's mission.

Acknowledgment

I wish to thank Joseph Murphy (Outdoor Recreation Planner, USFWS) for his help in preparing this paper.

Appendix A

Fiscal year 1988
United States Fish and Wildlife Service
Challenge Grants Program Report

In fiscal year 1988 the Service initiated 31 cooperative Challenge Grant Projects. These projects were conducted with the assistance of 6 public agency and 35 private sector cooperators.

- Six of the projects were devoted to the development of public use facilities such as hunting blinds, picnic shelters, handicapped fishing docks, sanitary facilities and the refurbishment of visitor centers, public use cabins and field camps.
- Five of the projects were devoted to development of waterfowl habitat including the construction of impoundments, fish barrier and related water control structure installation and repair as well as the maintenance and enhancement of existing habitat.
- Nine of the projects were devoted to the provision of interpretive services including the development, printing and distribution of a variety of environmental education materials, the construction and installation of boardwalks, exhibits, observation towers, signs, trail plaques and wildlife diorama.
- Two of the projects were devoted to development of fish habitat through the construction and maintenance of impoundments and ponds.
- Five of the projects were devoted to the wildlife refuge operations and maintenance, such as the purchase of radio and heavy duty equipment (earth scrapers), exotic vegetation control, public access development and open space preservation.
- Four of the projects were devoted to wildlife research projects involving heron rookery, peregrine hacking, ocelot habitat and tern population research.

The Arkansas Game and Fish Foundation: A New Funding Paradigm

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Most state fish and wildlife agencies are unable to fully meet diverse constituent demands or respond to resource threats. It is not that agencies lack expertise or desire—most lack adequate funding. In 1983, I stated that funding the state fish and wildlife agency would be the most critical natural resource problem of the eighties (Wilson 1983). I don't see that this problem has gotten much better for most agencies.

Cliff Hamilton, in a presentation to the Western Association of Fish and Wildlife Agencies in 1988, called for a change in mindset and approach—to a new funding paradigm—that focuses not on money and budgets, but instead on "getting the job done."

Involving the awesome potential of the independent sector through a foundation is one promising avenue to bring in not just money, but many other resources to "get the job done."

Eleven states (Arkansas, Connecticut, Florida, Michigan, Nebraska, North Dakota, Oregon, South Carolina, South Dakota, Washington and Wisconsin) have established foundations to assist their fish and wildlife agencies. The Arkansas Game and Fish Foundation is certainly not the biggest or most successful. My aim is to provide some information which may be useful if you are interested in involving the independent sector of our society in "getting the job done."

The Independent Sector

The independent sector encompasses what has been called the third, or voluntary, sector of American life. Since colonial times, the independent sector has been an important part of American life and, accordingly, our economy. How big is it? As the following figures illustrate—it's enormous!

In 1986, the independent sector was estimated to comprise 873,000 tax-exempt, voluntary and philanthropic organizations such as schools; hospitals; social service and advocacy organizations; civic, social and fraternal organizations; arts and cultural organizations and foundations and religious institutions.

The independent sector had annual funds in 1986 totalling about $300 billion from the following sources: private contributions—27 percent, dues, fees and charges—38 percent, government—27 percent and 8 percent from endowment and investment income. Total sources of support in 1986 for the independent sector were *$404 billion*, which included $104 billion in volunteer time. Between 1977 and 1982, this sector grew faster than business or government (Hodgkinson 1988).

Total private contributions were $93.7 billion in 1987. Per capita contributions averaged $248 in 1987 and the average household contribution was $562. Corporate giving, by contrast, amounted to $4.5 billion in 1986 (Hodgkinson 1988).

Agency History

The Arkansas Game and Fish Commission has evolved from an executive branch agency created by the legislature in 1916 to an independent agency created by Amendment 35 to the State Constitution voted by the people in 1944.

The Constitution prescribes funding from license fees and requires legislative appropriation of these funds. We're a very traditional game and fish agency.

Arkansas, by all economic measures, is a very poor state. Our agency budget did not reach $10 million annually until 1979. For the first 25 years after Amendment 35, there was little problem either meeting consumer demand, protecting our resources or matching federal aid.

Economic conditions in the late 1970s and early 1980s changed all that. An expanding constituency, diverse resource threats and inflationary chaos combined to make it impossible to get the job done. By 1982 we had to face cutting expenditures and finding a new source of money. We were in what Hamilton (1988) called the dominant agency funding paradigm—focusing on getting *money* and spending it within tightly controlled budgets.

We could no longer consider land acquisition, lake construction, or new equipment purchases much less non-traditional but much needed new programs in Information and Education, endangered species, urban and nongame wildlife and others. We were unable to provide the 25 percent state match for all our available Dingell-Johnson or Pittman-Robertson federal funds.

At the same time we were increasingly aware of a critical need for ways to fund very non-traditional things like lobbying, entertaining, public relations, market analysis and attitude surveys—jobs for which there was no funding mechanism, much less funds.

Foundation

These conditions led to conversations with fish and wildlife agency directors, private foundation leaders and leaders of non-profit organizations. Everyone pointed to involving the independent sector and ultimately to the creation of our Foundation.

The Arkansas Game and Fish Foundation was incorporated in 1982, exclusively for the benefit of the Arkansas Game and Fish Commission for charitable, scientific, literary and educational purposes within the meaning of Section 501(c)(3) of the Internal Revenue Code.

A Board of Directors of from 9 to 21 members was established to conduct business. The Director and the Chairman of the Arkansas Game and Fish Commission were established as *ex officio* members.

The Foundation was born with little fanfare publicly or within our agency. No staff was provided. Operation of the Foundation was handled through the Agency Director's office and frankly very little was done.

Dormancy prevailed until 1986. The opportunity for revitalization came from "left field" as many new ideas do. The *Arkansas Game and Fish Magazine* had experienced an unprecedented surge in subscriptions from 40,000 to 150,000 in two years! Our ability to continue to provide a free magazine was being jeopardized by its success. This led to an appeal to the readership for contributions. A one-page plea for donations with a return envelope ran in one issue. 15,356 readers responded by giving $83,654 or an average of $5.48 per response. This was gratifying but the significance of the response was lost on us. Luckily a friend in the fund raising profession saw the data and convinced us that it was very significant and indicated opportunity for philanthropy.

The Foundation decided to test this premise. A survey research firm was hired to measure the likelihood, level and nature of support among selected audiences for an operating and capital fund raising effort. The firm used depth interview analysis, focus groups and telephone surveys.

Objectives of the study were to:

- Define potential contributor groups within the selected audiences and the likelihood of each contributing to the Foundation on an annual basis.
- Define motivators which would attract the selected audiences to contribute.
- Identify perceptions about the Foundation and its role.
- Determine the level of importance which the selected audience places upon the efforts of the Commission.
- Define the best means for approaching a fund raising effort for the Arkansas Game and Fish Foundation.

Results were both gratifying and challenging. We found that:

- Seventy-six percent of those interviewed indicated that they would be likely or very likely to donate to the Foundation.
- The most common support would most likely be either a contribution or sponsorship of special events.
- The strongest motivator for many of the respondents would be making preservation of land a main priority.
- Eighty percent of the respondents were totally unfamiliar with the Foundation.
- The major issues, as perceived by the respondents facing the Arkansas Game and Fish Commission, were preservation of land, game and fish restoration and public access.
- Respondents recommended the following ways for creating more awareness of the foundation: develop a media campaign, establish awareness clubs and sponsor events.
- The most approved methods of fund raising were: planned giving of leased property, sponsorships of special events, person-to-person volunteer solicitation, an organized donation campaign and a recognition symbol.

Based on the research findings, the study group recommended that the Foundation:

- Develop and implement a comprehensive public awareness program.
- Focus activities on issues identified as greatest concern to the public.
- Plan and coordinate sequential fund raising effort over 3–5 years.
- Devise a program for performance evaluation.

The findings and recommendations led the Foundation to two critical decisions; (1) a long time employee (38 years) retired from the Commission and was hired by the Foundation, and (2) a professional fund raising firm was hired to develop the potential indicated by the research. The firm agreed to establish program objectives to raise the maximum amount possible from private sources.

The firm agreed to:

- Identify donors to be contacted.
- Evaluate prospects determining the desired level and potential giving level of each prospect.

- Determine degree of interest and kind of support expected, i.e., in-kind, cash, stocks, land, etc.
- Develop marketing and PR methodologies to provide the optimum climate for maximum support from individuals, corporations, foundations and others.
- Develop a solicitation strategy for a fund raising action plan.
- Identify, enlist and train volunteer support groups.
- Develop a calendar of events for the year.

The firm agreed to implement solicitation strategies including personal visits, direct mail, special events and other identified methods. A program for follow-up was devised for gift-processing and recording, reporting and donor recognition.

Activities

Research had shown that only 20 percent of the public had any awareness of the Foundation. Education and exposure were sorely needed. We began this effort in the *Arkansas Game and Fish Magazine* with a two-page article which was both a promotional piece and another fund appeal. This second fund appeal generated over $90,000 and increased public awareness of the Foundation. A new foundation logo and brochure were designed and printed. One hundred of the state's most influential people were identified and invited to a reception where the Foundation was explained. They were asked to help and are now very generous and active supporters.

One issue of the *Arkansas Game and Fish Magazine* each year is a calendar in which local artists are featured. The original works of the 13 selected plus the original art of the state waterfowl stamp were shown at six cities around the state as a Foundation-sponsored activity. Potential local supporters were invited for wine and cheese on opening night of each of these exhibits. A waterfowl art poster was also published as a joint venture with Ducks Unlimited. The Foundation sponsored fishing rodeos for kids on National Fishing Day, and about 20,000 kids participated statewide.

Internally, our agency staff began a series of meetings which were aimed at developing a "wish list" or catalog of needs. This catalog would be used to let prospective donors shop for ways to help. Heavy equipment, office supplies, electronics, personnel and land were common items listed.

Concurrent with the public awareness effort was a grassroots organizational effort. The ultimate goal was to create an active group in each of the 75 counties. We began by selecting a regional chairman in each congressional district. Regional chairmen then selected county chairmen and helped them organize the county committee. The county committee was charged with organizing membership drives, sponsoring local projects and developing local public awareness.

Membership applications were printed, with individual classes of membership ranging from $5.00 for a Member to $5,000 for a Lifetime Sportsman. These application forms were placed with 1,000 selected license dealers around the state with an incentive whereby they would receive a $1.00 rebate from each membership.

Also concurrently we announced a statewide fund raising drive. This was a concentrated six-month effort aimed at generating exposure as well as operating capital. A board member who was also a successful charity fund raiser agreed to chair the drive. A statewide press conference announced a goal of $250,000. Personal contact and direct mail were the key strategies. A VIP list was invited to a dinner party, heavily covered by the media, where the chairman announced a gift of 100 acres of wetlands. Guests were told about the program and asked to help. Another statewide press conference announced the successful end of the campaign. The effort resulted in gifts of land, equipment, cash and time valued at over $500,000.

Generating the resources to provide the 25 percent match for our federal aid program has been a challenge the past 10 years. Two unique, creative ventures, which have been popular both with donors and with our staff, have helped meet our federal aid match.

Local fishermen groups have generated funds which they donate to the Foundation. These funds are for specific Dingell-Johnson projects and the donation serves as the 25 percent state match. Often the donation is in the form of land either for a lake site or access site. This process has enabled us to complete several Dingell-Johnson projects which would not have been possible otherwise.

Heavy equipment dealers who are sportsmen/supporters have donated from 25 to 50 percent of the cost of much needed equipment which was purchased under the federal aid program. These donations could have been made directly to the agency with the same mechanism and benefits except that by going through the Foundation they generate public awareness, good-will and cooperation.

We are in the process of constructing District offices with a more involved joint venture approach. A local log home dealer is donating 25 percent of the cost of the log home to the Foundation. The local home builders' association is donating local member builders' time for construction. The local city government is donating land for the office site and the balance is being paid by Dingell-Johnson funds.

Other activities include a mobile home dealer donating 25 percent of the cost of several mobile homes which will be purchased under the Dingell-Johnson program for offices or residences. A local corporate paper company is donating an engineer from their staff for a six-month period to do critical design work for fisheries projects.

Although we made a lot of mistakes in the first year, not everything we did was wrong. Those things we did right have been very helpful and positive. We did make mistakes which can be avoided.

I would make the following recommendations:

- Get a commitment for an underwrite on the front end—if nothing else but for the salary of the executive director.
- Don't begin without a separate, paid, full-time executive director. It is not a part-time job.
- Involve and educate agency personnel from the beginning.
- Involve professionals in foundation events.
- Don't rely solely on a professional fund raising firm—people give to people not to a fund raising firm!
- Do research. The results should provide an immediate action agenda.
- Board members should come from a broad spectrum of interests and backgrounds.
- Have an accounting and bookkeeping system in place from the start.
- Have a follow-up member/donor recognition service in place from the beginning.

The independent sector has awesome potential to help but is not a panacea. This past year donations to the Foundation accounted for about 2 percent of the total agency budget. That could easily grow, in my opinion, to 20 percent. We must continue to develop a system which will allow us to use the appropriate tool or set of tools necessary to get the job done.

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The Sikes Act: A Neglected Partnership Opportunity

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In 1974, the United States Congress amended the Sikes Act, originally passed in 1960. By taking this action, the politicians handed wildlife managers a partnership opportunity that was neglected until 1985. The opportunity was a provision in the legislation that allowed the states to enter into an agreement with the United States Forest Service (USFS), the Bureau of Land Management (BLM), and/or the Atomic Energy Commission (AEC) to require a public land management stamp be purchased by persons hunting, fishing, and/or trapping on lands administered by those agencies. The funds from these stamp sales are collected and controlled by the state wildlife agency. Also, the funds must be spent on wildlife-related projects on the public lands from which the funds were collected. These projects include, but are not limited to, habitat management, research, census, protection, law enforcement, propagation, live trapping and transplantation, regulated taking, and purchase of access. The purchase of access was added as a legal use during the 1988 reauthorization and requires a willing seller. The projects selected to receive stamp revenues must be agreed upon by all cooperating agencies.

In 1985, the New Mexico Department of Game and Fish entered into an agreement with Region 3 of the USFS to require a \$10 stamp on the Valle Vidal Unit at the Carson national Forest. This was not the first special fee required on National Forest lands for hunting. The states of Virginia (Danner 1988) and Arizona (Arizona TWS 1988) both collect a fee for hunting on public lands, but both of these programs predate the Sikes Act. Several other states charge fees on special management units, some of which contain Forest Service lands. These programs are excellent examples of state/federal partnerships that are working. The Sikes Act gave us statutory authority to conduct these programs and also insures the funds are dedicated to the land from which they were collected.

Prior to the passage of regulations requiring the public land management stamp on the Valle Vidal, we held numerous public meetings to gauge the public reaction to the program. The public response surprised us. Their response was not only positive for the Valle Vidal, they encouraged us to test the program in other areas of the state. They also asked that the funds derived from stamp sales be used for habitat management programs. Another occurrence at these public meetings was the large number of people who indicated that they would be willing to volunteer for work projects on the unit. Utilizing the volunteer labor, Forest Service Cost Share Program, and Federal Aid Programs, we have been able to build partnerships that have resulted in \$40,000 worth of habitat improvement projects annually. All because the Sikes Act stamp sales gives us \$10,000 in seed money each year. Our partners include businesses, sportsmen clubs, individuals, grazing permittees, and news media; all working together for a common goal on Valle Vidal.

Encouraged by the reaction to the program on the Valle Vidal, the state held additional public meetings throughout New Mexico. Once again the public asked that we test the concept in one or two areas and that the funds be used for habitat improvements. The areas selected for a $5.00 stamp requirement were the Lincoln National Forest and adjacent BLM lands in southeast New Mexico and the Jicarilla Division of the Carson National Forest in the northwest quarter of the state. The stamp requirement on these areas started in our 1986–87 license year and is scheduled to run for three years. After this three-year period, the program will be evaluated to determine the public reaction and the benefits to the wildlife resource.

The first year the entire program was in place in new Mexico, we were able to dedicate $180,000 from stamp sales to wildlife habitat improvement projects. The Forest Service matched the funds spent on their lands with challenge cost share funds while the BLM matched about half of the funds on their lands. Combined with the value of the numerous volunteer partners, we achieved over $300,000 worth of projects on-the-ground in New Mexico. Projects completed include: 36 water unit installations, 15,000 acres of prescribed burns, 2 wetland enhancement projects that include pothole blasting and waterfowl nesting habitat development, 50 miles of obliteration and reseeding of unused roads, 25 miles of riparian enhancement, 19 spring developments, 1 turkey transplant, and the establishment of an annual fund of $10,000 for maintenance of projects (Morrison 1988).

The most common question asked about the Sikes Act is: Why was it neglected so long and why haven't other states followed New Mexico's lead? To answer these questions, we must look into the past. With the exception of some national parks, the public lands have been available to hunters, fishermen and trappers free of charge. This tradition of free use of public lands is the major reason the Public Land Management Stamp Program is not used throughout the country. It is the professional's fear of this tradition, not the sporting public's use of it, that has built walls around the user-fee concept for hunting, fishing and/or trapping on public land. Our experience in New Mexico has shown that the public is not only willing to pay a fee, but is ready to contribute even more through volunteer efforts to complete worthwhile projects. This acceptance of the program by the sporting public has conceived the development of numerous, solid partnerships. These partnerships give the public a vested interest in their lands through the investment of their money, time and labor. The program has also given the state and federal agencies a closer working relationship. We can now state, with full confidence, that the private and public sectors in New Mexico are full partners in managing wildlife habitat on segments of public land. Our goal is to extend that partnership to all public lands within the state. I am fully confident that other states will follow with their own Sikes Act Programs once they fully realize the positive impacts of the program. Through the use of a neglected federal law, we have been to generate over $500,000 for wildlife habitat improvement in a two-year period. This was accomplished utilizing stamp receipts, federal aid funds, USFS and BLM challenge cost share funds and volunteer time and labor. This joining of efforts from multiple government agencies, non-profit organizations and interested individuals has formed a partnership that will insure adequate funds and labor are available to carry out much needed wildlife habitat improvement work on New Mexico's public lands.

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The Peregrine Partnership: Partners in Recovery, Awareness and Education

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Introduction

Recovery of the American Peregrine Falcon (*Falco peregrinus anatum*) began in Colorado in 1972, when the Colorado Division of Wildlife started monitoring active and historical nest sites. Over the past 17 years we have stabilized a viable population of peregrine falcons on the western slope of Colorado's Rocky Mountains. In recent years, we have shifted our emphasis to the eastern slope, to achieve statewide recovery. We have worked cooperatively with the U.S. Forest Service, National Park Service, Bureau of Land Management, Fish and Wildlife Service and Peregrine Fund to recover the peregrine falcon population in the wild. A proposed metropolitan release, however, posed new and different challenges and opportunities.

The Project

In 1985 the Colorado Wildlife Federation initiated the idea of an urban peregrine falcon release in Denver. The Division of Wildlife was skeptical. However, after exploring our concerns with people from other states who have conducted successful urban releases, we took an enthusiastic role in planning and implementing the project. The goal was to release peregrine falcons in downtown Denver during the summer of 1988.

The Partnership

The Peregrine Partnership was formed in 1987 as a cooperative venture initially between the Colorado Division of Wildlife and the Colorado Wildlife Federation. It was an informal relationship with responsibilities mutually agreed upon based on expertise and contacts. We began by outlining tasks, opportunities, responsibilities and costs.

We spent 1987 assembling fund raising information, determining possible sources for obtaining peregrines and quail, designing the hack box, securing an observation area, developing training sessions, coordinating with downtown business associations, and developing a logo (Figure 1) and theme for the project—"Peregrines Are Coming to the Canyons of Denver." It was decided that a majority of the funding required for the project would come from outside contributions, rather than from agency/organization budgets. It was further decided that funds raised for the project should not come to the state agency, since the funds could be used more quickly and efficiently if held privately. Thus, the Federation handled the funds. Because of the monetary arrangement, the scope of the project, and the length of time involved, a partnership began to form. The structure of the partnership itself was informal, but

Figure 1. Peregrine Partnership logo.

the paperwork (i.e., the agreement about who does what) became increasing complex. In fact, we ended up signing a contract, although it was not completed until four months after the birds were released downtown.

In January of 1988, the Denver Museum of Natural History joined the Partnership. Since the museum has a long history of public support and involvement, the resources, expertise and ideas they offered were a welcome addition to the project.

The remainder of 1988, up to the release in July, was spent obtaining building variance permits; constructing the hack box; organizing and carrying out planned events; dealing with unplanned events; fund raising; making presentations to schools, civic groups, and downtown businesses; and coordinating with city and county agencies, the federal Aviation Administration (to reduce air traffic while the birds were fledging) and the media.

The Partnership had to overcome obstacles such as: (1) if we worked closely with one television station (e.g., to set up closed circuit television), we risked alienating others from covering the project; (2) the federal agencies, without whose participation wild recovery could not have happened, felt the need for recognition during the urban release, even though they were not actively involved in it (while information was given to the media, we could not control what was mentioned and what was not); (3) each partner felt they were doing more than their "fair share," and each felt slighted in gaining acknowledgment in media coverage; (4) numerous decisions had to be made requiring compromises; and (5) sometimes biology outweighed timing of media coverage, and sometimes the weighting was reversed.

Objectives of the Partnership

The Peregrine Partnership had three primary objectives for its urban release project. The project, first and foremost, was done to complement overall recovery of the peregrine falcon in Colorado. Denver is a known historical site for wintering peregrines. With increased recovery efforts taking place on the eastern slope, the Denver site filled a void between sites near Colorado Springs and those in Rocky Mountain National Park. Even if peregrines do not come back to Denver to breed, they should contribute to the population elsewhere along the Front Range.

The second objective of the project was awareness. More than 60 percent of Colorado's population lives in the Denver metropolitan area. Our objective was to increase the public's awareness of: (1) peregrine falcons; (2) endangered species and efforts to recover them; (3) urban wildlife; (4) wildlife in general and (5) the nongame income tax check-off.

Awareness was created through placement of video monitors in several downtown locations and through media coverage of various events, some of which were planned, others of which were not. The planned events included: an invitational kick-off reception at the Governor's Mansion; opening of a peregrine falcon exhibit at the Denver Museum of Natural History; a media tour of wild peregrine nest manipulations at Dinosaur National Monument; arrival of the falcons in Denver; and the appearance of Jim Fowler of "Wild Kingdom." Unplanned events included: initial announcement of the project one and one-half months prior to our intended announcement; coverage of the first falcon flights and subsequent flight-related rescues, injuries, and rehabilitation; and a radio program jokingly encouraging the "shooting" of peregrines.

Initially we were concerned that the public would think the downtown release was the extent of Colorado's peregrine recovery program. In response to this concern, we organized a media tour to Dinosaur National Monument while we were collecting eggs and placing chicks in nests. The media were able to get good photographs and footage of wild recovery efforts and have questions answered—all in an informal and enjoyable environment, fostered by the National Park Service. This helped put the downtown project in its proper perspective.

The third objective of the project was education. (We distinguished education from awareness; media coverage of the project created primarily awareness.) Components of the project that were specifically educational in nature included: training and using over 100 volunteers to watch the peregrines as they fledged and reached independence; using these volunteers to talk to people watching the peregrines downtown; and presenting slide shows and making presentations with live birds for school groups, civic groups, and the general public. In addition, the Denver Museum of Natural History developed an exhibit at the Museum that interprets peregrine recovery efforts in Colorado and features a repeating video presentation about peregrine falcons, focusing on the downtown release. Finally, the education objective also included the production of a Peregrine Teacher Resource Packet, which was developed by the Peregrine Partnership and various scientific and educational consultants from school districts, wildlife agencies and organizations. The activities in the packet were designed to complement existing school curricula.

Success in Meeting Objectives

The project was a tremendous success and all three objectives were met. All of the released peregrines reached independence (albeit with a lot of help). We have added five peregrines to the wild population. Four of the falcons migrated south. The fifth falcon may have remained downtown through the winter.

The awareness objective was definitely accomplished. We knew we had made an impact when the project: was front page news for an entire week; was covered daily on major TV and radio stations; was joked about on radio; and caused business people downtown to bring scopes and binoculars to work with them. Peregrine falcons—Denver's newest residents—became ingrained in the culture of the city—at least for the summer. Given the short attention span of the public to news events, the peregrine release appeared to capture the imagination of Denverites for an unusually long time.

The short-term educational objectives were met through programs offered to thousands of people; museum tours, lectures, and an exhibit; and contacts made by more than 100 active volunteers. The measure of accomplishment of the longer-term educational objective will primarily come through use of the Teacher Resource Packets. We distributed 4,300 packets within six weeks to school districts that requested them, reaching one-third of the teachers in the Denver metro area. This objective will continue to be met throughout the school year as teachers use the resource packets with their students. We included a response card in the packets so we can get feedback from teachers on the use of the activities as well as suggested changes for future reprintings.

Benefit of Partnership

Formation of a partnership made it possible to expand the objectives of the project. The project originally focused on recovery, but the addition of the Colorado Wildlife Federation and the Denver Museum of Natural History allowed additional focus on awareness and education. It also enabled us to accomplish more within each objective through increasing the type, timing, location, audience and number of events.

The partnership allowed new resources to be made available for use in the project. In general, these were resources one partner had that the others did not. The availability of additional resources resulted in a decrease in the cost of many individual aspects of the project.

The partnership approach, and the decision to administer funds outside the state agency, enabled us to tap new sources of money and in-kind contributions traditionally not available to the agency. It also exposed us to a new arena of fund raising, providing contacts and sharpening skills which will be useful in the future.

The partnership fostered communication between and among the partners, directly leading to more open working relationships, the generation of new ideas, and the planning of additional projects. Through the partnership, we were able to gain better information about our external environment. Each partner had information and expertise that helped us understand and reach our various audiences.

Prior to the formation of the Peregrine Partnership, the Colorado Division of Wildlife had not really incorporated the word "partnership" in its organizational vocabulary. We worked "cooperatively" with other agencies or groups to accomplish projects, such as wild peregrine recovery, but we had not undertaken this new type of working arrangement. In a partnership, we see a greater involvement of the private sector than in traditional agency working relationships. The Peregrine Partnership had three major sponsors, and numerous individuals, corporations and other private business contributed to the success of the project.

The Colorado Division of Wildlife has since entered into other partnerships including the Urban Wildlife Partnership, formed in 1988. This partnership is a coalition of the Division of Wildlife, the Denver Museum of Natural History, the Colorado

Wildlife Federation, the Denver Audubon Society, a book publisher, and a team of professional wildlife photographers. At least three other smaller partnerships are being formed to work on other wildlife projects.

Costs of Partnership

Partnerships have costs attached to them as well as benefits. While we were able to expand the objectives of the project through partnership, and accomplish more within each objective, the project required more money and resources than originally anticipated.

The amount of time required on the project increased in order to accommodate meetings, planning and coordination, and all the additional communication necessary. Each entity in the partnership had its own objectives that needed to be accommodated in addition to the common objectives of the project. This required more time, with some personal stress, as ''turf'' questions and funding questions needed to be resolved.

Internally, the cost of institutionalizing a new concept was also measured primarily in terms of time. Continual explanation of the partnership to all levels within the organization was necessary. The development of a formal contract was required. The contract took nearly a year and was actually finalized after four of the first year's birds had migrated south for the winter.

Evaluation

There is a lot happening over which wildlife agencies generally have little control, and there is far more to do than can be accomplished by a single effort. When agencies work in a vacuum, they can lose sight of the people for whom they are working. Using public and private sector involvement through formation of a partnership in order to accomplish specific projects responds to these problems. Partnerships work well to accomplish certain projects. They get people used to working together and make full realization of available resources. Through the formation of a partnership, many projects could be accomplished that otherwise would not be feasible. The ideas, resources, manpower and energy created by the formation of a partnership are well worth the effort. However, we do have some cautions:

1. Pay close attention to communication. A partnership is subject to all the troubles of any relationship—most of which are due to poor communication.
2. Do not fear chaos. By its very nature, a partnership runs much like a political campaign—chaotic at times. Do not heavily involve people who demand structure and order. Instead, involve people who can work in a relatively unstructured environment.
3. Be careful that details do not get lost. This happens easily, and is probably due to the chaotic nature of the arrangement. One very important person was accidentally not invited to a special event because the detail was overlooked—a ten cent error that caused a lot of consternation.
4. As much as possible, have clear, written understandings about areas where potential for conflict exists. For example, we thought we had a clear understanding of the ownership and royalty agreement with professional wildlife

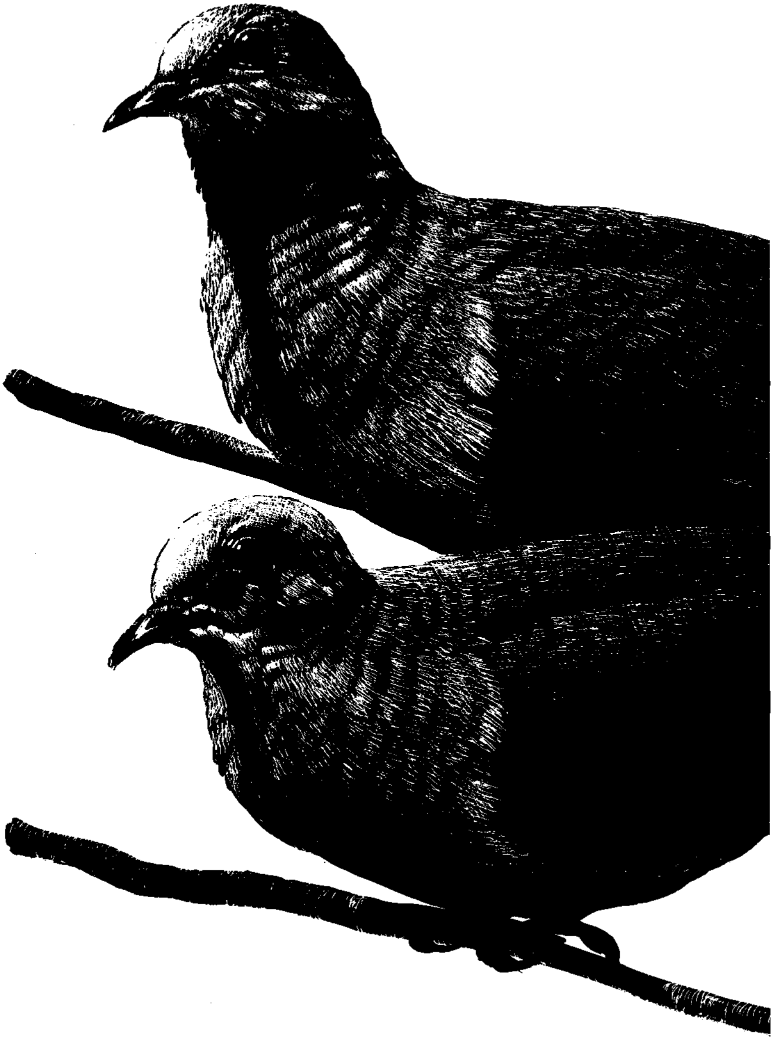
photographers. It would have saved aggravation on all sides, however, if the understanding had been written down and signed.

Conclusion

The formation of the Peregrine Partnership was a vehicle to accomplish a metropolitan peregrine release in Denver. Partnerships with public and private sector entities, such as our experience with the Peregrine Partnership, can be of great benefit in accomplishing high-profile wildlife projects, especially ones which have major public relations potential. Partnerships also provide an opportunity for people who are not usually associated with wildlife organizations or activities, but who are interested in wildlife, to become involved in positive and meaningful projects.

Acknowledgments

The authors wish to acknowledge the time and effort of the Colorado Wildlife Federation, the Denver Museum of Natural History, and the numerous in-kind contributors, volunteers and donors for making the first year's release such a success. We also thank the people of Colorado, whose contributions to the Nongame Wildlife Fund have made peregrine falcon recovery in Colorado possible, as well as the federal agencies with whom we have worked so closely.



Special Session 6. *Conservation Law Enforcement: Status and Challenges*

Chair
CLARK R. BAVIN
U.S. Fish and Wildlife Service
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Cochair
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Drawing the Line: Innovative Investigative Techniques Versus Outrageous Government Conduct

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Introduction

As our precious wildlife resources are dwindling, the commercial value of the remaining wildlife and products has risen dramatically. With the increase in profits to be made in commercial violations of fish and wildlife laws, we have seen the criminal element become more sophisticated. Their activities have become more organized, more secretive and increasingly more difficult to detect through traditional overt investigative activity. Wildlife management officials have discovered that in order to combat this increased sophistication of criminal activity, their enforcement personnel must be innovative and imaginative in their investigative methods. This entails the increased use of enforcement officers infiltrating and participating in the criminal activities of defendants through such techniques as undercover operations, paid informants and decoys. The investigation of commercial wildlife crime today requires the same skills as are needed to combat other types of criminal conduct involving commercial fraud, contraband products—such as drugs, stolen property and illegal firearms—and smuggling. In fact, as a result of the high profit potential in wildlife crime and the relatively lesser penalties upon conviction, some of these other criminals are turning their attention and resources toward poaching for profit.

The courts have recognized that law enforcement officers may use modern and innovative techniques and equipment in waging war on the criminal elements of our society. The use of electronic surveillance and tracking devices, for instance, has tremendous potential in wildlife investigations. These "beepers" can be placed in the carcasses of animals, attached to suspect's vehicles or aircraft, or implanted in illegal wildlife mounts in order to track the activities of suspects and contraband with little risk of discovery of the officer's presence. Concerning the use of such modern methods, the Supreme Court has said: "Nothing in the Fourth Amendment prohibited the police from augmenting the sensory faculties bestowed upon them at birth with such enhancement as science and technology afforded them in this case" (*U.S. v. Knotts*, 460 U.S. 276, at 282 [1983]).

Recognizing that law enforcement is entitled to utilize modern technology in gathering evidence of criminal activity, the Supreme Court has, nevertheless, provided guidelines on where the line is to be drawn between legal police conduct and impermissible activities that infringe upon a person's "reasonable expectation of privacy" and right to be free from "unreasonable" searches and seizures (*Katz v. U.S.*, 389 U.S. 347 [1967]). But what about those activities of the police that don't fall within the type of conduct that can be readily measured by the established standards of the law of search and seizure?

The use of spies, paid informers and undercover agents to ferret out, penetrate and expose criminal conduct has always been a valuable and often essential weapon in society's war on crime. The Ninth Circuit Court of Appeals recently approved the following jury instruction in a case involving undercover officers. The case concerned drug trafficking, but applies to criminal activity regarding any type of commodity, such as illegal wildlife.

> *. . . law enforcement personnel have turned to one of the only practicable means of detection, the infiltration of drug rings and a limited participation in their unlawful present practices. Such infiltration is a recognized and permissible means of investigation necessary to gather evidence of illegal conduct. An agent does not violate any federal statute or rule or commit any crime in infiltrating the drug enterprise. The undercover activity may take many forms including persuasion, fraudulent representations, threats, coercive tactics, harassment, promises of reward or pleas based on need, sympathy or friendship. A solicitation, request or approach by law enforcement officials to engage in criminal activity, standing alone, is not an inducement. Law enforcement officials are not precluded from utilizing artifice, stealth and stratagem such as the use of decoys and undercover agents in order to apprehend persons engaged in criminal activities, provided that they merely afford opportunities or facilities for the commission of the offense by one predisposed or ready to commit it. They may properly make use of undercover operations, in which they use false names and false appearances. They may properly assume the roles of members of criminal organizations.*
>
> (*U.S. v. North*, 746 F.2d 627 [9th Cir. 1984])

Despite the broad range of activities that courts have approved in undercover operations, law enforcement does not have carte blanche to do whatever seems expedient. *All* is *not* fair in the war against crime and there are Constitutional limits beyond which government agents may not go to pursue a criminal prosecution. The Supreme Court has recognized two similar, yet separate and distinct, defenses against government overreaching in enforcement activities: "entrapment" and "outrageous government conduct." In the following sections we will examine the nature of these defenses as set out in the major court decisions and apply them to the specific investigative techniques being used today to fight wildlife-related crime. Suggested guidelines will assist the officer and administrator in understanding where to draw the line between a good, innovative investigative activity and an unacceptable, abusive police tactic. As the Supreme Court said in *Sherman v. U.S.*, 356 U.S. at 372 (1958) ". . .a line must be drawn between the trap for the unwary innocent and the trap for the unwary criminal."

The Entrapment Defense

The Supreme Court first recognized and applied the entrapment defense in *Sorrells v. U.S.*, 287 U.S. 435 (1932). Under the theory put forth by the Court, the entrapment defense prohibits law enforcement officers from causing criminal acts to be committed by persons "otherwise innocent" in order to lure them into commission of illegal acts in order to prosecute. Thus, the focus of the entrapment defense is on the conduct of the defendant and his predisposition to commit the crime.

As a rule of criminal procedure, entrapment occurs when officers of the government conceive, plan and implement an offense and then induce an otherwise innocent person to commit a criminal act not contemplated by him. It is an affirmative defense which may be raised on a plea of not guilty. The defense alleges that the defendant is a victim of intense government persuasion, who through a character weakness, not criminal intent, has been ensnared in a criminal activity. It is often the only defense available to an individual who has clearly been caught in the commission of an illegal act by undercover officers.

Unless the evidence is so clear and convincing that the judge can rule as a matter of law that the defendant was entrapped, the question is normally one of fact to be decided by the jury (*Sherman v. U.S.* 356 U.S. 369 [1958]). When the defendant produces evidence to indicate that the government may have illegally induced or persuaded him to enter into criminal conduct, the government must prove beyond a reasonable doubt that the defendant was predisposed to commit the offense. If it is shown that the criminal intent was already formed in the defendant's mind and that the government merely afforded the opportunity for the commission of the offense, the defense of entrapment will not be available to that defendant (*U.S. v. Russell*, 411 U.S. 423 [1973]; *Hampton v. U.S.*, 425 U.S. 484 [1976]).

The federal standard for determining whether entrapment occurred pivots on the state of mind and conduct of the defendant and is called the "subjective" test by the courts. This federal standard has been adopted by the vast majority of state jurisdictions as well.

In 11 states, a minority standard is applied that focuses primarily on the conduct of the enforcement officers to determine whether overzealous pressure or extensive involvement of the police exists which would be likely to induce a normally law-abiding person to commit the offense. This process is referred to as the "objective" test. In practice, there is little difference in the results of the application of the two tests as they both are designed to protect innocent persons from unreasonable governmental actions that would pressure the ordinarily innocent person into committing a criminal act not otherwise contemplated by him.

Due Process of Law

In the *Russell* decision, the Court acknowledged that there could be a constitutionally-based due process defense as a result of law enforcement conduct under appropriate compelling circumstances: "While we may some day be presented with a situation in which the conduct of law enforcement agents is so outrageous that due process principles would absolutely bar the government from invoking judicial processes to obtain a conviction, cf. *Rochin v. California*, 342 U.S. 165,. . .(1952), the instant case is distinctly not of that breed. . . The law enforcement conduct here stops far short of violating that 'fundamental fairness shocking to the universal sense of justice,' mandated by the Due Process Clause of the Fifth Amendment" (*U.S. v. Russell*, 411 U.S. at 431-432).

In *Russell*, the defendants had set up a lab to manufacture illegal drugs. Before they could make the drugs, however, they needed one hard-to-get, key ingredient. An undercover agent managed to gain the defendant's confidence and worked his way into their illegal operation by providing the key ingredient that allowed the defendants to consummate the crime. The Court found neither entrapment nor outrageous government conduct in the use of this undercover tactic.

The "due process" defense finds its basis in the U.S. Constitution, Amendment V, which states in part: ". . .nor shall any person. . .be deprived of life, liberty, or property, without due process of law." What constitute "due process" can not be reduced to any exact formula. Its content is not defined by any code or statute. It can best be described, as it applies to law enforcement conduct, as fundamental fairness. Throughout the course of court decisions, each case is examined in the context of the totality of the circumstances surrounding the questioned conduct and then a balancing test applied. That balance is the one which our Constitution demands between respect for the liberties and rights of the individual to be free from unreasonable governmental interference on the one hand, and the responsibilities and needs of organized society for effective law enforcement on the other.

The due process or outrageous government conduct defense is separate from entrapment and can be, and often is, raised by a defendant in addition to entrapment. The due process defense focuses on the conduct of the government officers and asserts that some acts of governmental conduct are so outrageous or contrary to the universal concept of fundamental fairness that they cannot be tolerated. Any use of such excessive and flagrant conduct cannot be allowed to support a prosecution of a person whose constitutional rights under the due process clause have been thus violated.

In *Hampton v. U.S.* 425 U.S. 484 (1976), the Court again recognized that a due process defense is possible, but would be "rare." The conduct of the police would have to ruse to a "demonstrable level of outrageousness" to be unconstitutional. Where established, however, the predisposition of the defendant will not bar his assertion of the defense (*Hampton*, at 495 n.7, and 497; *U.S. v. Bogart*, 783 F.2d 1428 [9th Cir. 1986]).

In Hampton, the defendant indicated to a government informant that he was interested in selling heroin and had buyers but no supply of the drug. The informant obtained some heroin from undercover agents for whom he worked and supplied it to the defendant. After the defendant sold the contraband to another undercover agent, he was arrested and convicted. The defendant raised both entrapment and outrageous government conduct defenses. The Court rejected the entrapment defense because the defendant was found to be predisposed to commit the offense and the government had merely provided him the means to do so. The Court also rejected the due process defense finding it not outrageous for agents to provide contraband in an undercover operation to allow criminals the opportunity to complete their illegal plans.

It should be noted that since being recognized as a potential defense, outrageous government conduct has been raised frequently by defendants, but rarely has it been successful. The Supreme Court has not reversed any convictions on this ground, and there are only three lower federal court cases where the defense has been successfully applied. Part of the reason for this is that the question of whether government conduct is so outrageous as to constitute a violation of due process is a question of law to be determined by the court, not the jury (*U.S. v. Quinn*, 543 F.2d 640 [8th Cir. 1976]; *U.S. v. Graves*, 556 F.2d 1319 [5th Cir. 1977]; *U.S. v. Salazar* 720 F.2d 1482 [10th Cir. 1983], cert. denied 469 U.S. 1110 [1985]). The courts are extremely cautious in reviewing questions of legality of law enforcement methods and are reluctant to find due process violations in undercover settings (*U.S. v. Gambino*, 788 F.2d 938, at 945 [3rd Cir. 1985]). It is also harder to show a due process violation because only extreme conduct that is truly outrageous will bar a prosecution. (*U.S. v. Stenberg*, 803 F.2d 422 at 429 [9th Cir. 1986]; *U.S. v. Thoma*, 726 F.2d 1191 at 1198 [7th Cir. 1984]; *U.S. v. Marcello*, 537 F. Supp. 402,[C.D. California, 1982]).

Many cases are not decided on the basis of a due process violation because some other rule or principle of law applies and the due process consideration is reserved as a last resort when there is no other remedy to protect against overreaching and improper government conduct. Even the celebrated stomach pump case, *Rochin v. California*, cited previously in the *Russell* case as an example of the type of egregious law enforcement conduct that could be a violation of due process, was decided on the basis of Fourth Amendment search and seizure. In *Rochin*, the defendant was forced by officers to undergo a stomach pump procedure in order to force him to regurgitate evidence he had swallowed. Justice Frankfurter found that this conduct did ". . . more than offend some fastidious squeamishness or private sentimentalism about combatting crime too energetically. This is conduct that shocks the conscience" (342 U.S. at 172–173, [1952]).

Judicial Review of Enforcement Techniques

When outrageous government conduct is alleged by a criminal defendant, the federal courts will consider a variety of factors in deciding whether the due process defense will prevail. They consider the "totality of the circumstances" in each case and do not focus on any one particular factor. Some of the more prominent considerations analyzed from the cases have been combined into the four categories set out below.

The Type of Crime Being Investigated

The degree of difficulty that the government has in detecting certain types of criminal conduct has a bearing on the need or reasonableness of investigative techniques such as decoys, undercover officers offering or supplying contraband, storefront "sting" operations, or undercover infiltration and participation in targeted criminal activities. The so called victimless crimes, such as drug sales and possession, bribery and corruption, pornography, and wildlife crimes are especially difficult to detect due to the lack of a complaining witness. The impact on society, and in the case of wildlife crimes the resource itself, is substantial. Government involvement in a covert capacity is thus considered essential to protect the interests of society in exposing these types of crime (*U.S. v. Murphy*, 768 F.2d 1518, [7th Cir. 1985] approving decoys to ferret out corrupt judges; *U.S. v. Thoma*, 726 F.2d 1191 [7th Cir. 1984] approving undercover business set up to identify persons dealing in child pornography; *U.S. v. Engler*, 806 F.2d 425 [3rd Cir. 1986] undercover purchase of wildlife; *U.S. v. Williams* 705 F.2d 603 [2nd Cir.] cert. denied 464 U.S. 1007 [1983] upholding ABSCAM bribery conviction).

Predisposition of the Defendant

As previously noted, the focus of the due process defense is on the conduct of the government rather than the defendant. Outrageous government conduct can be a defense even if the defendant is found to be predisposed to commit a crime. In practice, however, the more involved or predisposed a defendant is, then the less likely the chance that the due process defense will succeed. In *U.S. v. Stenberg*, the Ninth Circuit Court of Appeals stated that regardless of predisposition, a defendant could raise the outrageous government conduct defense. They went on to hold, however, that the outrageous conduct defense is not generally available ". . . where the criminal enterprise was already in progress before the government became involved or where the defendant was involved in a continuing series of similar crimes during the government conduct at issue" (803 F.2d at 429). The defendants had objected to the conduct of the undercover Fish and Wildlife officers in soliciting and participating in illegal hunts of wildlife. The court rejected their defense because the record clearly showed that they were already engaged in a continuing pattern of criminal activity during the period that the undercover officers were involved with them.

Degree of Government Involvement

In this area, the courts will look at the quality and the quantity of government involvement in the criminal activity to determine whether the conduct can be classified as outrageous. Did the undercover officers merely participate in a criminal enterprise with the defendant, or did the officers engineer and direct the criminal activities from "start to finish?" (*U.S. v. Ramirez*, 710 F.2d 535 [9th Cir. 1983]; *U.S. v. Bogart*, 783 F.2d 1428, at 1436, [9th Cir. 1986]).

Another question to be asked is to what extent did the government provide the necessary resources for the completion of the crime? We have seen that it is not outrageous for the government to provide essential ingredients or even contraband. Where the government, however, provides all of the equipment, supplies, contraband and support services for the criminal conduct, with only minimal participation by the defendant, government conduct crosses the line from crime detection to crime creation.

The only three reported cases in the federal courts that have sustained the defense of outrageous conduct involve extensive government engineering from start to finish; government provision of essentially all supplies, support and resources; and minimum participation by the defendants who were not already engaged in any similar criminal activity. In *Green v. U.S.*, 454 F.2d 783, (9th Cir. 1971), the court found that a number of factors, acting in combination, resulted in outrageous government conduct. The defendant had just been released from jail after serving a sentence for illegal alcohol violations when he was approached by an undercover officer who knew of his previous case. The officer solicited the defendant's help in setting up an illegal bootlegging operation. For over two years, the officer supplied all the equipment and supplies for the still, urged the defendant to continue making the liquor, and was the only customer.

The second case finding outrageous conduct is *U.S. v. Twigg*, 588 F.2d 373 (3rd Cir. 1978). The government used an informant to set up a lab for the manufacture of drugs. The government provided the location, the equipment, the chemicals and the customers. The informer enticed the defendants, who had no chemical background and were not already involved in ongoing criminal activity, to enter the business where they provided minimal assistance. The court found that the government ". . . set him up, encouraged him, provided the essential supplies and technical expertise . . . this engregious conduct . . . generated new crimes . . . fundamental fairness does not permit us to countenance such actions by law enforcement officials and prosecution for a crime so fomented by them will be barred" (588 F.2d at 381).

The third, and latest case, is *U.S. v. Batres-Santolino*, 521 F.Supp. 744 (N.D. Calif. 1981). In this case, once again, the government agents and their informant engineered a plan whereby the defendants would smuggle and distribute cocaine into the United States from Ecuador. The government agents ran the enterprise from start to finish and supplied all necessary equipment, supplies and contraband. They kept the defendants involved in the scheme. Although the defendants were willing to commit the crime (predisposition), they were novices and did not have any criminal records nor were they engaged in any other criminal activities. The court acknowledged that it is not one fact here but the combination of factors that causes the government conduct to rise to the level that violates "fundamental fairness' and shocks the "universal sense of justice." "There are few cases where the government has so clearly exceeded the bounds of permissible law enforcement conduct. Permissible conduct has been described as that which, even with the use of stealth and subterfuge, is designed to expose illicit traffic, illegal conspiracies, violations or would-be violations of the law and to prevent crime. . . . However, this is not a case where the government is ferreting out ongoing criminal activity. It is a case where the government, through its agent, went about putting persons into the business of crime for the first time" (521 F. Supp. at 752).

Another factor the courts consider regarding the quality of government conduct is whether the actions of the officers can be said to be *malum in se*, or bad in and of themselves. Outrageous conduct is not equated with negligence or mere poor judgment. It must be of such a degree as to "shock the conscience" (*U.S. v. Wiley*, 794 F.2d 514 [9th Cir. 1986]). In *Wiley*, undercover officers infiltrated a group involved in smuggling narcotics into a prison. The officers botched a controlled delivery and some of the drugs found their way into the prison where they were consumed by prisoners. This mistake did not constitute outrageous conduct.

Conduct that would be bad per se would be things like unwarranted physical or mental coercion, or participation in violence against innocent persons or property. Generally, conduct that merely violates state or federal laws not affecting fundamental rights to life, liberty or property is not considered outrageous (*Sorrells*, 287 U.S. at 442; *U.S. v. Sanford*, 547 F.2d 1085 at 1090, n. 8,[9th Cir. 1976].

In the *Stenberg* case discussed above, the killing of some of the wildlife was done by undercover officers being guided by the defendants. Although the taking of animals in this case was found not to be outrageous, the court had some cautionary language for undercover wildlife officers. "The killing of wildlife, on more than one occasion, by an FWS agent raises significant questions as to the extent to which government agents may commit serious crimes in order to prevent others from committing similar offenses. . . . Under different circumstances such active criminal behavior by a government agent might well result in our upholding a defense of outrageous government conduct" (803 F.2d at 430–431).

Infiltration of Criminal Activities or Creation of Crime

This last factor is similar to the ones above. The best way to avoid a successful claim of outrageous conduct is to establish that the defendant was already engaged in criminal activities in which the government merely infiltrated. In the three cases previously discussed, *Twigg*, *Green*, and *Batres-Santolino*, the common denominator was that there was no illegal activity ongoing into which the government entered in order to ferret out and prevent crime. Instead, the courts found that the government's undercover activities created an essentially new crime. This cannot be allowed. The Court said in *Sherman v. U.S.*: "The function of law enforcement is the prevention of crime and the apprehension of criminals. Manifestly, that function does not include the manufacturing of crime" (356 U.S. 369, at 372, [1958]).

Guidelines for Officers and Administrators

A review of the court decisions provides law enforcement officers and supervisors with some definite guidelines that will, if recognized and followed, encourage officers to be innovative and creative in developing covert tactics and procedures to combat wildlife crime. At the same time, they can minimize the risk of crossing over the line into outrageous conduct and thus avoid a successful entrapment or due process claim being made against their enforcement activities.

Officers must remember that predisposition of the potential defendant is essential to blocking a claim of entrapment. It is also a crucial element to establish in order to lessen the likelihood of a due process defense. Predisposition should be shown in every case by evidence of prior, similar crimes committed by the defendant; by showing that the defendant is already engaged in an ongoing criminal enterprise; or conduct involving a series of similar crimes and demonstrations that he is ready and willing to engage in the illegal activity charged.

Officers have a wide latitude in acceptable conduct that can be utilized to ferret out criminal conduct. They may hold themselves out to be purchasers of illegal wildlife. They may open an undercover business and become dealers of illegal contraband and wildlife. They may use decoys and set traps for unwary wildlife violators. They may also participate in certain criminal activities, within reasonable bounds, where necessary to gain the confidence of criminals and to gather evidence against them. But government has an obligation to use these authorities in good faith and in a responsible manner so as to discover and eliminate criminal conduct, not create new crimes. Remember that it is contrary to due process and fundamental fairness to punish a person for a crime he would never have committed were it not for the creative activity of officials of the law.

Government agents should be cautious of providing too much of the equipment, supplies and expertise to defendants in an undercover operation. While it is permissible to provide these things, including contraband and the illegal wildlife itself, it is better if a quantity of these things are provided by the defendant in order to establish a substantial participation in the illegal enterprise by the defendant.

If officers engage in overzealous, illegal enforcement tactics and the courts find a violation of due process, not only will there be a dismissal of the case, but the officer, his supervisors and even the department may find themselves subject to civil liability damages. The key to avoiding this potential liability is proper management supervision and training. In fact, the courts recognize that law enforcement administrators have a duty to train carefully, competently and professionally the officers they employ. The negligent failure to provide adequate training involves a breach of executive duty and imposes the same liability as if the agency or administrator had participated in the actual injury caused by an officer's actions (*Parker v. District of Columbia*, 850 F.2d 708,[D.C. Cir. 1988]). The U.S. Supreme Court has established the standard of reasonableness for measuring an officer's actions in order to defend against liability suits. The test is what would a ''reasonably well-trained officer'' have done in similar circumstances (*Malley v. Briggs*, 475 U.S. 335, 106 S.Ct. 1092, at 1098 [1986]).

Conclusion

Undercover work is an acceptable, often essential tool of law enforcement. The infiltration of criminal organizations, association with violators, and limited participation by law enforcement officers in the criminal's illegal operations and plans, if conducted responsibly, is a legitimate technique to ferret out crimes and identify those responsible. Officers may even afford convenient opportunities or provide necessary supplies or facilities for the defendant's commission of a crime without violating due process or defeating the prosecution. Supervisors and officers both should, however, be well versed in those tactics that avoid the potential for an outrageous conduct defense. There is enough existing criminal activity in society for law enforcement to concentrate on, that we don't need or deserve criticism alleging that we create our own crimes for prosecution.

Unlawful Commercialization of Wildlife Parts

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Introduction

The unlawful commercialization of wildlife parts continues to threaten wildlife resources that are diminishing rapidly worldwide. This paper will focus on particular areas of the illegal parts trade (excluding fur, skins and meat) in North America and other countries, discuss efforts currently underway to combat such activity, and make select recommendations regarding increased enforcement effort.

Illegal Commercialization of North American Wildlife Parts

Wildlife Trophies

A major focus of undercover wildlife investigations by United States Fish and Wildlife Service (Service) Special Agents during the past several years has been the illegal hunting guide business, particularly for big game. Outfitters and guides prosecuted as a result of Service investigations have commanded high prices for closed season or otherwise illegal hunts, particularly from clients seeking a trophy animal that might make the record book. Intelligence from these investigations has demonstrated the existence of a commercial market for mounted heads, horns and antlers of the rarer, trophy-size specimens of big game animals. These animals are killed, either lawfully or otherwise, and then sold on the open market. Heads making the record book easily bring prices reaching into the range of several thousand dollars. Fabich (1980) reported that, as early as 1978, bighorn sheep (*Ovis canadensis*) taken illegally in and around Yellowstone Park frequently had only the heads and capes removed, and the carcasses then left to rot. He stated that prices for illegal sheep heads averaged \$2,000–\$2,500. While working undercover in Colorado from 1981–1984, I had a standing offer from one particular subject of several thousand dollars for any bighorn sheep head, legal or illegal, with horns measuring over 40 inches in length. Currently, record book sheep heads may bring as much as \$8,000 to \$10,000 (pers. comm., Scrafford, USFWS Special Agent, Billings, MT, 1989).

High prices may apply to other species as well. For example, in May, 1988, a large set of elk (*Cervus canadensis*) antlers brought \$1,950 at the annual antler auction in Jackson Hole, Wyoming (Griffin 1988). Whitetail deer (*Odocoileus virginianus*) and mule deer (*Odocoileus hemionus*) antlers meeting trophy specifications are also highly valuable to collectors, sometimes bringing thousands of dollars within select circles. The incentive to take such animals illegally and sell their parts on the commercial market is evident and, as with any rare commodity, prices rise inversely with the availability of the product.

Undoubtedly, heads of trophy animals will increase in value as wildlife habitat diminishes and pressure on the trophy-size animals within the remaining populations rises. Where legal commercialization exists, identifying heads from unlawfully taken animals is difficult once the parts are removed from the kill site. In these cases, successful investigations either evolve from undercover work or are overt cases based upon tips or other intelligence that identify a particular head as illegal. In order to control the continued commercial marketing of large trophy heads of rarer species such as bighorn sheep, western states have initiated a marking system for heads from legally taken animals by inserting a numbered "plug" in the horns, thus identifying them as from a legally taken animal. To further restrict the potential illegal market, possession of sheep skulls from winter kills, or "pickup" heads, is no longer allowed in many western states. A permanent marking system such as this could be applied to other big game species as well.

Nontrophy North American Mammal Parts

In order to enter the commercial market, a North American animal does not need to be a trophy. The African Import Company (1988) quoted prices for shoulder mounts of fairly common species such as pronghorn antelope (*Antilocapra americana*) ($250–$450), mule deer ($325–$425), and mountain goat (*Oreamnos americanus*) ($1,200), a rarer animal. In an appraisal provided by the Chicago Appraisers Association, a collection of six mule deer shoulder mounts was valued at $7,500, while a single pronghorn antelope shoulder mount was valued at $2,500 (J. Gavitt pers. files, 1981).

Other parts of wildlife in this country aso bring lucrative prices to a more limited market. For example, the teeth of species such as coyote (*Canis latrans*), racoon (*Procyon lotor*), badger (*Taxidea taxus*), and porcupine (*Erethizon dorsatum*) may vary from about $0.50 to $2.50 each, while elk "ivories" bring $9.50 each. Claws are also marketable, ranging anywhere from $0.50 in beaver (*Castor canadensis*) to $18.00 for cougar (*Felis concolor*). Alligator (*alligator mississippiensis*) feet and teeth, snapping turtle (*Marcroclemys temmincki*) shells, skunk (*Mephitis mephitis*) and muskrat (*Ondatra zibethica*) skulls and rattlesnake products are also legally available to the public for a variety of prices (African Import Company 1988). Thus, the incentive to poach for profit certainly exists for even the common, less valuable species of wildlife, particularly when large numbers of animals can be taken illegally.

A total ban on commercialization of wildlife parts does not ensure total compliance, even in the face of felony criminal penalties. The purchase and sale of migratory birds and their parts continues to surface in areas throughout the nation. A recent Service investigation in the Southwest (centered in the Gallup, New Mexico area) revealed a thriving black market in parts from numerous species of protected migratory birds, including eagles and other raptors along with several species of songbirds. Prices for whole carcass birds and parts varied considerably, depending upon their condition and the rarity of the species. This illegal market continues to exist because of continuing illegal demand for (1) crafted items containing migratory bird feathers and talons, (2) whole carcass birds mounted and sold by taxidermists to museums or private individuals and (3) feathers (particularly from eagles and other raptors) used for trade or barter between private individuals.

The Oriental Medicinal Trade

Contrary to popular belief, the use of animal parts as aphrodisiacs in the Far East is negligible when compared to those employed for medicinal purposes (Klein 1982).

The Asian attitude toward plant and animal substances for medicine is compared by Dickinson (1986) to aspirin in the United States. Dickinson further reported that traditional Oriental medicine is practiced by one-third of the world's population and has existed for centuries. Approximately 3,600 ''Hanyuk'' or traditional medicine shops are located throughout Korea alone (Milliken 1985).

Bear gall bladders, or ''ungdam'' to Koreans, are a primary focus of the Oriental trade. After a bear is killed, the hunter or guide ties off the gall bladder. It is cut above the tie to prevent leakage and frozen. The frozen, or ''wet,'' gall is then sold to a buyer for a price that may vary from $30.00 to $100.00. Frozen galls are then dried and sold to an exporter, who may receive about $3,000 per pound in overseas markets. Reisner (1987) stated that one pound of powdered gall bladder will command a price of up to $5,000. Milliken (1985) reported that gall bladders from Asiatic black bears (*Selenarctos thibetanus*) wholesale overseas for about $454 per ounce, and will retail for almost double that amount.

Investigations have revealed that some private zoos and game farms in the United States have been involved in elaborate laundering schemes, whereby live black bear (*Ursus americanus*) that are either captive-bred or illegally trapped are shipped overseas for the Oriental market. This is especially damaging to the black bear resource when wild females are shot in the den, and the cubs removed for shipping overseas (Dickinson 1986). Even Asiatic black bears shipped to South Korean zoos are allegedly killed for their gall bladders and other parts (Milliken 1985).

The demand for galls is almost insatiable in some areas of the world. With approximately 200,000 black bears in the lower 48 states (Pelton 1987), the impact of an unregulated commercial market can cause significant declines in populations. In 1987, an importer inquired about the legality of shipping 2,500 bear galls to China, which would be collected from bear hunters throughout the nation (J. Gavitt pers. files, 1987). In 1981, California initiated a seven-month investigation into illegal commercialization of bear parts, focused on guides who hunted with dogs. It was discovered that, of 100 houndsmen contacted during the investigation, virtually every subject was involved in illegal commercialization. Major buyers of bear parts were discovered in Los Angeles, San Francisco, and the state of Washington (Klein 1982). Reisner (1987) reported that, of 12,000 to 15,000 black bears left in California, the estimated illegal kill exceeds the 700 to 900 bears taken legally each year.

In another investigation, Arizona wildlife officers seized over 20,000 pills containing bear gall, with an estimated value of $26,000 (Smith 1987). Two recent Service investigations centered in and around Shendandoah and Great Smoky Mountains national parks documented a commercial market for bear parts that, if left unchecked, would have decimated black bear populations in large areas of the Appalachians. Bears in the Southeast are located in isolated pockets of public land and are more susceptible to the impact of illegal killing. Undercover agents documented several hundred black bears that were illegally killed for the commercial market during the three-year investigations that terminated 1988. Further north, subjects illegally sold undercover agents from Massachusetts and New York parts from approximately 400 bears, ranging from adults to small cubs.

Elk antlers are in similar demand, although less available throughout the country. The antlers are sliced into paper-thin cross sections, for mixing in teas and other liquids for health purposes. Fabich (1980) reported that the antler market started in Montana when a local buyer began purchasing them for about $1.00 a pound.

Recently, the hard antler has generally sold for $6.00 to $8.00 per pound, depending upon current economic conditions. Thus, an average 15-pound elk rack can bring up to $120. Recently, 5,000 pounds of hard antlers were sold legally at the annual auction in Jackson Hole, Wyoming for $8.92 per pound (Griffin 1988).

"Velvet" or "blood" antlers (still in growth stage) have brought considerably more, up to $70.00 per pound. Klein (1982) reported that undercover officers in California were offered $110 per pound for antlers in velvet. However, Scrafford (pers. comm., 1989) advised that the price has recently dropped to approximately $20.00 per pound in areas of Montana. Velvet antlers allegedly contain medicinal properties of higher quality than those found in hard antlers. Their value has promoted elk ranching strictly for the purpose of cutting off and selling velvet antlers from bulls in the late spring to early summer months. Velvet antlers are one of the few animal parts that are intrinsically illegal, unless they can be traced to a commercial elk ranch. In spite of this, the incentive to exploit wild elk populations is great, when one dead elk can bring several hundred dollars to a poacher in antlers alone. Also, Fabich (1980) reported that, unless detailed record-keeping systems are established on game farms, it is quite easy to launder wild elk into a market through a private preserve. Scrafford (pers. comm. 1989) reported that elk herds are currently being built up by commercial dealers overseas, and that as a result, elk calves may be worth as much as $5,000 to a commercial dealer in the United States.

Intelligence and information from past investigations have documented that some dealers openly promote illegal activity. A dealer in New York advised a Colorado rancher that, since he owned private property, "hunting in the summer is permissible in Colorado. Therefore, antlers with velvet are obtainable in your area" (J. Gavitt, pers. files, 1983). While working undercover from 1981–84, I purchased and sold antlers as part of my cover while contacting defendants during an investigation in Montana. There were never any questions asked by the subjects who purchased antlers, and payments were almost always made in cash.

Disturbingly, other North American mammal parts are receiving increasing attention from individuals involved in the Oriental medicinal market. A recent article in the *Washington Post* quoted a local dealer as stating that sliced deer antlers keep a person warm in winter, increase energy and help with blood circulation (J. Gavitt, per. files). Surprisingly, even elk penises bring approximately $5.00 each. Klein (1982) stated that a commercial dealer ordered 150 bear paws and 15 cougar galls in a single day from undercover investigators.

Select Recommendations Regarding Wildlife Parts Trade in North America

Theoretically, commercialization of wildlife parts in North America could continue as long as there are healthy wildlife populations to sustain the trade. However, with the exception of fur-bearing animals and skins from some other species, the taking of any species of wildlife with the primary purpose of selling its parts in a commercial market is a philosophy that may conflict in the future with long-range management goals in the United States. The effects of unregulated markets for wildlife parts in North America have been devastating in the past, and actually served as the stimulus for fish and wildlife management programs still in effect today (Boddicker 1977). I would not be inclined to encourage regulations that allow marketing of wildlife parts, as commercialization only increases the likelihood of illegal kill. The privilege of an individual to purchase a trophy head for his den, elk "ivory" for jewelry or an elk penis for that matter, must be weighed against this risk.

We should remember that wildlife in America is utilized for recreational purposes by the majority of the public, whether for consumptive or nonconsumptive activities. Legal commercialization not only stimulates an illegal market that will operate much more openly than if sale was prohibited; the legal commercial market itself can create a dilemma for managers dedicated to providing quality recreation to the majority of the public. There is a real conflict in attaining this goal when the guide or hunter, having taken his share of trophy animals, pulls the trigger again on another, simply because the head might bring thousands of dollars in the open market.

Geist (1988) stated that, when legal commercial markets for wildlife are established, criminal activities soon follow. Commercial demand requires strict regulation of the market, and resource agencies should respond accordingly. The creation of undercover investigative units within many of the agencies has been a positive step in not only curbing illegal activity, but lending insight into the actual effects of an illegal commercial market upon wildlife populations. Klein (pers. comm. 1989) noted that, due to information gathered as part of an undercover investigation of illegal commercial harvest of black bears during the bear hound training season in California, that season was virtually eliminated in 1984. As a result of this protective action, the legal bear kill within the state increased significantly during the next three years.

Resource agencies must take into account the potential number of bears that might be killed out of season, and therefore never available to legal recreational pursuits, in order to accommodate a medicinal market that has little scientific basis for its existence in the first place. The oriental wildlife parts market is so broad that parts from most North American mammals may have some commercial value. To what extent this commercialization will be allowed to affect wildlife populations is a matter of concern for resource managers throughout the continent. Foreign trade in wildlife products utilized for medicinal purposes extends far beyond North American species. Tiger (*Panthera tigris*) bone to relieve backache, cobra blood and gall bladder to inhibit old age and reduce fever, and rhino horn as a treatment for illnesses in babies, are all examples of the overseas medicinal market in wildlife products (Nichol 1987). Unregulated commercial sale of products derived from foreign wildlife has contributed to significant population declines in some species. There is no reason to think the same could not happen in North America.

The most effective way to curtail illegal markets is to totally ban commercialization, as Federal legislation has done for migratory birds, with the exception of some captive-bred species. Elimination of commercialization can have marked positive effects on wildlife populations. When sale of migratory birds was prohibited in the early part of this century by legislation which stopped mass illegal killing, populations rebounded strongly. The same is true of the American alligator which, because of strict enforcement of a ban on the sale of skins and other parts, has now recovered to the extent that a limited harvest can be sustained for a legal commercial market.

Before prohibiting the sale of wildlife parts, resource managers usually consider the proposed measure in terms of its benefits to the wildlife resource, set against the economic loss to a particular region. As a result, many states restrict the lawful sale of parts to a particular wildlife species, rather than totally prohibiting a commercial market. I agree with Geist (1988), however, who stated that conservation is best served when the economic value of activities surrounding living wildlife are emphasized, as opposed to a local economy benefiting from sale of meat or parts from deal animals. With the notable exceptions of fur and other skins, I believe the elimination of commercial markets for parts from native wildlife, particularly those destined for the Oriental medicinal market, would not place a significant economic burden on the citizens of our country, and would have a positive effect on the wildlife resource involved.

The Illegal International Trade in Wildlife Parts

Magnitude of trade

Illegal commercialization of parts from foreign wildlife should not be discussed without a brief insight into the general market for world wildlife. The lawful commercial trade is mind-boggling. The United States is the largest consumer of wildlife in the world, importing and exporting over $1 billion in live wildlife and products a year (Hemley 1988). In 1986, almost 33 million wildlife items in over 64,000 shipments were legally imported into the United States from foreign markets worldwide, with a declared value of nearly $640 million. The estimated value of imported products made from wildlife (almost $500 million) exceeded the value of live wildlife ($41,855,826) almost tenfold, followed by skins ($61,628,669) and raw products ($37,261,608). The magnitude of imports of wildlife products into the United States in 1986 is demonstrated by the following: 5–10 million raw furskins, 6–8 million pieces of elephant ivory, and 15–20 million finished reptile products (Roeper 1988).

Estimates of the illegal trade in wildlife parts range from one-quarter to one-third of the total, with a value of $100 to $250 million annually (Hemley 1988). Clearly, without proper controls, this country's purchasing power may be a significant factor contributing to the decimation of foreign wildlife populations, particularly in the third-world countries.

Some Species Most Affected by the Trade in Foreign Wildlife Products

Elephant ivory presents one of the greatest challenges to international trade controls for wildlife. There has been a steady decline in the African elephant (*Loxodonta africana*) and Asian elephant (*Elephas maximus*) populations, linked at least in part to the large-scale illegal trade that began in the 1970s, when ivory increased in price from $7.42 per kilo to $74.42 per kilo in eight years (Douglas-Hamilton 1987). Currently, all tusks from legally taken animals must be marked and are tracked by a special unit of the Secretariat for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). During the first year of such tracking, the African Elephant and Rhino Specialist Group estimated that only 22 percent of elephant ivory exported that year was legal. That is to say, the tusks from 89,000 elephants were exported illegally. The Group further reported that widespread corruption within many countries prevents effective management of elephant populations (African Elephant and Rhino Specialist Group 1987). Nichol (1987) reported that, with export restrictions in some countries, tusks and sometimes even the elephants themselves are smuggled from countries prohibiting export to those where legal documentation can be obtained. False documents can be purchased in many countries to conceal the illegality of the export. To address these problems, Congress passed the African Elephant Protection Act of 1988, permitting the United States to ban ivory imports from countries that do not meet certain criteria for elephant conservation and trade controls.

Trade restrictions in the United States certainly do not guarantee protection elsewhere. Sea turtle populations have suffered because of the unwillingness of other countries to comply with international restrictions. Japan, a member of CITES, but a problematic country when dealing in certain species of wildlife, has exempted itself from prohibitions relating to sea turtles, and annually imports approximately 28,000 endangered hawksbill sea turtles (*Eretmochelys imbricata*) (Hemley 1988). Rhinoceros populations, particularly the black rhino (*Diceros bicornis*), continue to dwindle, even with trade prohibitions. Rhino horn is available for export to the Middle East (North Yemen) for use in the carving of traditional knife handles. However, its primary commercial purpose is medicinal, along with other parts from the animal. Even the toenails and urine in the bladder from a rhino are utilized for one treatment or another (Nichol 1987). Because of commercial demand, it is unknown whether remnant rhino populations will survive beyond the end of this century. Martin (1983) estimated that 50 percent of world populations disappeared during the 1970s, and have continued to dwindle since then. In 1980, a single Indian rhino horn weighing 720 grams could bring $875 to the poacher and $6,000 to $9,000 per kilogram on the commercial market. The smuggling of rhino parts into the United States still occurs. In a 1988 Service investigation, one subject was arrested while attempting to sell two rhino horns for $40,000 each to undercover agents, and two members of the South African Defense Forces were indicated as accomplices.

Enforcement of International Trade Within the United States

In order to regulate the flow of wildlife products from foreign countries, the United States Fish and Wildlife Service has designated ports-of-entry through which, unless an exception is granted, wildlife parts involved in foreign commerce must pass. Further, the law requires that such products must be declared and are subject to inspection. Primarily responsible for ensuring compliance are inspectors from the United States Fish and Wildlife Service and United States Customs Service. However, of an estimated 90,000 declared shipments each year, only one in five is physically examined at all. Commercial wildlife traders are required to be licensed by the Service, thus providing revenue for inspections. With only 60 Fish and Wildlife Service inspectors, monitoring declared shipments becomes an almost hopeless task.

Investigations involving smuggling of foreign wildlife products have enjoyed a limited degree of success. The Lacey Act Amendments of 1981, along with United States Customs law, provide strong criminal penalties for transporting wildlife in violation of foreign law. However, Service Special Agents are encumbered in several areas. In order to substantiate criminal charges in United States courts, documentation of the violation usually must be made at the port-of-entry. Otherwise, it is extremely difficult to prove the illegality of wildlife products entering the United States in violation of foreign law, for several reasons. First, most wildlife products enter the world markets from the tropical regions of Africa, Southeast Asia and South America. Laws relating to wildlife protection in those countries are ever-changing, commonly misleading, and difficult to interpret. Availability of foreign witnesses for testimony in United States courts as to current or past wildlife laws may be difficult to arrange, depending on the current political situation in a particular country. Second, mere statements of illegality by a defendant dealing in smuggled wildlife goods are not sufficient evidence to convict; there must be some independent verification of illegality. Third, and most important, Service agents have generally either been restricted or forbidden by policy from conducting investigations, covert or otherwise, outside of United States borders.

Select Enforcement Recommendation Regarding International Trade

Wildlife resources are best fostered in the modern world when it can be demonstrated that their intrinsic value exceeds that of the conflicting use being considered for a population or its habitat. The value of wildlife can be evaluated in terms of either the living animal or its products. From a management and enforcement standpoint, the banning of trade in products from a particular foreign species of wildlife can be beneficial or harmful, depending on the wildlife's economic value and ability of the country to manage the species. If populations of the species have declined to the point at which a sustainable harvest is not possible (as with the black rhinoceros), then certainly the import of commercial products should be banned. However, a national interest in wildlife populations equalling that in the United States does not exist in many foreign countries. Therefore, a valid argument exists to allow export of products from healthy foreign wildlife populations, to provide economic value to a resource which might otherwise be ignored. Organizations that wish to ban consumptive utilization of healthy foreign wildlife populations for products must consider the fact that they may be ensuring the demise of a particular species through neglect, unless tourism, hunting or other recreation can provide the local economy with an alternative source of funding.

Unfortunately, as demonstrated in many rain forests of Central and South America and in other countries, planning for a sustainable resource often cannot compete with poverty, rampant inflation, an unstable political system and an attitude toward natural resources much the same as that in the United States until early in this century. The inability of other countries to control the harvest of a commercially marketed species is a real problem. Hemley (1988) states that, where a commercial market exists without controls, intense harvest pressure will remain constant until that species is almost totally depleted, and will then shift to another, more numerous species until it, too, becomes commercially "extinct." Nowhere was this more evident than in the crocodilian (now caiman) skin trade and the whaling industry. Further complicating matters, captive breeding of wildlife for the commercial market is rapidly expanding overseas, and there is additional pressure to allow exemptions for products of certain crocodilians and other restricted species to enter the United States. The success of this wildlife "ranching" should be evaluated carefully on a case-by-case basis before imports of captive-bred specimens are permitted. The potential problem of "laundering" illegally taken wildlife through such facilities becomes a reality when an exemption is granted.

CITES is currently the primary agreement which restricts the international movement of wildlife and plants and monitors the wildlife trade between party countries. Although 96 countries are members of CITES, there are varying levels of commitment to enforcing wildlife trade restrictions. The lack of concern for wildlife resources demonstrated by many countries restricts enforcement coordination between nations. In order to slow the widespread destruction of many wildlife species, limited economic sanctions may have to be levied against countries that do not comply with trade restrictions and other conservation policies.

As the largest consumer of wildlife products in the world, I believe that the United States has a responsibility to provide enforcement assistance to other countries. An increase in the number of Wildlife Inspectors at ports-of-entry is only a partial solution. A Service Special Agent could also be assigned to the CITES Secretariat for full-time liaison work in enforcement matters. This concept has the full support of the Secretariat, and it is hoped that it will eventually be realized. With proper coordination, an international enforcement network focusing on wildlife offenses could be established, functioning in the manner of Interpol. Such cooperation is essential if we are to prosecute individuals involved in wildlife crime that transcends political boundaries.

Finally, I recommend that the Service coordinate with the United States Department of Justice and Department of State to aggressively pursue concurrence from host governments for Special Agents to work with foreign investigative agencies, for the purpose of gathering intelligence and conducting investigations on foreign suspects based overseas. Otherwise, our enforcement effort in international circles will continue to be extremely limited.

Summary

North American wildlife parts will continue to be sold illegally on commercial black markets, located within the United States and overseas. Agencies involved in resource management must decide whether our native species of wildlife can withstand the additional strain of legal commercialization, while at the same time confronted with increasing habitat loss and recreational demands by the public. With the economic base in this country, the United States still has the option to make management decisions in favor of wildlife populations, as opposed to allowing unregulated commercialization of their parts.

I believe that international markets for foreign wildlife parts are out of control in many areas of the world. The attitude in the United States toward foreign wildlife is one of concern, reflected by market controls at our borders and the Service emphasis on interdiction of illegal shipments at ports of entry. However, direct steps to halt species eradication in foreign countries have been funded primarily by private organizations. I recommend that the United States Fish and Wildlife Service take a leading role in an aggressive international enforcement effort to stop unlawful illegal trafficking in wildlife parts, in order to target smugglers and dealers involved in exporting illegal shipments of parts through false documentation or elaborate laundering schemes. With this goal in mind, the Service would reach beyond normal investigative constraints in order to effect prosecutions of illegal wildlife dealers worldwide.

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Regulatory Enforcement and Implementation Theory as Predictors of the Performance of Wildlife Trade Controls: A Case Study

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The History of Wildlife Trade Controls

Ever since the international millinery trade was identified as a threat to several bird species in the late 1800s, wildlife trade controls have found their way into most of this century's international wildlife agreements. Prior to the development of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), however, such controls failed to achieve a high international profile, and there is no evidence that they had a significant conservation impact. The drafting of CITES during the 1960s reflected a growing perception among wildlife exporting nations that they could not longer domestically control the exploitation of species, and that a flourishing international black market was depriving them not only of their wildlife, but of much needed revenues. CITES offered conservationists the opportunity to go beyond the mere incorporation of trade control provisions into instruments designed for other, more broader, purposes, and to build instead an international infrastructure targeted solely at preventing biologically detrimental wildlife trade. This infrastructure became reality with CITES' entry into force in 1975. CITES has now become the flagship of international wildlife cooperation, and, with almost 100 contracting parties, is one of the most popular international treaties.

An important question is why trade controls have developed as the species conservation mechanisms of choice for intergovernmental efforts. Their role goes well beyond what would be suggested by an objective analysis of the relative threat posed by the trade. While notorious examples of overexploitation for international commerce do exist, the impacts of habitat destruction, domestic overexploitation and exotic species introductions continue to result in the endangerment and extinction of many more species (Lyster 1985). Nevertheless, trade controls remain the primary vehicle through which countries cooperate to prevent species extinctions.

The role assigned to trade controls is easy to understand. In contrast to international efforts to protect wildlife habitat or to regulate wildlife exploitation within national boundaries, trade controls on international transactions pose little threat to perceptions of national sovereignty. And trade controls cost far less both politically and economically than most alternative conservation measure, while offering governments a high-profile way to illustrate their concern for wildlife. International trade controls in turn offer the non-governmental community an attractive alternative to attempting to affect the wildlife management laws and policies of individual nations, a serious historical stumbling block for conservationists (Boardman 1981). The high-profile nature of the trade, particularly that involving species such as leopards, elephants, and rhinos, has also made it a powerful public relations and fundraising tool for many conservation and animal welfare organizations. It is this symbiosis of interests that has helped make CITES the flagship treaty it has become.

The Basic Theory of CITES

The casual model underlying CITES is simple, notwithstanding the complex regulatory framework imposed. The export of any species listed on CITES' two primary Appendices must be accompanied by an export permit certifying that the transaction will not be detrimental to the species. Appendix I is to include all species threatened with extinction that are or may be affected by international trade; commercial trade in these species is generally prohibited. Appendix II is to include all species that might become endangered in the absence of trade controls. In order to ensure an unbroken paper trail as shipments are split up among final destinations and as specimens are processed into manufactured products, CITES paperwork is to be verified at each point of transit into or out of a member state. To achieve this goal, the treaty mandates the creation of national and international administrative bodies. Parties are to enforce the treaty's provisions and are to report on their trade to the international Secretariat. The Secretariat facilitates communication among the parties, and is charged with assessing the treaty's implementation. Biennial Conferences of the Parties (COPs) are to further interpret treaty provisions, agree on ways to improve treaty implementation, and modify the Appendices.

But while the casual model underlying CITES is simple, the informational and regulatory prerequisites to its successful implementation are considerably more complex. They include: (1) appropriate specification of the Appendices; (2) collection of sufficient biological data on the threats to and status of traded species to justify issuance or denial of export permits; (3) effective implementation of the treaty's paperwork verification and inspection procedures by each party; (4) effective sanctioning of treaty violations; (5) leadership from the Secretariat in facilitating and coordinating party communications, investigating perceived trade irregularities, and evaluating treaty implementation; and (6) fulfillment of the COP's policy-fixing role in guiding the treaty through its evolution.

Theoretical Approaches for Predicting Regulatory Success

As a social regulatory instrument, CITES establishes rules prescribing "responsible" behavior and requires that parties institute enforcement procedures to deter deviations from these rules. As an example of international regulation, however, it lacks the specific sanctions that one would find in national law.

We will use two theoretical approaches to understanding how CITES is likely to function as a regulatory instrument. The first is regulatory enforcement theory, which asks what configuration and level of rules or standards will raise the costs of noncompliance high enough to deter socially irresponsible behavior, in this case illegal wildlife trade (Viscusi and Zeckhauser 1979). The second is implementation theory, which questions not only the characteristics of the social regulatory instrument itself, but also the context within which it will function (Mazmanian and Sabatier 1983).

Both approaches grew out of analytical attempts to explain the failures of policies in other arenas, and both purport to have predictive value in projecting the performance of new policies.

Regulatory Enforcement Principles

The purpose of trade controls is to prevent biologically detrimental wildlife trade. Experience in other areas of social regulation suggests that most wildlife traders will comply voluntarily with this goal (Bardach and Kagan 1982), often for reasons that have little to do with fear of punishment; however, it is necessary to both deter the actions of traders who would pursue illegal trade and reinforce the honest behavior of the rest. Under CITES, deterrence is to include random inspections of paperwork and wildlife shipments and punishment for traders engaging in illegal trade. This deterrence, however, must be accomplished without unduly burdening the legitimate activities of honest traders. Otherwise, the moral basis of the regulation could be undermined and enforcement problems would be magnified. In economic terms, regulatory enforcement must adapt to the cost-benefit calculation facing traders when deciding whether to comply with trade controls. Compliance is likely to be costly in terms of paperwork requirements and foregone profit-making opportunities. Violating the rules may also be costly, depending among other things upon the probability of getting caught, the severity of penalties and likely level of damage to the firm's business reputation. If standards are set too low, the goal of preventing detrimental trade may not be achieved. If standards are set too high, excessively high compliance costs will encourage otherwise honest traders to engage in illegal activities. The goal of regulatory standard-setting must be to set the standard so as to maximize overall achievement of the regulatory purpose. That traders are likely to have widely varying perceptions of the costs and benefits associated with particular actions complicates achievement of this goal.

Implementation Theory

Implementation theory identifies variables perceived as important to successful policy implementation. These variables can be classified as variables affecting the tractability of the policy problem to regulatory intervention, statutory factors that characterize the internal robustness and health of the policy instrument, and variables establishing the social context for regulatory implementation (Mazmanian and Sabatier 1983).

Tractability variables. Certain policy problems will be inherently more difficult to address than others. Technical difficulties can arise if suitable performance indicators are not available, or if important causal linkages are inadequately understood. The magnitude of the regulatory problem also depends on the size of the group affected by the regulation, the heterogeneity of their behavior, and the degree of behavioral change that is required.

Statutory variables. Several elements of the structure of the policy instrument itself can prove pivotal in determining its success. The clarity of the policy's goals, the sufficiency of its causal model, and the availability of sufficient monetary resources are clearly important. For example, how direct is the link between the rules prescribed in the regulatory instrument and the achievement of the social objective being sought? Less obvious but equally important are what Mazmanian and Sabatier refer to as hierarchical integration, or the number of independent decision points involved in implementation (Mazmanian and Sabatier 1983). By analogy, the number of available veto points is also important.

Nonstatutory variables. While a policy instrument theoretically can be structured perfectly, external factors will inevitably play a major role in the degree to which its implementation is pursued. Does public support exist to keep implementation on track in the face of competing interests? How will the importance of the policy problem be ranked among competing demands for attention and resources? How variable is the socioeconomic environment within which policy implementation is being pursued? What is likely to be the level of leadership, skill, and commitment available in implementing officials? Moreover, political leaders outside specific implementing agencies are likely to have considerable input into implementation through their influence over financial resources and control over legal amendments (Bardach 1977).

The intention of this paper is to evaluate CITES' trade controls according to the criteria set out in the two regulatory "lenses" described above (Allison 1971). Doing so, however, requires a prior knowledge of key characteristics of the issue area itself.

The Wildlife Trade as a Target of Regulatory Action

The international wildlife trade is an extraordinarily complex economic activity (Trexler and Kosloff 1987). Thousands of species are traded regularly. Each species may involve distinct subspecies and several range countries. The legislation governing wildlife exploitation and consequent export is often different in each of those countries. Most wildlife trade originates in developing countries, many of which face social and economic problems that are likely to be perceived as more important than controlling wildlife exports. The complexity of the trade for regulatory intervention purposes can be illustrated at several levels.

First, the state of biological knowledge on traded species is often poor and sometimes nonexistent. There is frequently little agreement over the degree of threat posed by the trade to a particular species. Detecting changes in species' status is often impossible for lack of baseline data, and impacts of detrimental trade often cannot be differentiated from those of other variables such as habitat loss.

Second, customs infrastructures are often poorly equipped to focus on wildlife trade, particularly at the export level. Customs infrastructures tend to face outward rather than inward; even U.S. authorities admit to ignorance concerning domestic wildlife exports (J. Smith, pers. comm., 1985). Few countries have the financial resources to employ specialized agents for a narrow arena of economic activity such as wildlife trade. In addition, wildlife trade takes place within the context of a much larger international trade that relies more and more on containerized shipments and other large-scale trade-facilitating mechanisms that confound attempts to monitor small quantities of products. Free trade agreements also make border controls of the sort needed to implement trade controls less and less tenable.

Third, the commercial chain of even individual wildlife shipments can be very complex, often involving passage through several countries. Trading patterns can shift rapidly in response to changing consumer demand, changing species availability, and changing national laws. Millions of people make their living as collectors or intermediaries in what ultimately becomes the multi-billion dollar international wildlife trade. Millions more consume these products in a complex array of end-uses.

Most individuals at both ends of the commercial chain are unlikely to have any knowledge of or contact with the regulatory requirements surrounding the trade, nor are they likely to be able to differentiate between detrimental and non-detrimental transactions at the point of collection or of purchase. When animal protectionists sought to stop the clubbing of young harp seals in Canada, sales of all seal skins plummeted (Dixon 1984). This makes demand-control strategies risky in a situation in which many countries seek to promote legitimate trade in their non-endangered wildlife.

Applying Regulatory and Implementation Lenses to CITES' Trade Controls

The Regulatory Enforcement Lens

Looking through the regulatory enforcement lens, the key question is whether a set of regulatory standards can be developed that will maximize social utility. In particular, can the costs of non-compliance for potential illegal traders be adequately raised while at the same time not unduly impeding legitimate wildlife trade? Several attributes of the trade throw this goal into question.

First, governments themselves often will be unable to differentiate between detrimental and non-detrimental wildlife trade. In the absence of huge amounts of new biological research, there will be little basis for making the type of no-detriment finding required by CITES. However, it is the countries with the greatest responsibility for making such no-detriment findings that are least able to pay for the necessary research. Second, the same problem of inadequate knowledge can make it very difficult for even honest traders to know whether they are engaging in detrimental or non-detrimental trade. In a situation in which honest traders become confused about what is socially responsible and what is not, and in which infractions necessarily become much less visible, self-enforcement may well decline. As with almost any social regulation, self-enforcement by a majority of traders is pivotal to the success of trade controls. Third, few countries are likely to have available or be able to put into place the monitoring and enforcement infrastructures necessary to raise significantly the costs of non-compliance to illegal traders, even when such traders can be identified. Such infrastructures include not only specialized networks of trained border agents, but the courts, the laws, and the public perceptions necessary to adequately punish violations. Illegal trade in wildlife is close to being a victimless crime, and strict enforcement of controls is likely to be difficult, particularly in developing countries.

Enforcement theory predicts several likely outcomes for such a situation. Difficulty in measuring goal attainment, inevitable when governments themselves cannot differentiate between detrimental and non-detrimental trade, encourages regulators to settle on proxy measurements. These proxies can ultimately displace the fundamental objectives of the regulatory instrument (Diver 1980). The stages in this process often include a shift in regulatory concept from promoting a social good to preventing a social bad, a further shift from preventing the social bad to preventing adverse criticism of the regulators, and an increasing emphasis on performance measures that are activity-based and under the immediate control of the regulatory agency (Diver 1980). In the case of trade controls, these trends could be evidenced in a number of ways. First, achievement of species conservation through the use of selective trade controls could give way to broad-brush attempts to generally impede the wildlife trade, often perceived as a social bad. But this imposition of high compliance costs, if not coupled with high costs for non-compliance, not only may fail to sway the cost-benefit calculation of unscrupulous traders in favor of compliance, but may encourage illegal activity on the part of some traders who would otherwise have stayed honest. Second, implementation of trade controls could become defensive in nature, focusing on the semblance rather than substance of effectiveness, such as the periodic redrafting of legislation that always promises to revolutionize implementation, but never seems to do so. Lastly, inspections and forfeitures could become ends in and of themselves, rather than being means to deter detrimental wildlife trade.

The Implementation Theory Lens

The tractability of the international wildlife trade for policy intervention purposes is poor. It is simply too complex, too varied, and too fluid to maintain regulatory control. In addition, the population whose behavior is being targeted for change by trade controls is enormous and highly heterogenous. Few members of the target population are likely to know of the policy intervention, and many of them will be motivated to oppose it for self-interest reasons.

The socioeconomic context for trade controls is complex. Poor and wealthy countries must work together, and radically different priorities and availability of resources are inevitable. For many participants in the wildlife trade, the income derived is a matter of economic survival. For other participants, the trade represents primarily a source of luxury and exotic consumer goods.

It is in the realm of statutory variables, however, that the most obvious problems with CITES' trade controls appear. As an international policy instrument, it inevitably lacks the degree of hierarchical integration achievable with national policy. Not only does achievement of the policy objective require coordinated action by dozens and even hundreds of independent entities, but any one of these entities can actively veto goal attainment. Effective enforcement of CITES is dependent on the integrity of an international paperwork chain that can be broken by any one of numerous implementation failures. The issuance of illegitimate paperwork by one country, for example, is likely to make subsequent detection and penalizing of detrimental trade impossible. Unfortunately, the signers of CITES possessed little ability to dictate who would be charged with CITES implementation or to set up reward systems for good performance. Mazmanian and Sabatier (1983) attribute many cases of policy failure to this very problem.

One variable that merits particular attention is the causal model underlying CITES. For CITES to work, permitting authorities must be created, adequate biological knowledge for issuing permits must be collected, financial resources for permitting and enforcement activities must be allocated, and enforcement personnel must be trained. During the implementation itself, the causal model of CITES depends on the link between the design standard with which traders are required to comply (paperwork procurement) and the performance standard (no-detriment findings) which links the regulatory infrastructure to the regulatory objective of conserving species. If the performance standard is not adhered to, the design standard loses most of its validity, for paperwork verification per se does not relate back in any significant way to the policy goal of conserving species. Yet compliance with the performance standard is assigned to government agencies that are often unlikely to have adequate information expertise, or resources to make such findings. This is a crucially weak link in the causal model. It can easily be envisioned that this would result in implementing officials focusing on implementation of the design standards as ends in and of themselves, while losing sight of the policy's conservation goals. Lastly, even perfect implementation of CITES' trade control provisions at national borders may not significantly benefit the biological status of species listed on the Appendices. Many populations of a listed species may not be threatened; thus, trade controls will have no impact one way or another. Alternatively, threatened species may continue to be harvested for domestic purposes even in the presence of trade controls, or may succumb to habitat loss. In many cases the wildlife trade is not the primary problem facing the species in question.

Experience with CITES

The utilization of these two theoretical lenses raises major questions about how a policy instrument such as CITES would be expected to perform. The implementation deck is clearly stacked against achievement of species conservation aims through a predominant reliance on broad-brush trade controls of this sort. Although an in-depth review of CITES' actual performance is outside the scope of this paper, some brief conclusions with respect to the six prerequisites of CITES success identified above can be made:[1]

Appropriate specification of the Appendices. The CITES Appendices now contain at least 24,000 species, and possibly as many as 40,000.[2] Adding species to the Appendices has become a highly inappropriate proxy for the success of Conferences of the Parties. This is evidence of exactly the type of goal displacement previously suggested by theory. In addition, many species have been listed in the absence of any biological information suggesting a threat from trade. Consequently, it is becoming harder and harder to focus the enforcement process on the species of actual conservation concern.

Collection of sufficient biological data on the threats to and status of traded species to justify issuance or denial of export permits. CITES has not resulted in the collection of biological data its drafters envisioned (E. Baysinger, pers. comm. 1988). As a consequence, CITES Parties admit that few legitimate no-detriment findings precede the issuance of export permits, particularly for Appendix II species coming from developing countries. It is therefore generally unknown whether a CITES transaction, regardless of whether or not it is accompanied by a CITES permit, is likely to prove detrimental to the species involved.

Effective implementation of the treaty's paperwork verification and inspection procedures by each Party. Few countries have developed a coordinated inspection, detection, and prosecution system by which to implement CITES. In fact, little is known about CITES implementation in most party states. What is clear is that the

[1]These conclusions are based on the authors' ongoing research into CITES implementation and enforcement both domestically and internationally.

[2]Many listings are made at the genus or family level, so that taxonomic disagreement exists with respect to the actual numbers of species involved.

complexity of the implementation task has made it all too easy for implementation efforts to focus on "controlling the trade" while overlooking the issue of whether species are actually being benefited. This has led to considerable "regulatory unreasonableness" in the exercise of CITES responsibilities (Bardach and Kagan 1982). Overall, CITES is now implemented much more as a straightforward trade control instrument than as a species conservation convention. This is once again fully consistent with the prognosis of regulatory enforcement theory.

Effective sanctioning of treaty violations. Little is known about how CITES violations are penalized, although the available evidence suggests that penalties are likely to be inadequate in changing the behavior of illegal traders (Kosloff and Trexler 1987).

Leadership from the Secretariat in facilitating and coordinating party communications, investigating perceived trade irregularities, and evaluating treaty implementation. While the Secretariat has grown into an sizeable organization, governments and non-governmental organizations alike have raised questions about its effectiveness.

Fulfillment of the COP's policy-fixing role in guiding the treaty through its evolution. As previously mentioned, the addition of large numbers of species to the treaty's Appendices has become a proxy for COP success. For example, 300 species of hummingbirds were added to Appendix II in 1987. In addition, more and more elaborate (albeit nonbinding) Resolutions are negotiated at each COP to address perceived inadequacies with previous procedures set out in the treaty text or prior Resolutions. Once again, this is an outcome of the context of CITES implementation that was accurately predicted by regulatory theory. Little COP attention has focused on how implementation could realistically be improved in light of the types of constraints noted in this paper. There has been a general reluctance in the diplomatic environment in which COPs are held to cast the first stone over poor implementation. Overall, the COPs have failed seriously in their assigned role of guiding treaty implementation.

Conclusions

Notwithstanding the common characterization of CITES as one of the most successful international environmental legal instruments in existence, global implementation of its provisions is inefficient, fragmented, often self-defeating, and largely ineffective. The lenses applied to CITES in this paper, those of regulatory enforcement and implementation theory, suggest that broad-brush trade controls may be ineffective in achieving the goal of deterring violations while permitting legitimate trade to proceed without undue hindrance. This conclusion appears to be supported by empirical experience with CITES.

In view of the performance of international regulations in analogous arenas, this outcome should not be too surprising. In a recent study of national security export controls, for example, the National Academy of Sciences concluded that poor conceptualization of which exports should be controlled has resulted in too broad a control structure, administrative and enforcement resources are diluted by the controls' excessive scope, controls significantly and unnecessarily impede U.S. exports, and compliance is discouraged by the complexity of controls (National Academy of

Sciences 1987). A study of international cooperation in the transport of hazardous chemicals concludes:

> *For many of these national officials, protection of man and the environment from chemical hazards translates simply into the number of chemicals subject to test requirements or controls, the amount of data that industry must provide to public agencies, and the size of agency budgets. . . . [I]t is not surprising that agreements on procedures, methodologies, and priorities become ends in themselves at the international level* (Schweitzer 1983).

These examples and the results of applying the two regulatory lenses suggest that improving CITES' implementation cannot be seen as synonymous with simply "cracking down" on the wildlife trade. Trade controls are inherently susceptible to regulatory unreasonableness, and such a crackdown would only aggravate this problem. When hundreds of government agencies around the world produce CITES paperwork it is inevitable that many permits will be technically deficient, regardless of a trader's good faith. These deficiencies need not suggest biological detriment, yet it would likely be such shipments that would bear the brunt of enforcement crackdowns. It is a truism of enforcement theory that it is easier to find obvious but often relatively harmless regulatory irregularities than it is to identify and stop the true problems (Diver 1980). In the case of CITES, true problems will include shipments that have superficially valid paperwork, but which might actually be detrimental to the species in question. The most damaging shipments are likely to be smuggled shipments with no paperwork at all. Concentrating enforcement actions largely on that portion of the trade that may be the least threatening to wildlife species, i.e., declared trade with minor paperwork irregularities, can threaten the cooperation of legitimate wildlife traders in complying with the regulations, and thus further undercut the ability of the inspection infrastructure to target and stop truly detrimental trade. As in any regulatory program, any hope of CITES' success relies on the law-abiding nature of most regulates.

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Illegal Harvest of Waterfowl: What Do We Know?

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Man has been harvesting waterfowl world-wide for over 6,000 years (Alison 1978). However, waterfowl harvest was not regulated in North America until the late nineteenth century. Initial regulations were liberal and lacked uniformity among political entities. The Migratory Bird Treaty Act (1918), borne out of concern over unregulated harvest of North American waterfowl, served as the first unified attempt to manage continental waterfowl populations. But the treaty and subsequent laws to further limit the harvest of waterfowl were viewed as controversial by many hunters. Within a short period of time, selling waterfowl, spring hunting, use of live decoys, and baiting were all outlawed (Hawkins et al. 1984). Since enactment of the treaty, federal agents have apprehended violators and pointed to illegal harvest of waterfowl as a major management problem (Hall 1987). Recent sensational reports of illegal waterfowl harvest, especially in Louisiana and Texas, have suggested that illegal harvest is high. Reported estimates have ranged between one and four times the legal kill (Hall 1987, Anderson 1988), but these estimates have not been verified by scientific investigation.

Presently, a dearth of information exists on illegal waterfowl harvest and illicit behavior of waterfowl hunters. While some experts feel illegal harvest is not damaging to waterfowl populations, the fact remains that the problem threatens the integrity of sport hunting. Undoubtedly, recent national media attention has heightened the controversy over illegal waterfowl harvest. Thus, we believe a timely and essential endeavor is to summarize what is known about illegal waterfowl harvest and propose a course of action to combat the problem.

Illegal harvest of waterfowl has been documented in law-enforcement records for as long as there have been regulations controlling harvest. However, these data generally are not consolidated and organized to facilitate an efficient and accurate assessment of illegal harvest (U.S. Fish and Wildlife Service 1988). A review of the literature revealed that illegal waterfowl harvest and illicit behavior of hunters have been documented through observation and surveys of waterfowl hunters. The following review is organized accordingly.

Hunter-observation Studies

The relationship between waterfowl hunters and illegal activity has been the subject of several hunter performance studies in the United States and Canada between 1965–1984. In these studies, hunters were observed using the "spy-blind" technique (Carney and Smart 1964), with the observers either posing as hunters or remaining hidden from the observed.

While hunter observations reveal a greater number and incidence of violations than do hunter bag or field checks, hunting violations recorded from spy-blinds must be regarded as the minimal number that occur (Kimball 1972, Nieman et al. 1987). Observers generally cannot relate specific infractions or bagged birds to individual hunters within a hunting party. Therefore, only the behavior of the hunting party can be recorded, and only when the party exceeds the total limit for the group can overharvest be documented. Consequently, the actual occurrence of individual's violation(s) will be underestimated. Hunter observations also cannot account for "double-tripping" (i.e., hunting twice in one day and exceeding the bag limit), hunting without proper licenses or waterfowl stamps, using lead shot, and hunting over bait. Additionally, most hunter observations were conducted on public hunting areas during the legal hunting season, which do not account for violations on private property or those occurring on public and private lands outside legal hunting periods. Moreover, available information suggests that waterfowl violations are less likely to occur on public hunting grounds (Jackson et al. 1979, Hall 1987). Despite these limitations, hunter-observation studies provide most of the data on illegal hunting (Martin and Carney 1977).

Caution must be exercised in making geographic comparisons of data from hunter observations for the following reasons: (1) observer skill is highly variable (Martin and Carney 1977), (2) hunting parties and areas may not be chosen randomly (Martin and Carney 1977), (3) sample sizes vary substantially among studies (Geis and Crissey 1973) and (4) the duration of hunt observed is variable. Therefore, we will not compare violation data geographically or temporally.

Incidence and Types of Violations

Regulations controlling waterfowl harvest fall into 2 categories: fixed-limit and point-system (the former restricts a hunter to a fixed number of birds per day; the latter allows a hunter to harvest ducks of different point value until a bird is harvested that causes a daily total to equal or exceed generally 100 points [see Hopper et al. 1975]). Overall, violation percentages appear similar between fixed-limit and point-system regulations, averaging 14 percent and 16 percent, respectively (Table 1). In descending order of occurrence, common violations recorded during hunter-observations include shooting outside legal hours, overbagging or attempting to do so, discarding birds, shooting at protected game and nongame, and failing to retrieve downed birds. The various hunter-observation studies were designed and conducted for different purposes and, except for overharvest, the same violations were not always quantified among studies. Thus, overharvest will be the only specific violation we will attempt to summarize.

Overharvest

Overharvest of waterfowl can be affected by type of regulation. As mentioned previously, waterfowl harvest regulations can be categorized into either fixed-limit or point-system regulations. Hence, our review of overharvest will be presented relative to fixed-limit and point-system regulations.

Fixed-limit regulations. Fixed-limit regulations either allow harvest of a set number of birds, regardless of species, or a set number of birds which cannot include more than a fixed number of a certain species and/or sex. Fixed-limit regulations containing species restrictions require hunters to identify birds on the wing to avoid specific

Table 1. Violation statistics from hunter-performance studies conducted in the United States and Canada, 1965–84.

Regulations	Percentage of parties: N[a]	Percentage of parties: Violating	Percentage of parties: Overharvesting	Percentage (N) of parties attempting to overharvest after reaching bag limit	Reference(s)
Fixed limit					
With species restrictions[b]	844	13	4	c	Kaczynski 1967
	45	82	c	c	Sorensen and Bossenmaier 1968
	230	c	7	42 (36)	Kimball 1969
	46	33	20	38 (10)	Mikula et al. 1972
Without restrictions[d]	79	18	8	27 (8)	Mikula et al. 1972
	157	12	2	c	Hopper et al. 1975
	2,297[e]	12[f]	3	≥50 (≥68)	Nieman et al. 1987
Weighted average		14	4	≥44	
Point system	228	19	6	c	Hopper et al. 1975
	129	16	6	22 (9)	Mikula et al. 1972
	1,153	18	3	c	Geis and Crissey 1973,
	939	14	3	18 (41)	Kimball et al. 1971
Weighted average		16	3	19	Kimball 1972
Overall weighted average		15	4	≥31	

[a]Number of hunting parties observed.
[b]Regulations include species restrictions of 0 or one bird limits.
[c]Unable to calculate from available data.
[d]Regulations without restrictions of 0 or one bird limits.
[e]N = Number of hunters observed.
[f]Violation rate (number of violations/number of hunters observed).

bag-limit violations, while fixed-limit regulations without species restrictions do not. Consequently, unintentional overharvest of a certain species or sex of duck could occur under fixed-limit regulations with restrictions.

Several hunter-observation studies that monitored hunter compliance with species restrictions have been conducted (Table 1). During the first 10 days of the 1967 duck season in southern Manitoba, mallards (*Anas platyrhynchos*) were not permitted in the bag. Nonetheless, Sorensen and Bossenmaier (1968) estimated that at least 82 percent of the parties under observation fired upon mallards in range. During the special teal-only seasons of 1965–67 and 1969 in the Mississippi and Central flyways of the United States, Kimball (1970) reported that nearly 15 percent of the observed parties killed ducks other than teal. A daily limit of one mallard was in effect in the Central and Mississippi flyways during the 1965 and 1968 hunting seasons in the United States. Kimball (1969) reported that 7 percent of the observed parties exceeded the one-mallard limit and 42 percent of the parties that attained their one-mallard limit attempted to shoot additional mallards. Mikula et al. (1972) observed the behavior of hunting parties in Michigan in 1969 in relation to flyway regulations, which included a one-mallard limit as part of a daily bag of four birds. Thirty-eight percent of the parties that attained their bag limits attempted to overharvest, but all attempts were associated with the one-mallard limit and not the total bag limit. Mikula et al. (1972) reported that 20 percent of the parties actually exceeded the one-mallard limit. Kaczynski (1967) reported that 4 percent of the parties observed shooting at waterfowl during the 1965 and 1966 seasons in the United States exceeded the bag limits. A portion of these observations were conducted in the Central and Mississippi flyways where a one-mallard limit was in effect in 1965. Unfortunately, the data were not summarized by regulation or flyway, so inferences could not be made with respect to regulation compliance.

These studies reported relatively high noncompliance with special regulations, but it is not known if noncompliance was intentional or inadvertent. Numerous studies indicate that hunters have difficulty identifying waterfowl on the wing or even in hand (Sorensen and Bossenmaier 1968, Evrard 1970, Kimball 1970, Hochbaum and Caldwell 1977, Nieman et al. 1987). Consequently, some violators may have unknowingly shot at protected or restricted birds. Therefore, the only way an observer can ascertain that the party has intentionally overharvested is after the total daily limit, inclusive of special restrictions, is obtained for all party members.

Observational studies conducted under fixed-bag limits containing no restrictions or under the point system provide improved data to estimate intentional overharvest, because hunters do not have to identify birds until retrieved. Mikula et al. (1972) reported that about 8 percent of observed Michigan parties overharvested a 1969 experimental daily limit of two ducks of any species or sex, and 27 percent of the parties attaining their limits attempted to overharvest. Nieman et al. (1987) reported that an average of 3 percent of the hunters observed in Manitoba, Saskatchewan and Alberta overharvested during stabilized regulations (1979–1984), but more than 50 percent of the parties that attained limits attempted to overharvest. Hopper et al. (1975) reported that only 2 percent of the parties observed during experimental Colorado seasons in 1965–67 overharvested; however, they did not indicate the percentage of parties that attempted to overharvest after attaining their limit.

Point-system regulations. Point-system regulations virtually eliminate accidental violations (Martin and Carney 1977). Except for Jackson et al. (1979) (see also

Jackson and Norton 1978), other studies monitoring hunter compliance with point-system regulations were conducted while the point system was experimental. Jackson and Norton (1978) reported that 20 percent of the parties under observation violated various laws, including waterfowl regulations, trespass, boating and littering. However, percentages of hunters that overharvested or attempted to overharvest were not reported. Kimball (1972) and Hopper et al. (1975) created a category for estimating the maximum potential for overharvest under the point-system, labeling it ''parties in which overharvest could have occurred.'' Using this system, when the point total achieved by a party of two or more hunters exceeded the point limit for one hunter in the party, the party was marked for potential point-limit violation. Because the concept of potential point-limit violation could lead to erroneous conclusions, Martin and Carney (1977) felt its usefulness was limited. Consequently, only those hunter-parties exceeding the cumulative point total allowable for the entire party will be considered in violation herein, resulting in a conservative estimate of overall violation occurrence and overharvest.

The percentage of parties overharvesting under the point system was similar to those doing so under fixed-bag limits (3 percent versus 4 percent, respectively) (Table 1). Hopper et al. (1975) and Mikula et al. (1972) reported that 6 percent of the observed parties overharvested in Colorado and Michigan, respectively, while Geis and Crissey (1973) and Kimball (1972) reported that 3 percent of the parties observed throughout the United States overharvested. Only Kimball (1972) and Mikula et al. (1972) reported data from which to estimate the percentage of parties attempting to overharvest after reaching their bag limit (Table 1). While considerable differences appear to exist between fixed-bag limit and point-system regulations, with regard to parties attempting to overharvest (≥ 44 percent versus 19 percent, respectively), these differences could be due to sampling (i.e., variation in observer skill, duration of hunt observed, or choice of observation area).

Violation and Opportunity

Violations of waterfowl hunting regulations generally cannot occur unless hunters have the opportunity to shoot at birds (Jackson et al. 1979). While the reported percentage of parties overharvesting appears relatively low, it cannot be concluded from Table 1 that only 3–4 percent of waterfowl hunters are capable of overharvesting. A more realistic estimate of the percentage of hunters capable of overharvesting would be the percentage of parties with an opportunity to overharvest that attempted to do so. Only Kimball (1969) reported information from which to calculate this estimate, reporting that 73 percent of the parties with the opportunity to harvest more than their limit of mallards attempted to do so.

Kimball (1969) and Martin and Carney (1977) felt that sharply reducing the limit on a common and desirable bird within the bag severely stresses the ability and willingness of hunters to comply with regulations. They based their conclusion on observed reductions in overharvest, with changes from complete closure on the mallard to a one- and then a two-mallard limit. Indeed, Kimball (1970) showed that 10 percent of the parties under a one-mallard limit killed illegal ducks while only 3 percent did under the two-mallard limit. We offer an alternative explanation: as bag limits increase, the likelihood of achieving the bag limit decreases and consequently so too does the opportunity to overharvest.

Hunter Surveys

In 1974, the National Waterfowl Hunter Survey was initiated for the U.S. Fish and Wildlife Service. It sampled 6,000 federal duck stamp purchasers. This 43-page mail survey was a pretest to facilitate selection of questions for a proposed larger survey. Of the 3,600 respondents, 70 percent admitted to party-hunting (individuals shooting over their limit to help other party members obtain their limits) and 48 percent to shooting outside legal hours (Smith and Roberts 1976, USFWS-Office of Migratory Bird Management files). Additionally, 39 percent of the respondents in this study admitted to violating bag limits, which was similar to the overall percentage of observed hunters attempting to overharvest after attaining their bag limits ($\geq$31 percent, Table 1). Unfortunately, the full-scale study was not conducted.

To our knowledge, Jackson et al. (1979) (also see Jackson and Norton 1978) have conducted the only other waterfowl hunter survey involving illicit behavior. This study used hunter observations, followed by in-home interviews with 76 percent ($N=442$) of the observed hunters. Forty-six percent of those interviewed admitted to violating game-related regulations—such as shooting outside legal hours, overbagging, shooting at protected species and failing to retrieve downed birds—intentionally (Jackson and Norton 1978); but the frequencies of these violations were not summarized. Their data consistently indicated that hunting violations were strongly related to opportunity to shoot.

Conclusions

A review of the available literature suggested that illegal harvest and illicit behavior were related to shooting opportunity. Although most information on illegal harvest came from hunter-observation studies (which inherently underestimate violation rate and overharvest), these studies suggested that the majority of waterfowl hunters were capable of violating. However, the proportion of waterfowl hunters that actually violate, what types of violations they commit, how frequently they violate and what proportion of the total kill is taken illegally remain unknown.

Because hunter-observation studies measure behavior but not attitudes, beliefs and attributes of hunters, knowledge of illicit behavior is limited to incidence of occurrence. Equally important in knowing the extent of illegal harvest is knowing who is responsible for it, why they do it and what would make them stop. This information is necessary to design educational and enforcement programs to reduce illegal waterfowl harvest. Unlike hunter-observation studies, hunter surveys can sample a representative portion of all waterfowl hunters, including those who hunt on private property and outside legal hunting frameworks. We are developing a waterfowl hunter survey for waterfowl hunters of the Mississippi Flyway to estimate the extent of illegal harvest and illicit behavior, as well as elucidate socioeconomic characteristics of violators, why they violate and what would deter them from doing so.

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The Relationship of Enforcement, Courts and Sentencing to Compliance with Waterfowl Hunting Regulations

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Introduction

Reasonable compliance with hunting regulations has always been important for maintaining an adequate "breeding stock" to perpetuate waterfowl for future generations. However, current all time low populations, severe drought, and destruction of nesting and wintering habitat have served to emphasize the importance of law enforcement, court sentencing and education to maximize hunter compliance with game laws. Not enough is known, however, about the effective use of these tools. As stated by Purol and Gustafson (1986:1) "Shortcomings in an analysis of penalties are the lack of information about violator's views of the severity of penalties." Many authorities have contended that wildlife law enforcement today remains the least researched and least understood of the management functions (Giles 1971, Beattie et al. 1977a, Bavin 1978, and Hall 1987).

Review of the Literature

Laws that Charles Darwin discussed in *The Origin of the Species* were laws of nature, not man. "Yet it can hardly be doubted that the laws of man have also had a major impact on the tangled bank of life that Darwin described" (Bean 1983:1). Unquestionably, laws and their enforcement have had a major role in determining the rate of drain upon our natural resources and will continue to have such a role in the years ahead.

The American judicial system was founded upon the principle that law violators are punished to protect the public's interest, thereby promoting respect for the law while affording adequate deterrence to others, and also providing the convicted with the most effective correctional treatment. While society has upheld this system when applied to murderers, rapists and robbers, a comparable support has not yet developed toward wildlife law violators.

Borelli (1988:2) said, "That a professional poacher can achieve the status of a folk hero demonstrates the resilience of the frontier myth and our ingrained antagonism toward game laws.'' The social acceptance of wildlife crime in North America was partially a result of many years of harsh and cruel punishment of poachers in Europe and also a willingness to justify these behaviors in the name of subsistence. As the traditions of sport hunting developed, so did rationalizations for violating fish and wildlife laws. Smith and Roberts (1976:192) concluded, ''Undoubtedly, imposed rules [waterfowl regulations] that run contrary to traditions will be met with resistance.''

Acheson (1975) warned about the danger of disrupting traditions without fully understanding the nature and strength of these traditions. Smith and Roberts (1976:188) said, ''Over the years most management decisions concerning migratory birds have been made by specialists who devote entire careers to the study of birds. Much less time has been devoted to understanding people who utilize the resource.'' The time has come for managers to examine why these laws are not effective, because, as Erickson (1988:10) said, ''No matter how tireless the endeavor [wildlife management], most plans, studies, and efforts come down to the enforcement of laws to make them work.''

Regulatory Compliance

The success of other management functions relies upon maximum hunter compliance with waterfowl regulations. Since the enactment of the Migratory Bird Treaty Act in 1918, agents have consistently suggested that regulatory compliance and illegal harvest are major management issues (Hall 1987). In support of this assertion, numerous studies have documented the extent of non-compliance. In 1974 the U.S. Fish and Wildlife Service initiated a National Waterfowl Hunter Survey. Of the 3,600 respondents, 70 percent admitted to party hunting, and 48 percent to shooting before and after legal hours (Smith and Roberts 1976). Additionally, 39 percent admitted to violating bag limits. Similarly, 41 percent of the hunters observed by U.S. Fish and Wildlife agents during 200 undercover hunts on the Gulf coast of Texas over three successive hunting seasons took waterfowl in excess of daily limits (Gavitt 1988).

Over 600 waterfowl hunts were observed from spy blinds by retired game wardens and trained student observers in Wisconsin over two seasons (Jackson and Norton 1978). The researchers reported that 20 percent of the hunters broke a game law on the day of the hunt. Forty-six percent of the duck hunters interviewed in their homes after the seasons admitted to intentionally violating waterfowl regulations, and 85 percent answered ''yes'' to the question, ''Do you ever violate game laws?'' Smith and Roberts (1976:191) reported that ''66 percent of hunters indicated that they did not think violations of regulations were necessarily an indication of poor sportsmanship.'' Violations of waterfowl hunting etiquette were judged by hunters to be more serious than some violations of hunting laws.

In their final environmental statements for the issuance of annual regulations permitting the sport hunting of migratory birds, Greenwalt (1975) and Dunkel (1988) both expressed the need for more information on regulatory compliance and illegal harvest. The importance of this deficit was pointed out over 30 years ago when Day (1948:77) stated, ''We find ourselves with wholly inadequate information on the waterfowl kills and cripple loss each year. I hope this can be improved because it is something that is urgently needed in the over-all waterfowl management picture.''

Prosecution of Violators

Court decisions and sentences reflect societal attitudes about hunter behavior. Kelley (1962:6) said "that a game-law violator is a thief, but most courts still view conservation law infractions as minor irritants rather than crimes against people." Ortega (1988:b1) quoted a federal judge in Alaska during sentencing of a defendant for illegally taking a brown bear: "In my mind these offenses are no more serious than a moderate traffic offense, like speeding." Marshall (1989:c8) stated on this issue, "Judges who take a casual view of game and fish laws send a message to those inclined to violate the laws . . . it is worth the risk." Kelly (1952:2) agreed, "Jurists that fail to give game laws the consideration they merit, by their attitude on and off the bench actually encourage violations."

The assignment of low priority to game and fish cases by some courts is changing slowly. Describing a number of hallmark wildlife cases and record penalties, Weiss (1981:19) said, "Poachers are beginning to find themselves confronted with such stiff financial and jail sentences that they may soon think twice about stealing game." Purol and Gustafson (1986) conducted a survey of wildlife enforcement administrators on the effectiveness of penalty increases in deterring poaching. Most administrators (75 percent) reported that penalty increases are important in reducing fish and game violations. Purol and Gustafson (1986) concluded that a need exists to understand violator assessment of risks and rewards that would influence a reduction in poaching incidents. Beattie et al. (1977b), however, pointed out that imposing relatively severe penalties will probably not have discernible deterrent effects without a certainty of imposition.

Waterfowl Hunter Compliance Study

Methods

Before expressing their own recommendations on how to improve hunter compliance with game regulations, the authors felt it important to study the opinions and judgments of a sample of the Mississippi Flyway's conservation officers and waterfowl hunters. It was deemed necessary not only to validate the findings and assertions cited in the literature review, but also to elicit additional hypotheses and suggest new directions for further research and discussion.

Administrative officers in the enforcement division of three state natural resource departments agreed to cooperate in conducting a survey of their field officers (Louisiana, Minnesota and Wisconsin). In each state a questionnaire was sent to field officers through administrative channels along with a letter of explanation. The percentage of conservation officers (C.O.s) responding was 86 percent for Louisiana, 83 percent for Minnesota, and 69 percent for Wisconsin. The lower response rate for Wisconsin resulted when the questionnaires were sent to all wardens with the assumption that only those who felt they were significantly involved with waterfowl enforcement would actually respond. In the other two states, administrators made those selections (based on level of involvement) prior to distribution. Administrators in all states indicated that the relatively high level of response from extremely busy field personnel (fall hunting season) reflected great interest and concern for their enforcement duties connected with waterfowl hunting.

Because the investigators specifically wanted to obtain the opinions of experienced and committed duck hunters concerning compliance, leaders in state waterfowl organizations in the three states were also contacted. In the opinion of the researchers, joining such an organization indicated a significant interest in duck hunting and commitment to the waterfowl resource. Associations in Minnesota and Wisconsin agreed to cooperate by providing a random sample of their membership. A (100 percent) sample was used for the much smaller association in Louisiana. While the Minnesota group conducted its own mailing, the researchers initiated the survey in Wisconsin and Louisiana. Also, in Louisiana a 20 percent random sample was taken from the waterfowl lessees of two large land corporations in the southern coastal marshes, one in the southwestern and the other in the southeastern area of the state. The size of the original sample and percentage of response for each state was as follows: Louisiana: $N = 191$ (64 percent); Minnesota: $N = 200$ (48 percent); and Wisconsin: $N = 152$ (78 percent).

Finally, researchers obtained the names and addresses of individuals who had been convicted of serious violations of duck hunting regulations during the 1986 or 1987 seasons from the public record. Based on a consensus of enforcement administrators in the three states, ''serious violations'' were defined as follows: hunting during closed seasons, shooting over the bag limit, possession over daily bag or possession limits, hunting in a refuge or closed area, shooting protected species, and hunting over a baited area.

The letter of explanation and questionnaire sent to known violators was identical to those employed for the survey of waterfowl association members. No mention was made that investigators had knowledge of the convictions. The response rate to these mailings ranged from 33 percent for Minnesota to 42 percent for Wisconsin, to 44 percent for Louisiana violators. Additional contacts were made with Wisconsin hunters; two specially trained graduate students conducted phone interviews with violators. The questionnaires were open ended and dealt candidly with the fact that the respondents were convicted violators. Of the 52 hunters convicted of serious violations in Wisconsin (1987), telephone and personal interviews were conducted with 31 (60 percent). The interviewers generally reported a good attitude and willingness to cooperate among these subjects, in sharp contrast to the low percentage of response to the mailed survey. Time and budget were the only constraining factors; only one individual actually refused to be interviewed. It should be noted that this research was entirely funded by contributions from duck hunters.

Results

The bulk of the survey focused on questions employing Likkert scales, where respondents were asked to indicate their ratings on a continuum of 1 to 5 (low to high). The first of these questions asked the individual to assess the seriousness of a series of problems affecting duck hunting and the waterfowl resource. As can be seen in Table 1, conservation officers from all three states rated hunting before or after hours as the most serious of the 19 problems listed. There was general agreement from state to state on other top-ranked problems, including killing over the bag limit, taking shots beyond effective range, group bag, and double or triple tripping. Louisiana officers ranked two problems highest: baiting ducks with corn or other food, and poaching. In contrast, wardens from the two northern states saw failure in skill

Table 1. Ranking and mean ratings of conservation officer assessing the seriousness of problems affecting duck hunting and duck resource.

Categories	LA	MN	WI
Hunting before or after hours	(1) 4.44	(1) 4.15	(1) 4.36
Killing over the bag limit	(2) 4.26	(3) 3.67	(3) 4.21
Taking shots beyond effective range (skybusting)	(3) 4.02	(2) 3.86	(5) 3.97
Group bag (hunting for the party)	(4) 3.95	(4) 3.63	(7) 3.74
Double or triple tripping (taking a limit and returning to the field to take more ducks	(5) 3.81	(5) 3.61	(2) 4.24
Baiting ducks with corn or other food	(6) 3.77	(16) 2.38	(12) 3.35
Poaching (out of season; nights, etc.)	(7) 3.60	(15) 2.59	(14) 3.09
Number of ducks lost to cripping and not retrieved	(8) 3.59	(6) 3.43	(4) 3.99
Littering or other environmental violations	(9) 3.47	(13) 2.83	(15) 2.66
Shooting protected species	(10) 3.40	(9) 3.17	(9) 3.50
Failure in skill (or effort) to make adequate retrieval of cripples	(10) 3.40	(7) 3.36	(6) 3.88
Shooting illegal ducks and letting them lay or burying them	(12) 3.38	(10) 3.14	(8) 3.59
Continued use of lead shot	(13) 3.09	(12) 2.86	(11) 3.47
Lack of practice and poor marksmanship	(14) 3.33	(8) 3.21	(9) 3.50
Crowding, lack of consideration by other hunters	(15) 3.02	(11) 3.07	(13) 3.21
Usage of alcohol while or around hunting	(16) 2.98	(16) 2.38	(19) 1.35
Failure to seek permission of landowners	(17) 2.77	(14) 2.66	(17) 2.46
Taking migratory ducks for sale to others	(18) 2.74	(19) 1.77	(16) 2.48
Hunting accidents and unsafe gun handling	(19) 2.41	(18) 2.28	(18) 2.32

or effort to make adequate retrieval of cripples, and lack of practice and poor marksmanship, as more serious based on comparative rankings.

In responding to the same Likkert scales given to the conservation officer, hunters expressed their own unique views about the seriousness of problems affecting their sport (Table 2). Taking shots beyond effective range was ranked first by both hunters from Louisiana and Wisconsin and placed second by Minnesotans. Of the top seven factors ranked by Louisiana sportsmen (skybusting, killing over the bag limit, failure to retrieve, littering, ducks lost to crippling, baiting, and hunting before and after hours), six were found in the top seven for Minnesota hunters and five factors among the top-ranked problems for the Wisconsin waterfowlers. A comparable consistency can be noted at the bottom of the ranking: hunting accidents and unsafe gun handling were ranked lowest in all three states, and generally low ratings were given to taking migratory ducks for sale to others.

Inconsistencies among the hunting groups and between officers and hunters are of particular interest. As did their conservation officers, Louisiana hunters, for example, gave higher importance ranking to baiting and poaching than did their northern counterparts. In contrast, crowding, ranked fourth in both Minnesota and Wisconsin, received a ranking of ten from Louisiana waterfowlers and a mean rating below 3.0.

One particular issue suggested by this research is the contrast between conservation officers and hunters in their ratings for group bag (party hunting). This problem was ranked 4th by wardens in two states and 7th in the third. In contrast, hunters in the

Table 2. Ranking and mean ratings by duck hunters assessing the seriousness of problems affecting duck hunting and the duck resource.

Categories	LA	MN	WI
Taking shots beyond effective range (skybusting)	(1) 3.61	(2) 3.90	(1) 4.18
Killing over bag limit	(2) 3.58	(1) 3.94	(5) 3.43
Failure in skill (or effort) ot make adequate retrieval of cripples	(3) 3.34	(6) 3.46	(3) 3.74
Littering or other environmental violations	(4) 3.28	(6) 3.46	(8) 3.25
Number of ducks lost to crippling and retrieved	(5) 3.18	(5) 3.53	(2) 3.82
Baiting ducks with corn or orther food	(6) 3.18	(13) 2.98	(16) 2.60
Hunting before or after hours	(7) 3.02	(3) 3.70	(6) 3.33
Poaching (out of season; nights, etc.)	(8) 3.01	(11) 3.26	(13) 2.94
Double or triple tripping (taking a limit and returning to the field to take more ducks	(9) 2.96	(6) 3.46	(9) 3.18
Crowding, lack of consideration by other hunters	(10) 2.94	(4) 3.60	(4) 3.56
Shooting protected species	(11) 2.93	(9) 3.44	(12) 3.04
Group bag (hunting for the party)	(12) 2.83	(18) 2.58	(18) 2.46
Failure to seek permission of landowners	(13) 2.79	(11) 3.26	(10) 3.15
Lack of practice and poor marksmanship	(14) 2.73	(13) 2.98	(11) 3.11
Shooting liilegal ducks and letting them lay or burying them	(15) 2.67	(10) 3.31	(7) 3.29
Usage of alcohol while or around hunting	(16) 2.35	(15) 2.95	(16) 2.60
Continued use of lead shot	(17) 2.29	(16) 2.94	(14) 2.69
Taking migratory ducks for sale to other	(18) 2.22	(17) 2.71	(17) 2.55
Hunting accidents and unsafe gun handling	(19) 2.17	(19) 2.50	(19) 2.20

two northern states ranked it 18th of 19 factors and Louisiana ranked it as 12th. Comparably, hunters ranked continued use of lead shot below that of the conservation officers in all three of the states.

The second major question asked the respondents to rate the relative effectiveness of 23 different factors that could affect compliance with duck hunting regulations. Items ranged from the nature of duck hunting regulations through various forms of punishment to educational programming. As Table 3 indicates, certain factors were uniformly endorsed by the conservation officers. For example, seizure and forfeiture of equipment was ranked first in both Louisiana and Minnesota and placed 3rd on the Wisconsin officer's list. Other factors consistently top-rated by officers in the three states were: efforts concentrating on enforcement of those violations having the greatest influence on the resource, credibility and professionalism of local enforcement officers, and enforceability of regulations. Louisiana and Minnesota officers ranked 6-months jail time (6th) much higher than Wisconsin agents (12th), while wardens in both the northern states gave much lower ratings to 200 hours of community service (17th) and publication of the names of violators in local papers (15th) than did Louisiana officers. This state ranked these two items 4th and 5th.

Analysis of the responses of waterfowl association members to the scales rating the effectiveness of compliance were consistent with many of the evaluations made by the officers (Table 4). Seizure and forfeiture of equipment was ranked first by

Table 3. Ranking and mean ratings by conservation officers of the relative effectiveness of selected factors in improving compliance with duck hunting regulations.

Categories	LA	MN	WI
Seizure and confiscation of equipment	(1) 4.81	(1) 4.10	(3) 4.20
5-year license revocation (all hunting)	(2) 4.62	(9) 3.79	(2) 4.31
Efforts concentrating on enforcement of those violations having the greatest influence on the resource	(3) 4.51	(2) 4.09	(1) 4.32
200 hours of community service	(4) 4.33	(17) 3.39	(17) 3.46
Publication in local papers of names of violators and their crimes	(5) 4.32	(15) 3.50	(15) 3.59
6 months in jail	(6) 4.29	(6) 3.84	(12) 3.80
Credibility and professionalism of local enforcement offier	(7) 4.28	(2) 4.09	(7) 4.13
Enforceability of regulation	(7) 4.28	(4) 3.98	(5) 4.15
2 years of active probation (monthly reporting to probation officer)	(9) 4.21	(21) 2.88	(20) 3.04
Swiftness and sureness of court action	(10) 4.19	(12) 3.69	(11) 3.83
Simplified and understandable regualtions	(11) 3.95	(6) 3.84	(9) 3.87
Actions of local D.A. and judge in terms of fairness	(12) 3.85	(13) 3.65	(8) 3.90
1-year license revocation (all hunting)	(13) 3.83	(10) 3.73	(3) 4.20
Hunter knowledge and acceptance of regulations	(14) 3.76	(8) 3.83	(6) 4.15
Fairness of applicability of regulations	(15) 3.75	(11) 3.71	(10) 3.84
Uniformity of enforcement statewide	(16) 3.72	(14) 3.51	(14) 3.72
1 to 10 days in jail	(17) 3.71	(5) 3.85	(13) 3.74
40 hours of community service	(18) 3.67	(18) 3.32	(18) 3.19
Personal embarrassment from peers	(19) 3.62	(16) 3.42	(16) 3.58
Active involvement by hunter in wildlife management activities	(20) 3.57	(20) 3.04	(21) 2.88
Manadtory video interviews with agents as part of punishment	(21) 3.19	(22) 2.56	(22) 2.63
2 years of inactive probation (no report to P.O.)	(22) 2.22	(23) 2.09	(23) 2.33
High visibility profile of enforcement (seeing a lot of uniforms or cars)	(23) 2.17	(19) 3.19	(19) 3.07

Minnesota hunters and second by Wisconsin hunters. Five-year license revocation, enforceability of the regulations, and concentrating enforcement efforts on violations having the greatest influence on the resource were consistently supported by all groups. Violators and respondents who wrote notes on the survey instrument frequently were critical of the complexity of the waterfowl hunting regulations. Many respondents stated that complicated regulations "made violators" of them. One hunter pleaded, "Please don't legislate all the fun out of duck hunting!"

The differences between the states were more striking for compliance rankings than for the assessment of problems. Publications of names in local papers was ranked 3rd by Louisiana hunters, compared to 11th and 12th by the two northern states. Actions of the local district attorney and judge in terms of fairness and two years of active probation were perceived to be far more important by Louisianians.

Table 4. Ranking and mean ratings by duck hunters of the relative effectiveness of selected factors in improving compliance with duck hunting regulations.

Categories	LA	MN	WI
Credibility and professionalism of local enforcement officers	(1) 4.12	(4) 3.90	(6) 3.88
5-year license revocation (all hunting)	(2) 4.09	(5) 3.89	(3) 4.05
Publication in local papers of names of violators and their crimes	(3) 4.06	(11) 3.72	(12) 3.66
Enforceability of regulations	(4) 4.03	(7) 3.87	(5) 3.90
Efforts concentrating on enforcement of those violations having the greatest influence on the resource	(5) 4.00	(2) 4.04	(1) 4.15
Seizure and confiscation of equipment	(6) 3.92	(1) 4.08	(2) 4.11
Actions of local D.A. and judge in terms of fairness	(7) 3.90	(20) 3.35	(18) 3.37
Hunter knowledge and acceptance of regulations	(8) 3.89	(9) 3.77	(7) 3.87
200 hours of community service	(9) 3.87	(9) 3.77	(11) 3.71
Simplified and understandable regulations	(10) 3.84	(18) 3.46	(8) 3.82
Swiftness and sureness of court actions	(10) 3.48	(11) 3.72	(12) 3.66
Fairness of applicability of regulations	(12) 3.80	(19) 3.39	(15) 3.54
High visiblity profile of enforcement (seeing a lot of uniforms or cars)	(13) 3.75	(2) 4.04	(16) 3.45
2 years of active probation (monthly reporting to probation officer)	(14) 3.73	(21) 3.29	(21) 3.13
40 hours of community service	(15) 3.69	(8) 3.81	(9) 3.75
1-year license revocation (all hunting)	(16) 3.65	(14) 3.65	(10) 3.72
6 months in jail	(17) 3.64	(17) 3.50	(19) 3.34
Uniformity of enforcement statewide	(18) 3.62	(16) 3.51	(14) 3.64
Active involvement by hunger in wildlife management activities	(19) 3.58	(6) 3.88	(4) 3.98
Personal embarrassment from peers	(20) 3.57	(13) 3.68	(17) 3.39
1 to 10 days in jail	(21) 3.35	(15) 3.54	(20) 3.31
Mandatory video interviews with agents as part of punishment	(22) 2.95	(22) 2.93	(22) 2.84
2 years of inactive probation (no report to probation officer)	(23) 2.42	(23) 2.67	(23) 2.45

In contrast, Minnesota and Wisconsin hunters rated 40 hours of community service and active involvement by the hunter in wildlife management activities more effective in creating compliance than did Louisiana waterfowlers. This "active involvement" factor, it should be noted, was ranked very low by conservation officers in all three states.

Convicted violators, however, gave a very high rank to active involvement in wildlife management activities. This factors was rated second, fourth and sixth by Minnesota, Wisconsin, and Louisiana violators, respectively.

In a similar vein, hunters from two states put 40 hours of community service in the top half while wardens from all three states ranked it in the bottom fourth. Finally, it should be noted that six months in jail was much more popular with the conservation officers than with the hunters. Some hunters who rated it low noted that six months in jail was appropriate only for very serious violations or repeat offenders. Wardens tended, of course, to put the more severe punishments near the top of their rankings, while hunters put theirs in the lower half. One exception was the quite uniform high evaluation given a five-year revocation of license. As one violator put it in his interview, "Revocation hurts me and me alone, but a fine or a jail sentence hurts everyone in my family."

Waterfowl hunters selected for this survey also rated the temptation to violate offered by different management or hunting conditions. Duck hunters in the three states said their greatest temptation to violate was because of a perception that more ducks were being killed elsewhere. Minnesota and Wisconsin hunters rationalized violations because "the majority of ducks are being killed in the southern wintering grounds," while Louisiana hunters believed that "there is a much greater kill in Mexico." Louisianians strongly believe, as one hunter said, "What I'm taking makes no difference because they are being slaughtered by the millions in Mexico." Hunters indicated that this rationale resulted from seeing advertisements and photos in outdoor magazines and sportsmen's shows and from communications with hunters who have shot ducks in Mexico.

Hunters generally indicated a need for increased waterfowl law enforcement, believed most duck hunters will at times violate some regulation, expected to see more wardens in the field, were concerned about fairness of enforcement, and wanted more simplistic regulations and increased hunter awareness and education. Hunters in each state rated waterfowl law enforcement effectiveness below that of the wardens.

Duck hunters surveyed in this study demonstrated their intense interest in the sport in response to a question about not being able to hunt next season. Over 80 percent of the hunters in the three states said they would either miss duck hunting more than *most* or *all* other interests. They expressed their concern for the health of the resource in many ways. Evidence of this could be seen in the notes and letters attached to questionnaires, and in the oral comments of those interviewed. Hunters contacted in these surveys expressed a high level of agreement with a statement in the questionnaire, "I predict a gradual decline in the duck resource, habitat, bag limits and hunting opportunities" (top ranked in all states). Hunters from all three states gave a lower mean rating to the more positive statement, "I predict a continuation of duck hunting for the foreseeable future with improve habitat, and with hunters evidencing better personal compliance and policing of violators among their own ranks" (ranked 3rd in all states).

Discussion and Recommendations

Both conservation officers and hunters in three states have the lowest ranking to the very problem that in the late nineteenth century was considered the greatest threat to North America's duck population—declining populations from sale of ducks (market hunting). Market hunting motivated Congress to enact the Lacey Act in 1900 and the Migratory Bird Treaty Act in 1918. Although the destruction of wetland habitat is currently the greatest threat to waterfowl populations, we must take a lesson from the past. Actions to reduce violations of recreational hunting regulations can be as effective as those that limited commercial hunting.

Regulations and Enforcement

Conservation officers were typically quick to point out that one of the first criteria of a good regulation should be, "Is it enforceable?" A corollary is an assessment of hunter understanding and acceptance of the law. Officers wrote and spoke to us of the complexity of both the regulations and duck identification. Some were candid and admitted difficulty in identifying ducks and expressed a reluctance to check duck hunters because of this. Frustration in mastering the nuances of the complex regulations governing the sport was also frequently cited. We noted the consistent high ratings given to these two factors by C.O.s, duck hunters and violators. Comparably high ratings were also given to the need to simplify and develop understandable regulations. Fairness and uniformity of enforcement, in contrast, were rated relatively low.

A Wisconsin agent pointed out that he could cite almost every hunter he observed when he worked from a spy blind for a reasonable length of time. Hunters, aware of that, pointed out that when they saw an officer approaching or waiting at a landing, they had an anxiety attack wondering, "Well, what did I do?" We heard this from people who did not dare to violate, one a member of the governing board of the state agency. Serious duck hunters among the C.O.s admitted they went to Canada to hunt ducks because they feared making a mistake in their own state. In particular, hunters told us that the point system "made" violators of them. Apparently the temptation to reorder ducks was just too great.

Agents want more waterfowl law enforcement training; this should include, they suggested simulates spy blind surveillance investigations; waterfowl identification; and investigations of baiting violations and other illegal practices. Some expressed interests in assignments to taskforce details to other states. Indiana, Minnesota and Wisconsin, for example, have offered special in-service training on waterfowl enforcement to some of their wardens during recent years.

Agents from all states wanted more equipment for waterfowl enforcement efforts, i.e., boats, canoes, outboard motors, binoculars, spotting scopes, waders and cameras. They requested more discretion on scheduling working hours, additional hours in the field, and authorization to work in plain clothes with unmarked boats and land vehicles. There was complete agreement that enforcement of duck hunting regulations was the most difficult and time-consuming work in their schedule. Many spoke with contempt about the negligible impact of making the "easy busts." There was a definite consensus that enforcement efforts should be concentrated on those violations that have the greatest influence on the resource, the "tough busts." However, law enforcement success has frequently been measured by quantity of citations rather than quality. This standard of evaluation complicates the process of gaining support from prosecutors and courts that would enhance regulatory compliance.

On many important issues, agents' and hunters' opinions were similar. Both groups gave high rankings to killing over the bag limit, the five-year license revocation for all hunting, and the seizure and forfeiture of equipment. These similarities further the creditability of what wildlife officers say they know about waterfowl hunters, as previously reported by Jackson and Norton (1978) and Hall (1987).

Courts

Gerald J. Bonnaffons, Chief Probation Officer, United States District Court, Eastern District of Louisiana, has particular interest and knowledge concerning migratory bird cases both as a duck hunter and as a 21-year veteran of the Federal probation Office. He has had the opportunity to subjectively evaluate approximately 8,400 migratory bird cases during his career. The federal courts in Louisiana are unique in requiring that all federal wildlife violators cited by state and federal agents appear before a United States Magistrate for formal arraignment.

Court process for cases other than minor infractions is crucial to reducing wildlife violations. Requiring the defendant to appear before the court rather than permitting a citation to be satisfied by bond forfeiture has several beneficial effects. Court proceedings used in other criminal matters with appropriate decorum and formality—along with prosecuting attorneys, court clerks, marshalls, agents, the judge, and probation officers—all convey to the defendant that wildlife violations are serious matters. Those cited must be absent from work to attend court and have an opportunity to observe proceedings and sentencings against other violators. The common suspicion expressed by some hunters in this survey that enforcement is selective or discriminatory is diminished.

Sentencing and Compliance

Certainly sentencing in wildlife cases should be fair and just and should proportionately reflect the seriousness of the offense. Realistic sentences and familiarity with wildlife conservation issues are fostered by training seminars for judges and prosecutors. Conservation officers participating in seminars for court officials should plan and coordinate these activities through their respective probation offices. Innovative sentences and penalties involving loss of hunting privileges, community service, and special educational requirements including participation and viewing conservation videos all offer considerable promise. Convicted violators can exercise positive deterrence upon other hunters. In the past two years, judges have sentenced waterfowl violators to submit to videotaped interviews with U.S. Fish and Wildlife Service agents. A legal opinion on Creative Probation-Videotaped Interviews from the General Counsel, Administrative Office of the United States Courts, Washington, D.C., concluded, "A sentence requiring a defendant to submit to a video interview would in our opinion withstand challenge." To date all convicted violators sentenced to be video interviewed and their counsel have cooperated fully.

United States Magistrate Michaelle Pitard Wynne, New Orleans, Louisiana, stated during an interview, "Education is the key to compliance, and a prime means of achieving education is to compel convicted violators to view videotapes made with other violators. Today, in our court, it is a routine practice to require violators to be interviewed and to include viewing of videos as an element of a sentence. Interestingly, counsel, non-involved family members, and friends often voluntarily see the film with the defendant. The responses to videos featuring reformed violators have been overwhelmingly affirmative. Many "outlaws" after seeing films have returned to my court to advise me that their violating days are over because they finally realize the tremendous adverse impact that violations have on the duck population."

Individual, or specific, deterrence refers to the cessation of illegal activity by a convicted violator. Criminologists frequently research recidivism, the return to criminal offenses by convicted violators. It is certainly our impression that the rate of recidivism among migratory bird violators is much lower than that for other criminal violations, and we are convinced that the court process and types of sentences imposed contributes to this change in behavior and attitude.

General deterrence is the cessation of criminal activity or the decision not to commit a criminal act because of the conviction an sentencing of someone else for a similar offense. General deterrence is most dependent on public awareness. We believe it is beneficial to publicize enforcement activities and judicial action.

Federal probation records for 1987 indicate that 44 percent of the subjects on probation for violations of federal wildlife statutes reside in Louisiana. This statistic, however, is explained by the fact that in Louisiana all waterfowl violations require a federal court process, one used exclusively by both state and federal wildlife agents. Louisiana conservation officers ranked 200 hours of community service, two years of active probation, and publishing names of violators in local papers considerably higher than the C.O.s in Minnesota and Wisconsin. This difference is probably due to Louisiana C.O.s having had more opportunity to evaluate the effectiveness of innovative sentences commonly exercised by these courts. Louisiana C.O.s and hunters witnessed a remarkable improvement in duck hunter compliance during the 1988–89 season. Responding to a question to rate the trend of compliance by duck hunters, 60 percent of the Louisiana C.O.s and 74 percent of the duck hunters said compliance had increased this past season. Field enforcement records also validate improved compliance, both by fewer cases and decreasing severity of violations. Minnesota and Wisconsin C.O.s and hunters also suggested compliance had increased, but by lower percentages. Louisiana C.O.s and hunters credited the vast improvement in compliance to hunter awareness of increased priority for waterfowl law enforcement, severe and innovative court sentences, and intensified media coverage of the duck crisis. Additional research into the factors contributing to this dramatic change in Louisiana duck hunter's behavior is recommended.

The ultimate solution to any criminal activity (short of making the behavior legal) is to remove the opportunity to commit the crime. Obviously, when there are no more ducks, there will no longer be illegal duck hunting. Now, both hunters and C.O.s are agreeing that the first line of defense against duck hunting violations must be the wildlife agent. However this is neither a practical nor a permanent solution. There cannot be an agent in every blind. More enforcement and stiffer sentences will dissuade some, but not all hunters.

Education

While we have focused on regulations, enforcement and the judicial processing of violations, the authors emphasize the education must be a part of a coordinated approach to improving compliance with hunting regulations. Psychologists have long contended that morality or ethics cannot be legislated and that improving hunter responsibility must be accomplished through education, identification with appropriate models, and peer pressure. Tested approaches (the Wisconsin Model) for accomplishing this were presented at this conference (Jackson et al. 1987).

It is particularly significant that convicted violators also seemed to know this and indicated the same on their survey forms. Training in hunting skills, including waterfowl identification, was ranked highest as an activity for improving compliance by violators in all three states. Active involvement by hunters in wildlife management activities was ranked second in Louisiana and Minnesota and fourth in Wisconsin. Participation in hunter education courses for adults had the third highest mean in Minnesota and was fifth in Louisiana. Conservation officers, however, consistently ranked these factors in the bottom half among the many items ranked. Yet those rankings seemingly were contradicted by their response to the question, "What is the single most important factors to improve enforcement and compliance in your area?" Better public information and education was ranked most important by 26 percent of the officers in Minnesota and Wisconsin. Nineteen percent of the Louisiana C.O.s rated information and education as most important. About 25 percent of the hunters in all three states said information and education was the top-ranked factor to improve enforcement and compliance.

The education of a hunter is a life-long process. Certification in a basic course is only the beginning. Given the complexity of duck hunting, there is a constant challenge to provide information, upgrade skills, and develop a set of values that reflect responsibility, not opportunism and greed. Forty-five percent of Minnesota hunters and 65 percent from Louisiana and Wisconsin said they were introduced to duck hunting by their fathers. Because few duck hunters are introduced to the sport by the curriculum of basic courses, it is time that hunter educators and state agencies devote money and personnel to advanced hunter education programs.

Conclusions

Studies have consistently indicated that compliance with waterfowl regulations by sport hunters needs improvement. Conservation officers and hunters responding to this survey rated the sale of ducks as the least frequently violated regulation today. At the end of the nineteenth century, however, market hunting was perceived to be the greatest threat to ducks and other migratory birds. The threat of market hunting was also most responsible for the enactment of federal laws that regulate the harvest of waterfowl. Such actions that effectively deterred the sale of ducks should offer guidance to improve sport hunter compliance with regulations. The authors believe that the key to the success of those early regulations was changing hunter and public sentiment that would no longer tolerate market hunting. We realize, however, that permanent solutions are complex, involving multiple factors.

The researchers were encouraged by the results of this study. The survey respondents, both hunters and conservation officers, were sincere and candid about their concern for the present health of the waterfowl resource and recognized that duck hunters more than any group will be responsible for saving ducks and duck hunting. The views of conservation officers and hunters in all three states were similar on important issues, ranging from regulations and enforcement to court sentences and educational programming. We believe that innovative sentences supported by intensified media coverage will encourage social peer pressure that will dissuade other hunters from violating laws. But ultimately, compliance must be primarily self-motivated. Changes in past law enforcement techniques and philosophies are necessary to accomplish these goals. The most gratifying result was the agreement among hunter and C.O.s that compliance increased during the 1988–89 seasons.

The authors will continue to research and analyze data to prepare a model on waterfowl regulatory compliance, in order to foster better management of North America's duck populations.

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Strengthening Law Enforcement's Thin Blue Line: The Sportsman's Role

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North American outdoor recreationists, especially hunters and anglers, must do a great deal more to assist the continent's hard-pressed thin blue line of conservation law enforcement agents. The benefits of increased support of our federal and state fish and game wardens range from an enhanced outdoor experience to preservation of our hunting and fishing opportunities. As of this writing, total fish and wildlife law enforcement personnel in the United States and Canada stands at approximately 9,270 individuals. Of that number, there are 211 United States federal special agents and 65 wildlife inspectors, for a total of 276; the 50 states have 7,850 individual officers and Canada has a total of 1,387 in 12 provinces.

With nearly 70 million outdoor enthusiasts enjoying hunting and fishing on the prairies, plains, forests, rivers, lakes and streams of the United States and Canada—nations with 7,466,932 square miles of public and private lands and waters—these dedicated civil servants form the "thin blue line" of protection for our wild living resources.

The fish and game laws, rules and enforcement mechanisms set up through our governing bodies and fish and game commissions are effective only if sportsmen are confident that others are obeying those laws and regulations. That confidence lends legitimacy to the rules. Where such confidence breaks down, there is only chaos. If one individual or group feels that everyone else is violating the rules, the order of the day becomes "it's every man for himself." In part, that rationale may help explain the rampant overbagging of wintering waterfowl that was reported prior to the 1988–89 season. I will address that situation again later in this presentation.

As quality available space for our wild living resources continues to shrink due to the paving over, draining, plowing under, polluting and loving to death of our most productive habitats, the "warden's" job becomes tougher, not easier. Concentrating growing numbers of outdoor users on the best playgrounds increases hunter and angler competition for both prime habitats and the fish and game found there. Add in four-wheel-drive vehicles, C.B. radios, game counters, fish finders and a seemingingly endless parade of new laws aimed at both halting abuse of the wild living resources and corralling the abusers leaves the already overworked conservation agent sitting in courtrooms, spending extra hours in the field and developing new and more elaborate "sting" operations. Often too, he contemplates greener pastures for himself and the family he loves, but seldom sees.

What kind of return on their time and the sportsmen's dollar investment are these public servants producing? U.S. Fish and Wildlife Service figures for 1986 tell us that there were 12,626 investigations—that means cases where charges were pressed—and 9,621 criminal convictions, resulting in $1,610,440 in fines and 178 total years in jail. The year 1988 saw 14,472 investigations and over $3,300,000 in fines and penalties. There was also a 94 percent conviction rate. That latter figure leads me to believe that the caterwalling about unjust "stings," "entrapment" and "over-enthusiastic" agents is largely unwarranted. Even if there are flawed operations, a few such cases don't justify a call for the end of these covert operations any more than the 1987 story of a deer hunter wounding a passenger by shooting at a landing airliner justified a call for a federal law to prohibit hunting within five miles of all United States airports.

That story made headlines nationwide. The outdoor outlaw who fired that shot, wounding a passenger, was apprehended, convicted and sent to prison. Before the airplane shooting, what was the attitude of the shooter's hunting companions? Did they respect fish and game laws or violate them routinely? Did they disapprove of irresponsible and unethical hunting practices or join in? There is a very good chance that they were not paragons of sporting virtue.

Aldo Leopold said, "The mechanism of operation is the same for any ethic: social approbation for right actions; social disapproval for wrong actions." Sportsmen who do not use peer group pressure to promote ethical behavior of their companions make the conservation law enforcement agent's job much, much tougher.

I first spoke on the topic of outdoor ethics 12 years ago to a meeting of the Missouri chapter of the Wildlife Society. To help the thin blue line of fish and wildlife officers do their job of protecting us from ourselves I would like to repeat a small portion of that 1977 speech:

> *We've got to attack the problem [of unlawful and irresponsible behavior] at its source. Those of us who are hunters must isolate the outdoor outlaws from the mainstream of the sport—by our own action, on our own initiative, and with as much media coverage as we can get.*
>
> *We must re-examine our own habits and discard the ethically borderline hunting practices that are undermining the sport by chipping away at the fairness and challenge of the chase.*
>
> *There are many physical and psychic rewards we hunters gain from hunting—many reasons why we hunt: the taste of venison; the thrill when a grouse explodes in front of the dogs; the beauty of the fields and forest in the fall; the silence; the lonelines, and the companionship.*
>
> *Perhaps the companionship, the social side of hunting, offers us the handle we need. If we demand a lot of ourselves as ethical sportsmen, if we follow a strict code emphasizing the challenge of the chase rather than the comfort and convenience of the kill, then we have a right and a duty to demand as much from our hunting companions.*
>
> *I come reluctantly, but inevitably, to the conclusion that the day has passed when the ethics of the chase could be treated as a merely personal matter, an unwritten contract between a man and his conscience, and not the proper business of anyone else. The time has come when the contract must be enlarged and renewed. When we must assume our share of responsibility for the code of behavior of our friends, when we must admit that, whenever we silently countenance slob hunting in a friend, we become slobs ourselves.*
>
> *As much as it goes against the grain, we are called upon to place loyalty to the sport—to the traditions and limitations that make hunting worthwhile—ahead of our short term loyalties to our buddies. Simply put, we must be willing to refuse to hunt with a friend who is a slob, just as we would refrain from hunting with him if he were habitually careless about gun safety.*
>
> *We must enforce the rules and the code ourselves, personally and among our companions. It's not good enough to leave it to the state, the fish and game commission, the wardens and the law.*

The political and legal institutions of this country are demonstrably inadequate to regulate behavior in the field; that will continue to depend, as it always has, on what behavior we expect of ourselves and our companions and what they expect of us. Because the state cannot enforce a standard of ethics, the state cannot save hunting. Only we can do that.

As many of you know, that talk was the beginning of a still growing nationwide outdoor ethics improvement campaign affecting all facets of outdoor recreation. We have seen outdoor ethics get more and more attention in those intervening years, even to the point that it became important enough for President George Bush to call for a new outdoor ethic in America during his campaign. But how much has really been accomplished? How much have sportsmen and women personally done to resolve the problems of conservation law violations? How much have we who enjoy the hunting tradition done to halt resource abuse and how much have we done to promote understanding and appreciation of the natural world around us and those who care for it—not the least of whom are the game wardens?

Here we are at the universally recognized single most important conference of its type in the world, yet we seldom talk about *our* role in assisting those in our ranks who work most closely with the users of the resources so precious to us. They need and deserve our thanks; our active, openhanded support; and our friendship.

Here are a few things sportsmen and wildlife managers should consider doing for those who comprise that thin blue line:

- Learn their names. Know them at least as well as we know those of our Congressmen and Senators.
- Throw them an annual dinner, and be sure to invite their families. Thank them publicly and pledge your support.
- Promote and use tools such as TURN IN POACHERS (TIP), programs that help the agents do their job.
- Go in the field with them *when invited*. See what they do for you.
- Honor the judges and magistrates who mete out the punishment to the violators. Tougher penalties help reduce the number and severity of the challengers.
- Listen when the tell you what they need and heed their requests.

The latter may be most important. The recent case history of what has become known as the "helicopter campaign" offers a good example of the value of listening. Briefly, here are the details. Baiting and overbagging of migratory waterfowl had become a tremendous challenge to federal and state conservation law enforcement agents in Louisiana. The number of birds killed illegally was reported to be "at least as high as the legal kill." Federal special agent in charge, David Hall, told *St. Paul Pioneer Press Dispatch* outdoor editor Dennis Anderson that the tool most needed to control baiting and poaching was a helicopter. In early 1988, Anderson wrote a dramatic series of articles on the situation in Louisiana and called on his sportsmen-readers to contribute $600,000 to a "helicopter fund" being set up with the Izaak Walton League. Thanks to the help of more than 3,000 donors and the bipartisan support of state and federal government officials, the funds to buy a Bell Jet Ranger were guaranteed and the helicopter was ordered by the League on November 4, 1988. There were many other factors involved in the project's success, not the least of which was the drought of 1988 and the resultant dismal forecast for the fall duck migration.

The full impact of the campaign won't be determined for several years. But early indications are that the publicity generated around the campaign—together with the drought and actions of federal and state officials such as U.S. Fish and Wildlife Service Director Frank Dunkle, Louisiana Governor Buddy Roemer and his director of natural resources, Virginia Van Sickle—were the keys to a remarkable turn around in the pattern of baiting and overbagging violations. According to a recent report from Hall, where 79 baiting cases had been made in the 1987–88 season, there were but two by the same time this year.

We don't know whether the difference is 500,000 or 5,000 extra birds now returning to the nesting grounds. But whatever the numbers, the impact on the resource is clear. If we are willing to assume that hunting mortality is not 100 percent compensatory, then there will be more waterfowl winging toward the prairies than there would have been if concerned sportsmen had simply left the job to the game wardens and Mother Nature.

We sportsmen definitely have a major role in conservation law enforcement. Our approach must be two-pronged. We must show the self-discipline and the intestinal fortitude to use peer pressure to set and enforce a higher standard of behavior for ourselves and our companions in the field. And at the same time, we must lend to the thin blue line of wardens, agents, judges and prosecutors, our assistance, our wholehearted support and our appreciation.

Public Perceptions of and Participation in Fish and Wildlife Law Enforcement

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Introduction

Any program aimed at managing fish and wildlife populations must include law enforcement as an integral component. Morse (1973:39) noted that "without adequate law enforcement, the finest research and management will have little or no effect in protecting the resource." Yet there is evidence that traditional approaches to fish and wildlife law enforcement have not been adequate with respect to apprehending certain violators. For example, deer poacher detection rates in California, Idaho, and Maine are estimated to be 2.2 percent, 1.1 percent and 1.2 percent, respectively (Smith 1982). A 1980 deer poaching simulation study in California estimated that 75,000 mule deer (*Odocoileus hemionus*) are poached annually (Sheehan 1981). This means that twice as many deer are taken annually by poachers as are taken by legal hunters.

One way to enhance law enforcement efforts is to increase the number of enforcement personnel. In a national study, fish and wildlife law enforcement agency directors ranked increased manpower as the most effective and desirable way to reduce violations (Nelson and Verbyla 1984). Unfortunately, the restrictive budgets of most fish and wildlife agencies limit the number of enforcement personnel that can be hired. To further complicate matters, few enforcement officers devote all of their time to enforcing laws and regulations. Morse (1973) and Nelson and Verbyla (1984) reported that enforcement officers spend 41.0 percent and 35.8 percent of their time, respectively, on other wildlife management activities. Therefore, relying solely on enforcement personnel to get the job done has its limitations.

Another approach to increasing the efficiency of fish and wildlife law enforcement is to enhance public support for and involvement in the enforcement process. Research indicates that the public is concerned about violations of fish and wildlife laws. Eighty-seven percent of the respondents in a national survey thought that violators should receive stiff fines and possible jail sentences (Kellert 1979). Getting citizens to actually report violators is another issue, however. Traditional approaches to citizen involvement, such as violation report cards, appeals for information, and standing rewards have not motivated many citizens to turn in violators. Some newer approaches, such as secret witness programs, have been successful in some states. New Mexico's Operation Game Thief, for example, produced 397 citations with an accompanying conviction rate of 99 percent during its first three-and-a-half years of implementation (Sheehan 1981).

Research on the efficacy of various public involvement strategies and techniques is very limited. Nelson and Verbyla (1984:17) noted that "the effectiveness of . . . citizen participation campaigns has not been evaluated adequately." These researchers did study state law enforcement representatives' perceptions of the effectiveness of various approaches for gaining public compliance with regulations and increasing reporting of violations. They found that peer-group pressure and educational programs were perceived to be more effective than reward programs.

One of the first steps toward enhancing public involvement in wildlife law enforcement is for wildlife manager to understand current public perceptions of and participation levels in existing law enforcement programs. With the intent of developing such an understanding, a telephone survey of a representative sample of California residents was conducted by the Survey Research Center at California State University, Chico in cooperation with the California Department of Fish and Game. The purposes of the study were to determine public perceptions of current violations, assess current levels of public involvement in law enforcement, and identify what can be done to reduce fish and wildlife violations in the future.

Methods

Survey data were collected via telephone interviews with Californians age 18 and above living in households with telephones. Approximately 95 percent of all California households have a telephone. A total of 3,294 households were contacted in June 1988 using a random digit sample of telephone numbers generated by Survey Sampling, Inc. of Westport, Connecticut. Interviews were completed with persons in 2,525 households for a response rate of 76.6 percent.

Public Perceptions of Violations

Over 85 percent of Californians believed that fish and game law violations were either serious (47.2 percent) or somewhat serious (39.6 percent) types of violations. Only 10.1 percent of respondents believed that such violations were not serious. An analysis of responses by wildlife user groups revealed that purely consumptive wildlife users perceived fish and game law violations to be significantly less serious than other user groups (Table 1).

The majority of the 2,525 respondents (56.8 percent) felt that people who violate state fish and wildlife laws are hardly ever apprehended. About one-third of the respondents (35.4 percent) felt that violators are sometimes apprehended, 4.2 percent felt violators are often apprehended, and 0.9 percent felt violators were almost always apprehended. When asked to rate the effectiveness of law enforcement activities of the California Department of Fish and Game in protecting fish and wildlife, only

Table 1. Perceived seriousness of fish and game law violations by wildlfe user group.

	Percentage responding			
User group	Very serious problem	Somewhat of a problem	Not a very serious problem	*N*
Nonusers	45.4	39.0	15.6	436
Purely nonconsumptive users	49.7	42.6	7.7	1220
Mixed users[a]	50.0	38.5	11.5	724
Purely consumptive users	36.8	47.1	16.2	68
6 d.f., chi-square = 41.17, p = .0000				

[a]Participated in both consumptive and nonconsumptive activities during the last 12 months.

14.5 percent of respondents indicated that present enforcement activities were very effective. However, more than half (57.3 percent) felt that they were somewhat effective.

Public Involvement in Wildlife Enforcement

Almost one-third of the respondents (31.1 percent) indicated that they had personally observed someone violating a fish and game law. Cross tabulations of responses by wildlife user group revealed that a significantly larger percentage of mixed wildlife users (those who have participated in both consumptive and nonconsumptive activities during the previous 12 months) reported having observed violations than other wildlife users (6 d.f., chi-square = 259.32, p = .000).

Respondents who had observed fish and game violations were asked if they reported any of them. Of the 466 persons who responded to the question, only 17.4 percent (80 respondents) had reported the violation to law enforcement authorities. Observers of violations were more likely to report the violation to a park ranger (35.0 percent) than to any other person or agency. Other law enforcement authorities to whom violations were reported included the California Department of Fish and Game (26.2 percent), the local sheriff (10.0 percent), the local game warden (6.3 percent) and the local police (6.3 percent). Only 2.5 percent of these violations were reported through CalTIP (Californians Turn In Poachers), a secret witness program. Various other reporting patterns accounted for 13.7 percent of the responses.

The 371 respondents who had observed a violation but had not reported it were asked their reasons for not reporting. The number one reason was that they "didn't know where or how to report it" (22.4 percent). Other reasons for not reporting were: "didn't think it was serious" (19.7 percent), "didn't think reporting would make a difference" (10.0 percent), "no time to report it" (8.6 percent) and "didn't want to get involved" (7.3 percent). Various other reasons accounted for the remaining 32.1 percent of responses.

The 1,721 respondents who said they had not observed a fish and game law violation were asked to whom they would report a violation if they observed one in the future. The largest percentage indicated that they would report a violation to a park ranger (25.3 percent) or to the California Department of Fish and Game (23.6 percent). Respondents were less likely to report to the local police (11.1 percent), the local game warden (9.5 percent) and the local sheriff (4.8 percent). Only 0.4 percent (7 people) indicated that they would report a violation through CalTIP and only 0.3 percent (5 people) would report to the California Highway Patrol. Various other violation reporting patterns were indicated by 6.7 percent of the respondents. Almost one-fifth of the respondents (18.2 percent) did not know where they would report a violation.

Methods for Reducing Violations

Respondents were asked their opinions regarding the effectiveness of several approaches for reducing fish and game law violations. More than two-thirds (69.2 percent) thought that more patrolling of fish and wildlife areas by game wardens would be very effective in reducing fish and wildlife law violations. Almost two-thirds (62.2 percent) felt that making public reporting of violations easier would also be very effective in reducing violations. The ratings for other enforcement methods were as follows: imposing heavy fines (61.3 percent), increasing undercover enforcement (60.8 percent), imposing jail sentences for violators (59.0 percent), and increasing public education (33.6 percent).

When responses were cross tabulated by fish and wildlife user groups, several significant differences were found. A larger percentage of purely consumptive users believed that jail sentences and fines would be very effective in reducing violations than did other user groups (tables 2 and 3). Conversely, a larger percentage of respondents who participate in nonconsumptive fish and wildlife activities (pure nonconsumptive and mixed recreationists) believed that public education would be very effective in reducing violations than did purely consumptive users (Table 4).

Table 2. Opinions regarding the effectiveness of jail sentences in reducing fish and wildlife law violations by wildlife user group.

	Percentage responding			
User group	Very effective	Somewhat effective	Not effective	*N*
Purely nonconsumptive users	55.9	32.0	12.1	834
Mixed users[a]	61.7	25.7	12.6	715
Purely consumptive users	69.2	15.4	15.4	65
4 d.f., chi-square = 13.37, p = .0096				

[a]Participated in both consumptive and nonconsumptive activities during the last 12 months.

Table 3. Opinions regarding the effectiveness of heavy fines in reducing fish and wildlife law violations by wildlife user group.

	Percentage responding			
User group	Very effective	Somewhat effective	Not effective	*N*
Purely nonconsumptive users	59.4	36.2	4.4	847
Mixed users[a]	62.8	29.9	7.2	732
Purely consumptive users	68.1	26.1	5.8	69
4 d.f., chi-square = 12.80, p = .0123				

[a]Participated in both consumptive and nonconsumptive activities during the last 12 months.

Table 4. Opinions regarding the effectiveness of public education in reducing fish and wildlife law violations by wildlife user group.

	Percentage responding			
User group	Very effective	Somewhat effective	Not effective	*N*
Purely nonconsumptive users	34.0	56.1	9.9	849
Mixed users[a]	34.3	53.0	12.7	732
Purely consumptive users	20.3	62.3	17.4	69
4 d.f., chi-square = 10.10, p = .0388				

[a]Participated in both consumptive and nonconsumptive activities during the last 12 months.

Financing Additional Enforcement Services

Respondents were asked a series of questions regarding possible funding for fish and wildlife protection services. Three-fourths (75.7 percent) of the hunters and anglers in the sample indicated they would be willing to pay a $5.00 increase in hunting and fishing license fees to provide improved services.

Survey respondents who do not hunt or fish (nonusers and purely nonconsumptive wildlife recreationists) were asked whether they would be willing to pay a voluntary fee of $5.00 to the California Department of Fish and Game to provide increased fish and wildlife services including law enforcement. A total of 63.9 percent of the respondents said that they would be willing to pay the fee. A significantly larger percentage of purely nonconsumptive users of wildlife (71.7 percent) were willing to pay the fee than nonusers (51.5 percent) based on crosstabular analysis (8 d.f., chi-square = 99.72, p = .000).

Discussion

Californians are concerned that present fish and wildlife law enforcement programs are not adequately protecting fish and wildlife. The majority of residents felt that increased patrol by game wardens would help reduce fish and wildlife law violations. The direct beneficiaries of fish and wildlife, namely, consumptive and nonconsumptive users, were the most willing to provide funding for fish and wildlife protection services through license fee increases and voluntary fee programs. It appears that public reporting of fish and game law violations could be enhanced by making Californians more aware of options and procedures for reporting violations.

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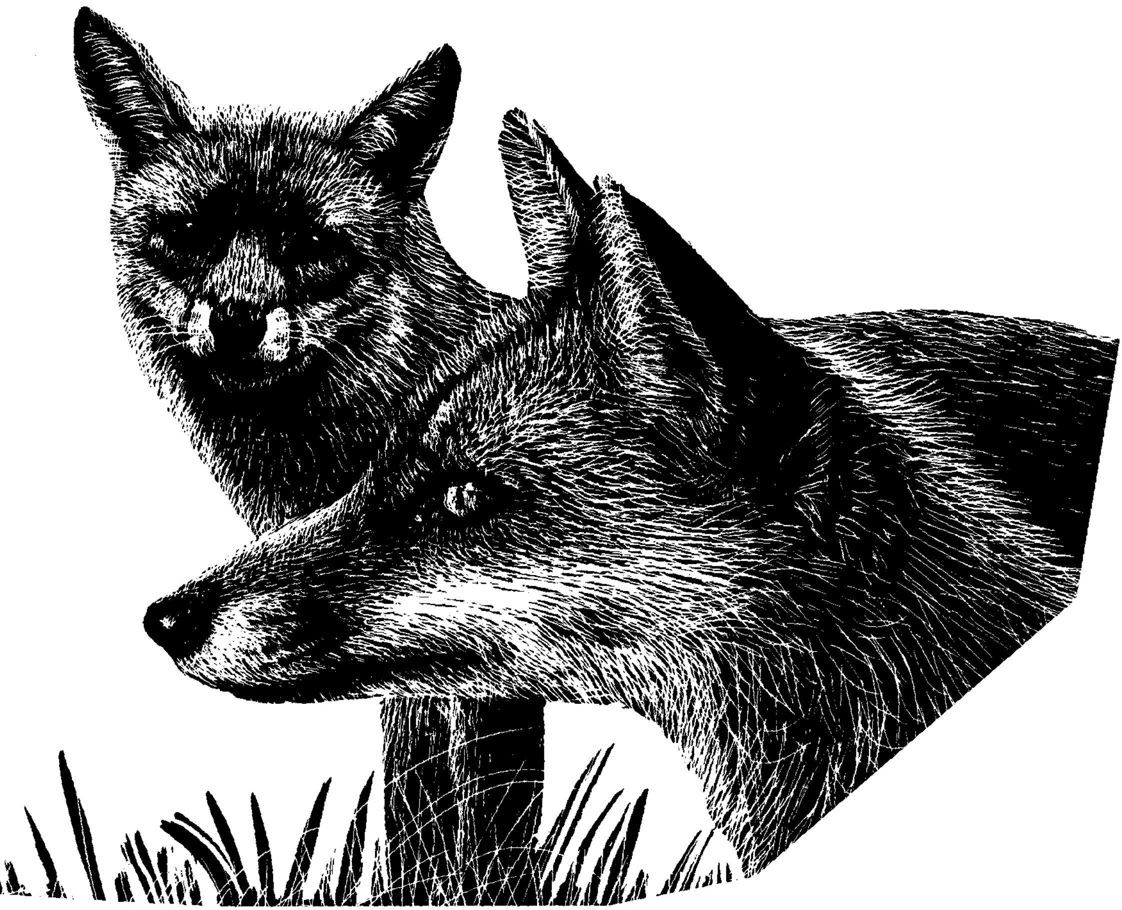

Special Session 7.
Integrated Conservation/Agriculture Programs: Accomplishments and Needs

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Effects of the Conservation Reserve Program on Wildlife Habitat: Results of 1988 Monitoring

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Introduction

The Food Security Act of 1985 authorized a Conservation Reserve Program (CRP) that provides payments to farmers who plant permanent cover on highly erodible cropland. The first seven sign-up periods under the program enrolled over 28 million acres of the 45 million-acre reserve authorized by Congress.

The CRP could have major benefits for wildlife, but differences between the CRP and previous set-aside programs (e.g., the Payment in Kind Program) make it difficult to predict these benefits or to identify program changes that could produce even greater benefits. It is possible that the CRP could have adverse impacts for some wildlife species if it eliminates needed winter food formerly available on cropland, or if disturbances occur such as mowing fields during nesting. If any adverse impacts are identified, the Program could be altered to minimize them.

In 1987, the states' fish and wildlife agencies, via the International Association of Fish and Wildlife Agencies, joined with the U.S. Fish and Wildlife Service to document the effects of the CRP on wildlife. The study's objectives are: (1) to describe the establishment of permanent cover and the characteristics of the vegetation on CRP lands; (2) to describe trends in wildlife habitat caused by the CRP; and (3) to summarize the results for Congressional deliberations of Farm Bills in 1990 and 1995. The study focuses on terrestrial habitat; it does not address benefits for fisheries resulting from reducing erosion or chemical applications on CRP fields.

Last year at this forum we described the study design (Farmer et al. 1988). This paper reports progress, with emphasis on the preliminary results of the 1988 sampling for the Midwest region, and plans for future data collection, analysis, model testing and reports. A full technical report on the 1988 results for all regions will be produced later this year.

Methods

The country was divided into four study regions. (Recently, New York and Pennsylvania were added to the Midwest region, North Dakota was added to the Northern Great Plains/Intermountain region, and Maryland was added to the Southeast region. The number of study regions was reduced from five to four). For each region, three indicator species (two game and one nongame) were chosen. Key habitat variables (such as height of vegetation) were identified for each species. These variables are being monitored approximately every two years between 1988 and 1994. Habitat quality is estimated from the habitat data using a Habitat Suitability Index (HSI) model for each species. The calculated HSI ranges between 0.0 (no value) and 1.0 (optimal habitat conditions). The contribution that the CRP makes to wildlife will be determined by comparing the HSI on CRP fields with the HSI calculated for the pre-CRP condition.

HSI models are working hypotheses capturing the professional judgement of species experts in mathematical form, while recognizing the practical limitations on field data collection. For example, the HSI model for ringnecked pheasants (*Phasianus colchicus*) hypothesizes that nesting cover is the limiting life requisite in the areas where CRP fields are located. Nesting cover is hypothesized to be a function of the visual obstruction readings (VOR, Robel et al. 1970) just before greenup, when hens first establish nests, and again in midsummer (20 June to 10 July) when renesting occurs. The nesting suitability of VOR's is described as a stepwise linear function, with a value of 0.0 at VOR = 0.0 dm, and an optimum at VOR > 1.5 dm during pre-greenup, and > 2.5 dm during midsummer. The model uses a weighted average of VOR's; the suitability of pre-greenup is given a weight of 0.7 and the suitability of midsummer is given 0.3. Unless good nesting is within two miles of high quality winter cover, and available winter food is within 0.25 mile of the winter cover, the model assigns an HSI of 0.0. Definitions of "high quality winter cover" are dependent on local climate, so each state developed its own specific definition of the conditions required to meet these criteria.

A computer database was constructed from information about CRP contracts provided by the Agricultural Stabilization and Conservation Service (ASCS). It was used to select contracts for sampling and to calculate weighted averages for all contracts in the region. In the Midwest region, we sampled Conservation Practices (CP) 1 (tame grass), CP 2 (native grass), CP 3 (trees), CP 4 (wildlife plantings), CP 5 (shelterbelts), and CP 10 (already grass). CRP contracts were divided into 28 sampling populations on the basis of the CP, the year the contract took effect (1986 or 1987) and, for CP 1 and CP 2, which base crop was retired. More than 95 percent of the CRP contracts in the first four sign-ups in the region were in our sampling populations. For each population, 30 contracts were randomly selected, and at least one CRP field was sampled for each contract; two fields were sampled if there was more than one field in the contract. If a sampled contract was observed to have a change in CP or year planted, it was moved to the appropriate population. Because populations are defined for five base crops in each of CP 1 and CP 2, approximately five times as many contracts were sampled for these CP's than for the others.

During 1988, data were collected in 27 states for all four study regions (Figure 1). In the Midwest region, data were collected in 10 states on a total of 853 fields from 547 contracts. Except as noted below, statistical differences between populations were assessed using Kruskal-Wallis tests because the distributions were not normal and variances were not homogeneous. Weights used for weighted means are the relative abundances of the contracts in each population.

Results and Discussion

The results and discussion are organized around the following questions:

1. How is establishment of permanent cover progressing?
2. What are the characteristics of the vegetation on undisturbed fields of the various CP's, and do these CP's differ?
3. How suitable is the habitat on undisturbed fields of the various CP's, and do these CP's differ in HSI?
4. How much disturbance has occurred, and what are the impacts of these disturbances?
5. What are our plans for future activities?

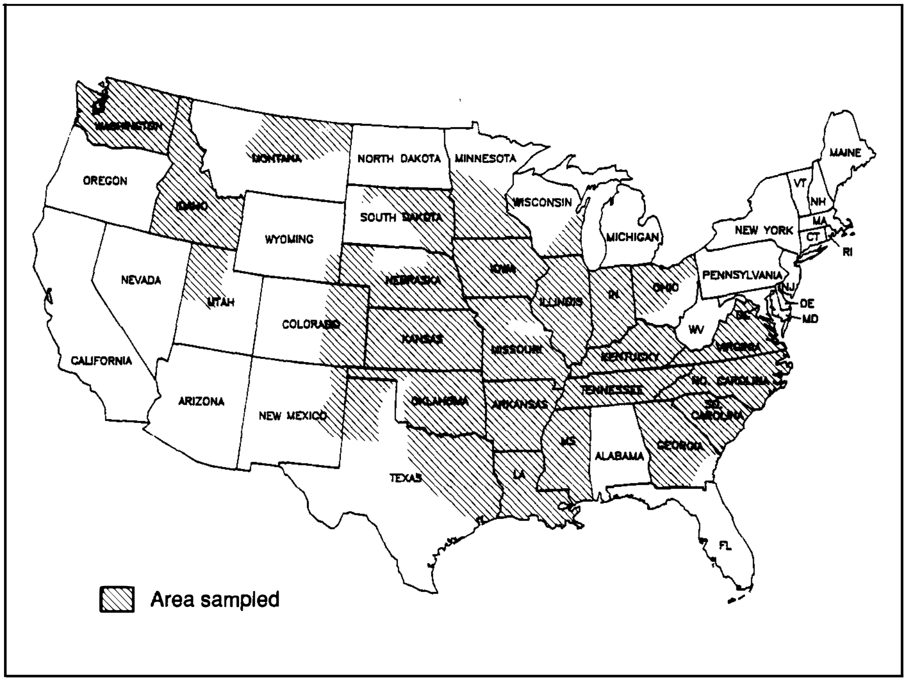

Figure 1. Area sampled in 1988.

Establishment of Permanent Cover

We looked at two indicators of successful establishment of cover: (1) the presence of the planted species on the field; and (2) the dominant species on the field. Most of the contracts sampled had the contracted permanent cover species present (88 percent of the 1986 contracts, and 86 percent of the 1987 contracts). However, these estimates may be too high because grass seedlings are difficult to identify positively.

The data on dominant species are inconclusive because both the dominant species and the planted species were reported for only 36 percent of the fields. For this limited sample, 66 percent of the 1986 contracts and 46 percent of the 1987 ones had a species included in the seed mix reported as the dominant species. These percentages indicate that the planted species are either better established on the older fields, or overlooked on new plantings.

For those fields with a dominant species that was not in the seed mix, two weedy genera were reported most often: foxtail (*Hordeum* sp., 50 percent of these contracts), and brome (*Bromus* sp., 11 percent), with several other taxa dominant on the remaining fields. It is expected that the planted species will become dominant with time, and weedy volunteers will decline. This change in dominant species may or may not be important to wildlife, depending on how much the weedy species contribute to the availability of food, perch sites and cover.

Characteristics of the Vegetation

The objective for this part of the study was to assess the differences in vegetation between CP's and to describe the changes as the vegetation becomes established. Comparing data from the 1986 and 1987 contracts may allow us to see trends with age; although differences could be caused by other factors such as differences in weather from one year to the next. Because disturbances might obscure differences due to CP or age, we first considered only fields that had little disturbance. Mowing is the predominant disturbance reported, so we excluded those CRP fields that had 30 percent or more of their area mowed prior to the time of sampling.

If vegetation differences between 1986 and 1987 contracts suggest trends with age, then one might expect that all the VOR and herb cover values would start low, then increase asymptotically. Pre-greenup VOR and herb cover values might increase more slowly than midsummer values, because several weedy species contribute to high midsummer cover, but produce residues with low persistence. The proportion of grass in the herb cover may increase as grasses out-compete weedy forbs. Eventually, shrub cover might increase, with a consequent decline in herb cover.

Mean values for some of the habitat variables measured are presented in Table 1. The values for CP 1 and CP 2 are weighted means combining the base crops. Those for "all CP's" are weighted means across all sampling populations with the same contract year.

Comparison of VOR values from the different CP's within the same year showed significant differences between CP's for both 1986 and 1987 midsummer sample, and for the 1986 pre-greenup CP's. The highest pre-greenup average was on CP 2.

Herb canopy cover is significantly different between CP's for the 1986 contracts, with the values on CP 10 higher than either CP 1 or CP 2 in both years' samples. The CP 10 stands are older than the others, so the greater cover is expected, and suggests that the canopy cover will increase on CP 1 and CP 2 as their stands age.

Table 1. Values for selected habitat variables on unmowed fields. "VOR" is visual obstruction reading. "Cover" is canopy cover. "Herb" includes grasses and forbs. "Grass/herb" is the proportion of herb cover contributed by grasses. "p" is the level of significance. "n.s." means not significantly different. "All CP's" are weighted averages.

	Pre-greenup			Midsummer			
Population	VOR (dm)	Herb cover (%)	Shrub cover (%)	VOR (dm)	Herb cover (%)	Grass/ herb (%)	Herb height (dm)
1986 contracts							
CP 1	2.8	65.9	0.4	4.3	53.1	58.0	3.1
CP 2	4.5	67.8	0.1	4.6	67.8	63.1	3.8
CP 3	2.3	88.6	0.0	4.3	69.7	60.9	4.1
CP 4	2.6	56.5	0.0	3.9	49.3	71.3	3.3
CP 5	1.1	49.8	0.1	3.9	39.5	47.6	3.7
CP10	1.9	83.5	0.4	5.2	76.2	65.7	4.2
p	<.001	<.001	n.s.	<.01	<.001	n.s.	<.05
All CP's	2.9	69.6	0.3	4.5	59.4	60.4	3.5
1987 contracts							
CP 1	1.6	45.2	0.3	4.7	66.0	53.6	4.0
CP 2	2.3	59.6	0.0	3.1	61.6	50.0	2.3
CP 3	1.5	59.5	0.3	3.8	66.4	83.3	4.3
CP 4	2.2	68.9	0.0	4.5	65.7	52.4	3.0
CP 5	1.9	34.1	0.2	4.3	50.0	59.0	3.1
CP10	1.8	89.1	0.0	4.9	76.5	68.4	4.7
p	n.s.	<.01	n.s.	<.01	n.s.	n.s.	<.001
All CP's	1.7	55.2	0.2	4.5	67.8	56.9	3.9

The percentage of the herbaceous cover made up of grasses does not significantly differ between CP's.

Shrub cover is almost absent on all contracts, even CP 5 (shelterbelts). This suggests that planted shrubs are still very small, and that invasion of volunteer shrubs is not significant. Shrub cover can be expected to increase on CP 5 over the next several years, but not quickly. Shrubs may increase on the other CP's, especially if they are not suppressed by mowing or herbicides.

We directly compared contracts for CP 1 with those for CP 2 because these are most abundant of the newly planted CP's (CP 1: 66 percent, CP 2: 9 percent). Significant differences were found in midsummer herb cover for the 1986 contracts ($p < 0.01$). Pre-greenup VOR ($p < 0.05$) and herb cover ($p < 0.05$), and midsummer VOR ($p < 0.001$) and herb height ($p < 0.001$) differed for 1987.

When we compared 1986 and 1987 contracts, the data support our expected development through time if one year old stands have already reached the asymptote for midsummer herb cover, and if it is too soon for shrub invaders to be conspicuous. VOR values averaged across all CP's were 2.9 dm in pre-greenup for 1986 contracts, and 1.7 dm for 1987 contracts. Midsummer values are higher (both 4.5 dm), and the difference between 1986 and 1987 contracts has disappeared. The differences are statistically significant for pre-greenup VOR ($p < 0.001$) but not midsummer VOR. In addition, significant differences exist in pre-greenup herb canopy cover ($p < 0.01$) and midsummer proportion of grass in the herb cover ($p < 0.05$).

In summary, the CRP fields have the characteristics of young plantings of grasses: rather open stands of herbs that are rich in weedy species. The 1986 stands differ from the 1987 ones as expected for better-established stands.

Habitat Quality

The objectives for this part of the study are: (1) to assess the contributions CRP fields make to habitat for the three indicator species; and (2) to look for differences between CP's in these contributions. Once again, fields with more than 30 percent of their area mowed were excluded. Each species is considered separately below, followed by overall recommendations.

Pheasant. The mean HSI's calculated from the habitat measurements on each contract are given in Table 2. Mean HSI values across all CP's for both years were near 65 percent of optimum. The difference between 1986 and 1987 contracts is highly significant ($p < 0.01$), although the mean HSI for 1986 is only slightly higher than for 1987 (67 percent versus 62 percent). The change is in the direction of improving HSI with the age of the stand, as might be expected from the greater pre-greenup VOR readings (Table 1). It is reasonable to expect still further improvement on undisturbed fields as permanent cover species become better established.

Comparison of HSI's across CP's within years shows more variability, with means ranging between 45 percent and 74 percent of optimum. The differences between CP's are statistically highly significant (Table 2).

Differences between CP 1 and CP 2 considered alone are not significant for either year. This may appear surprising considering that pre-greenup VOR's are significantly

Table 2. Habitat Suitability Indices calculated for unmowed fields. "*p*" is the level of significance for differences between CP's within years. "n.s." means not significantly different. Values for "all CP's" are means weighted by number of contracts.

Population	Pheasant	Meadowlark	Cottontail
1986 contracts			
CP 1	0.71	0.16	0.02
CP 2	0.74	0.15	0.00
CP 3	0.45	0.18	0.00
CP 4	0.68	0.11	0.00
CP 5	0.46	0.06	0.00
CP10	0.52	0.16	0.00
p	<.01	n.s.	n.s.
All CP's	0.67	0.15	0.01
1987 contracts			
CP 1	0.62	0.24	0.00
CP 2	0.55	0.29	0.00
CP 3	0.49	0.21	0.00
CP 4	0.70	0.22	0.00
CP 5	0.51	0.17	0.00
CP10	0.62	0.22	0.00
p	<.01	n.s.	n.s.
All CP's	0.62	0.24	0.00

different, but mean VOR's for both CP's are in the optimum range, so no difference occurs in the contribution made to the calculated HSI's.

We examined individual life requisite indicators as well. The biologists collecting data were asked to evaluate the availability of winter cover and winter food, both on the CRP field and in the vicinity. Average ratings of winter cover on the CRP fields for the individual CP's (Table 3) range from 1.2 to 2.4 on a scale of 1 (poor) to 4 (excellent), and averaged just under 2 (fair). Differences between CP's within years are significant for both years in midsummer, and also for the 1986 contracts in pre-greenup. Winter cover values appear to be higher on fields planted in CP 2. However, winter cover of the quality needed to allow pheasants to survive severe winter is absent on most CRP fields, and is likely to develop only on those few CRP fields where patches of shrubs and other persistent species are planted.

For winter cover on a CRP field to be usable, winter food must also be present either on the field or within 0.25 mile. Winter food is available for 62 percent for 1986 contracts and 69 percent for 1987 contracts. Little of this food is available on the CRP field itself (Table 3). Unless high quality winter cover is developed on more CRP fields themselves, it seems likely that this winter food will only contribute to usable pheasant habitat in years that have mild winters.

Considering the individual CP's within years, the highest frequencies of on-field winter food were for CP 2 on 1986 contracts and for CP 4 on 1987 contracts. The frequencies range widely between CP's, from 0 to 58 percent (Table 3). CP's are significantly different from one another for both 1986 and 1987.

Excellent winter cover was present within two miles of approximately 85 percent of contracts across all CP's for contracts of both years. Differences between CP's within years are significant for 1986 contracts, but not for 1987 contracts. Although winter cover is frequently present, it is important to note that the data do not include the size of the winter cover patches that were available. The possibility that some patches were very small could explain why, although winter cover was present in the vicinity of about 85 percent of the fields, the biologists selected winter food or winter cover as limiting life requisite in the vicinity of more than half of the fields. It would appear that the CRP could improve pheasant habitat by planting more winter cover and winter food where these resources are in short supply.

To assess the validity of the assumption that nesting cover was the most limiting life requisite prior to the CRP, we asked the field biologists to choose between nesting cover, winter cover and winter food as the most limiting in the vicinity of the CRP field—but not including the CRP field itself—during both pre-greenup and midsummer sampling. Table 3 shows that nesting cover was chosen most frequently across all CP's for both sampling periods and both years, ranging from 35 percent to 49 percent of the responses for both years. The differences in frequencies of responses between CP's was significant for 1987 contracts, but not for 1986 ones (Chi square test). Because nesting cover is the limiting life requisite in less than 50 percent of the contracts, it appears that the available quality and quantity of winter cover and winter food are more important than first expected. It may be appropriate to consider increasing the detail on these life requisites in the HSI model, and to test it against field data on pheasant population response to the quality and quantity of each life requisite. The pheasant model is being tested by Dr. Paul Vohs and associates at the Iowa Cooperative Fish and Wildlife Research Unit.

Meadowlark. Eastern meadowlarks (*Sturnella magna*) are used in this study to

Table 3. Pheasant habitat quality indicators on unmowed fields. "Winter cover class." is the average of subjective rating of individual contracts for winter cover during pre-greenup sampling, or forecast for the year following midsummer (1 = poor, 4 = excellent). "Winter food" is the percentage of contracts with winter food on the field. "Most limiting life requisite" is the percentage of contracts reporting each for the vicinity of the sampled field. "NC" = nesting cover, "WF" = winter food, "WC" = winter cover. "*p*" is the statistical significance of differences between CP's within years. "All CP's" is a weighted mean for all CP's within years.

	Pre-greenup							Mid-summer			
	Winter cover class	Winter food	Most limiting life requisite (%)			Winter food, 0.25 mi. (%)	Winter cover, 2 mi. (%)	Winter cover class	Most limiting life requisite (%)		
Sampling Population			NC	WF	WC				NC	WF	WC
1986 contracts											
CP 1	1.9	8.2	41.6	33.1	25.3	63.7	86.3	2.0	44.7	23.2	32.1
CP 2	2.4	33.1	33.5	42.1	24.4	71.2	88.6	2.3	27.8	36.5	35.7
CP 3	1.3	7.7	46.2	23.1	30.8	31.6	75.0	1.3	35.7	57.1	7.1
CP 4	1.9	8.3	30.4	43.5	26.1	65.2	63.6	2.0	50.0	35.0	15.0
CP 5	1.4	14.3	0.0	63.6	36.4	44.4	93.8	1.6	0.0	50.0	50.0
CP10	1.8	0.0	26.3	36.8	36.8	38.5	82.4	2.0	26.3	52.6	21.0
p	<.05	<.001		n.s.		<.05	<.001	<.01		n.s.	
All CP's	1.9	11.3	37.6	35.1	27.2	59.1	84.7	2.0	35.1	28.3	27.8
1987 contracts											
CP 1	1.5	14.9	39.8	20.8	39.4	65.9	86.4	1.8	40.7	23.8	35.5
CP 2	1.8	44.4	59.5	15.4	25.0	75.9	89.9	1.9	44.0	21.2	34.8
CP 3	1.2	0.0	66.7	33.3	0.0	42.9	66.7	1.3	60.0	40.0	0.0
CP 4	2.0	58.3	61.5	15.4	23.1	94.1	72.7	1.9	46.7	26.7	26.7
CP 5	1.2	7.7	50.0	0.0	50.0	50.0	63.2	1.2	23.5	23.5	52.9
CP10	1.6	5.3	27.8	36.8	36.8	45.8	85.7	1.6	85.7	14.3	0.0
p	n.s.	<.001		<.05		<.05	n.s.	<.05		<.01	
All CP's	1.6	16.8	41.2	23.1	35.7	63.4	84.9	1.8	49.3	22.6	27.9

represent a nongame species that can fulfill its life requisites on old field and prairie cover types (at least during the summer nesting period). Mean meadowlark HSI's across all CP's was 15 percent of optimum for 1986 contracts, and 24 percent for 1987 contracts. These differences are highly significant ($p < 0.001$).

The lower HSI values for the older contracts are unexpected, and are due to the hypothesized optimum height of herbs. Heights taller or shorter than the optimum produce lower HSI values, and heights in this study (Table 1) are often taller than optimum. However, the "height" measured in this study differs from that intended in the original research papers upon which the model is based. For the model to work as intended, sparse plant parts that extend above the general herb canopy (e.g., grass flowers) should be excluded when measuring height. We intend to revise our field methods and to correct the 1988 height measurements using a correction factor developed from new field data.

Mean HSI values for the individual CP's within years were between 6 percent and 29 percent of optimum. No significant differences were found between CP's for either year. The meadowlark model is to be tested by biologists under the direction of Kevin Church of the Kansas Department of Wildlife and Parks.

Cottontail. Eastern cottontail (*Sylvilagus floridanus*) HSI's were almost zero in all CP's for both years (Table 2). The cottontail model focuses on CRP as it contributes to cover, which we hypothesized to be the most limiting life requisite in the vicinity of CRP fields. The low value for cottontail habitat results from lack of shrub cover on the CRP fields. Cottontail habitat may increase in the future if persistent herbaceous plants increase and shrubs invade on older CRP fields. The current model does not recognize improvements in habitat possible if the replacement of crops with permanent grasses and forbs improves food near existing cover on field edges. Dr. Henry Short of the National Ecology Research Center, U.S. Fish and Wildlife Service will begin testing of the cottontail model in 1989.

Disturbances

Data were collected on disturbances during both pre-greenup and midsummer sampling. The field biologists estimated how much of the field was affected by each of several types of disturbance, but did not describe the intensity of the disturbance, when it occurred or whether the points actually measured were within the disturbed area.

The data reported here were collected before 10 July. Until emergency haying was authorized by the U.S. Department of Agriculture (USDA) on 16 June 1988, mowing was allowed only for weed suppression or as part of the planting process for permanent cover. Although emergency haying was extensive in many states in the Midwest, most of our data were collected before the haying began. This was not true everywhere, however. In Minnesota, haying was concurrent with data collection (Don Nelson, pers. comm., 1989). Thus, part of the data included in "mowing" here could actually be from haying.

Most fields were undisturbed when sampled: 57 percent were undisturbed at pre-greenup sampling, and 76 percent were undisturbed when sampled during midsummer. Mowing was the most common disturbance observed, with 45 percent (pre-greenup) and 22 percent (midsummer) of the contracts having at least some mowing. Furthermore, the mowing was extensive. On those contracts with some mowing, an average of 82 percent (pre-greenup) and 65 percent (midsummer) of the areas of the fields were mowed. Grazing and burning was reported on less than 1 percent of the contracts. The disturbance category of "other," most of which was spraying with herbicides, was reported on 11 percent of contracts during both periods. Furthermore, about 50 percent of the area of the field was disturbed by this cause.

Disturbances were more common on the 1987 contracts than the 1986 ones. For example, pre-greenup mowing was reported on 45 percent of the 1987 contracts, but only on 38 percent of the 1986 ones. Similar differences were found for midsummer mowing and "other" disturbances. These differences are expected if cover crops are planted then mowed or sprayed the following year before permanent cover is planted.

To determine if mowing had a major impact on the vegetation of the CRP fields, we compared mowed and unmowed fields in the sampling populations with the most mowing: 1986 contracts of CP 1. We found that mean midsummer VOR's for the unmowed fields (mean = 4.5 dm) is highly significantly different ($p < 0.001$) from the VOR's for mowed ones (mean = 1.5 dm). Because the pheasant and meadowlark HSI models do not consider the mortality or nest destruction mowing can cause, we cannot calculate meaningful HSI values where there was mowing or haying after greenup. The impact of mowing, even without future emergency haying, is important enough to justify collecting more detailed data in future sampling.

Our data do not allow determining the impacts of the haying on habitat during 1988. However, we can make some educated guesses about the impacts. Both the pheasant and meadowlark models assume that habitat characteristics recorded at pre-greenup and midsummer adequately characterize the entire nesting period. In some states, pheasants and meadowlarks that nested near greenup may have still been on the nest when haying occurred, with direct mortality or nest destruction likely. The observed age structure of young pheasants in 1988 in Iowa supports the belief that this impact actually occurred. Birds of the size consistent with late hatching from nests established near greenup were much less abundant than slightly older ones, suggesting that the later nests were less successful (Allen Farris, pers. comm., 1989). Given the degree to which CRP fields supplied relatively good nesting cover at pre-greenup, nesting birds may have been concentrated on those fields. If they were, the regional impacts of disrupted nesting on CRP fields could have been much larger than the proportion of CRP in the landscape might suggest.

Pheasant and meadowlark nests established in midsummer could have sustained an impact by direct nest destruction or the reduced availability of cover on hayed fields in mid- to late summer. In summary, haying likely had a significant impact on pheasants and meadowlarks in 1988, and may have had a major impact in areas where nests established near greenup were disrupted.

Furthermore, the 1988 haying may also impact pre-greenup nesting cover in 1989, even if the plants grew well after the haying was completed. Because the drought was both widespread and severe, growth was probably minimal in most areas. Hence, the 1989 pre-greenup cover will almost certainly be much poorer than if haying had not occurred. The pheasant specialists who developed the HSI model attributed 70 percent of the total annual nesting habitat value to pre-greenup nesting, so the impacts of the 1988 haying on pheasants may be even greater in 1989 than in 1988. Data collection before greenup is scheduled for the Midwest region to allow quantifying the impact of haying on 1989 pheasant nesting cover.

Planned Activities

The current plan is to: (1) continue sampling at two-year intervals until 1994 (except that the 1990 Midwest sampling will be moved ahead to 1989 to quantify impacts of haying); (2) continue the tests of habitat models that started in 1988 and begin testing remaining models in 1989; (3) collect data on crops to establish the baseline conditions before the CRP; and (4) develop forecasts for future habitat conditions past 1994 (especially for tree plantings). We believe that we can decrease the workload of sampling in the Midwest region without impacting statistical validity by eliminating sampling of the second field on contracts with more than one field. At the same time, we recommend collecting somewhat more detail on several characteristics, including disturbances. Decisions will be made in close collaboration with the International Association of Fish and Wildlife Agencies.

An unresolved issue exists for CP fields that will become dominated by trees (e.g., CP 3), especially in the Southeast study region. The current indicator species use herb dominated habitats and are likely to decline when trees begin to dominate, but other wildlife species may benefit from an increase in young tree stands. However, indicator species for young forests that have high public interest may be lacking, and adding species would complicate analysis and habitat monitoring. Should indicator species be added to document benefits for young tree stands? Another potential issue is whether CRP sign-ups 5 and later are dissimilar enough from sign-ups 1–4 (included in the study) that they should also be sampled.

Extrapolations of our results to the entire population of CRP contracts in the Midwest will be done by using ratios calculated from the ASCS contract database. Calculation of these ratios now is complicated by modifications in CRP contracts that occurred after the contracts were added to the database. For example, comparing the CP number in the database against the one reported on the current version of each CRP contract for the Midwest region showed discrepancies for CP 1 and CP 2 contracts that took effect during 1987. About 9 percent fewer contracts were actually planted to CP 2, while 9 percent more were actually planted to CP 1. In addition, about 10 percent of the contracts that were to take effect during a given year were actually planted at least one year later. All of the analyses reported in this paper are based on reassigning contracts to populations based on the actual time and CP planted.

The differences in the ASCS contract database are consistent with reports that limited supplies and high prices of seed for native grasses and forbs caused some farmers to switch from CP 2 to CP 1, or to delay planting. (In the Southern Great Plains study region the discrepancies are even larger, with 29 percent of the contracts sampled planted one or more years late, and another 28 percent had a change in the CP actually planted.) The ASCS is updating its database to incorporate modifications in contracts (Michael Linsenbigler, pers. comm., 1989). Until this update is completed, these differences may have significance in interpreting the results of not only our study, but other analyses of the CRP as well.

The final analysis in 1995 will compare two scenarios, each including the period from 1985 to 1997 (the end of the 1987 contracts) for all CP's except CP 3 (tree plantings), which will be extended to the time of merchantability of the trees. Both scenarios will start with the reconstructed 1985 conditions. One scenario will describe the observed characteristics on the fields as they develop under the CRP, the other will describe the fields in cropland (under the assumption that without the CRP cropping would have continued). Differences in habitat between the scenarios will be attributed to the CRP. We also intend to identify differences between CP's, plantings, and management practices and identify which alternatives are better for wildlife. Results of this study for all regions will be available in a series of annual technical reports.

The economic implications of the CRP's effect on wildlife recreation will be analyzed by Dr. Richard Johnson (National Ecology Research Center, U.S. Fish and Wildlife Service). Two levels of analysis are planned. The regional-level analysis will add wildlife demand and expenditure information to the input-output models and data now being used by the USDA Economic Research Service. The second level focuses on individual farms and farmers. It will use standard economic impact analysis methods to assess the potential return to farmers from wildlife recreation on their CRP lands. A follow-up study may be done to assist farmers in planning plantings and management to maximize their return from CRP wildlife recreation.

Conclusions

We draw the following conclusions for the Midwest region:

1. Vegetation establishment is progressing on CRP fields. Most fields are in early establishment stages, with weedy species often dominant. CP's differ from one another, with the highest persistent cover on CP 2.
2. The CRP already provides good nesting habitat for pheasants, and fair nesting habitat for meadowlarks in the Midwest, with further improvement likely. We have not detected improvement in cottontail habitat quality.
3. Pheasants may be more limited by winter food and winter cover than nesting cover near some CRP fields, so plantings of woody plants, herb species with residues, and food plots should be encouraged.
4. Mowing and haying probably affected pheasants and meadowlarks in 1988 and and will almost certainly impact pheasant nesting in 1989, but more data are needed to quantify the impacts.

Acknowledgments

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Wildlife Management on Conservation Reserve Program Land: The Farmers' View

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Introduction

The Food Security Act of 1985 created opportunities for enhancing fish and wildlife on millions of acres of private farmlands (Jahn 1988). Title XII, Subtitle D of this Act, established the Conservation Reserve Program (CRP). It allows direct payments to farmers for retiring eligible cropland on a 10-year basis. The potential to develop CRP land as prime wildlife habitat is immense, but what happens on the ''back forty'' regarding wildlife management depends on the farm owner or operator. Farmers can determine the quantity and quality of wildlife habitat, the harvest rate of game animals, and who can access their CRP land to hunt. We studied how farmers learned about and reacted to the wildlife potential of their retired land to aid CRP participants, agencies and policy-makers in meeting their wildlife resource objectives. Our research was supported in part by the U.S. Fish and Wildlife Service.

Methods

A questionnaire was designed to elicit CRP participant responses regarding interest in improving wildlife habitat, adequacy of available information concerning wildlife habitat options, present management of retired land and financial incentives required to implement a wildlife plan.

A pilot study using the questionnaire was conducted in Poweshiek County, Iowa, where all CRP participants (n = 245) received a one-time mailing. Nearly half (49 percent) of the pilot surveys were returned and analyzed. After some minor changes to the questionnaire, it was randomly sent to 50 percent (n = 808) of the Virginia farmers using CRP in 1988. The Virginia questionnaire was designed and carried out following Dillman's (1978) recommendations. Nonrespondents were sent follow-up mailings three and five weeks after initial contact.

Results

The usable response rate to the Virginia mail survey was 76 percent (n = 616). We analyzed data for nonresponse bias by looking at trends in responses to three variables; respondent age (AGE), education (EDU) and desire to improve CRP wildlife habitat (IMP). Contingency table analysis was used to test independence of the variables over the response period. It was assumed that a significant test statistic would indicate a change over time and a probable nonresponse bias. The results were not significant (AGE, X^2 = 14.98, p = 0.45, 15 d.f.; EDU, X^2 = 13.13, p=0.78, 18 d.f.; IMP, X^2=5.49, p=0.14, 3 d.f.).

Attributes of CRP Participants

Age comparison of Virginia CRP respondents ($\bar{X}$ = 60 years) to all Virginia farmers ($\bar{X}$ = 53 years; U.S. Department of Commerce 1984), shows that CRP participants are significantly older ($X^2 = 96.6$, $p < 0.001$, 5 d.f.). Most of the observed difference is due to a greater than expected number of CRP participants in the 65 and over age group ($X^2 = 49.04$, $p < 0.001$, 1 d.f.). More ($X^2 = 249$, $p < 0.001$, 1 d.f.) of the survey respondents were female (25 percent) than expected from census statistics (7.8 percent). Farming supplied one-quarter or less of most (78 percent) respondents' incomes. The majority (70 percent) of respondents lived on or within 5 miles of their CRP land. Respondents controlled more land ($\bar{X}$ = 323 acres, se = 23.4) than the average Virginia farm ($\bar{X}$ = 182).

Interest in Improving Habitat

When Virginia CRP participants were asked if they would like to improve wildlife habitat on their retired land, 72 percent indicated yes. In Iowa, 73.5 percent indicated yes. Given a choice of nine reasons for improving wildlife habitat on their CRP land, the respondents were asked to indicate the most important. "Seeing wildlife" (23 percent), "hunting opportunities for self" (21 percent) and "wildlife values for future" (18 percent) ranked highest.

Those respondents who indicated a positive interest in improving wildlife habitat on their CRP land were asked about their past behaviors that aided wildlife on their farms. A preponderance (82 percent) of this group indicated at least one behavior (e.g., planted trees and shrubs for wildlife, avoided grazing woodlands, left brushy fencelines) that was used purposely to aid wildlife.

Likewise, the respondents who did not want to improve the wildlife habitat on their retired land were asked their reasons. Most (43 percent) indicated that they wanted to avoid attracting unwanted hunters. The second highest ranking reason was lack of money to spend on wildlife habitat (16 percent).

Wildlife Habitat Information Sources

When asked if they had been informed about improving the wildlife habitat on their CRP land, 62 percent indicated they had not. Nearly half of these checked "No, but I wish someone would." Of the respondents who did want to improve the wildlife habitat, 75 percent indicated they did not seek out information. County level ASCS-SCS personnel were the major source of wildlife habitat information for 24 percent of the respondents. Some commented that the information they did get was of a general or superficial nature. Fewer than 2 percent of the respondents got information from a wildlife biologist. Similarly, Kelley (1981) found that most Vermont farmers had never been contacted by fish and game department biologists or technicians although they knew the names of local game wardens.

Present Management of CRP Land in Virginia

Most respondents (73 percent) knew the acreage and what was planted on their CRP land. Survey respondents in Virginia indicated that nearly half of their retired land was put into pines (49 percent), followed by fescue-clover mix (19 percent) and fescue (15 percent). Only 5.6 percent of the respondents' retired land was signed up as wildlife habitat, and less than 1 percent was designated as wildlife food plots.

For weed control, 47 percent of the Virginia respondents indicated that they mowed their entire CRP acreage. One-half of this group checked that the mowing was done before August. Of those respondents who planted only grasses or herbaceous cover, most (58 percent) indicated that they mowed the entire acreage to control weeds. There was no evidence that wanting to improve CRP wildlife habitat had an effect on the 'mow it all' behavior ($X^2 = 0.36$, $p > 0.95$, 3 d.f.).

Most CRP land in Virginia (63 percent) is posted, and very little (4 percent) is leased to hunters or hunt clubs. Of those that did lease for cash, the average amount charged was \$2.04 per acre per year (se = \$0.47, $n = 13$). When asked to indicate the reasons they did not lease their land to hunting rights, the predominant reasons were lack of enough wildlife habitat to make leasing worthwhile (19 percent), concern about accidents and liability (19 percent), desire to let friends and neighbors hunt for free (15 percent), privacy (11 percent), and desire to hunt own land (10 percent). Nearly half the respondents (48 percent) indicated that they would not allow lease hunting on their land no matter what fee was paid, but 10 percent would lease their land if their price were met, over half of which ($n = 30$) would lease for \$5 or less per acre per year.

A question was posed concerning an additional payment to CRP participants for providing public access to their land for hunting. The overwhelming majority (82 percent) of respondents would not consider allowing public access, while a portion (12 percent) would not require any additional payment.

Financial Incentives to Implement Wildlife Plan

Virginia farmers were queried about their acceptance of wildlife plans developed for their CRP land. If all costs of implementing these plans were paid by a conservation agency or organization, would farmers require an additional one-time payment, no payment, or would they volunteer to pay part of the cost? The results were as follows: no response/not interested (41 percent), those who would implement the plan if they would receive a one-time payment (37 percent), those who required no payment (19 percent) and a few who volunteered to pay a portion of the cost (3 percent).

Discussion

Virginia and Iowa farmers in the CRP do have a high interest in improving wildlife habitat. Other studies have documented the importance of wildlife to landowners (Ruff and Isaac 1986, Alexander and Kellert 1984). Wildlife habitat on CRP land is plainly underdeveloped. Isaacs and Howell (1988) reported that slightly more than 9 percent of the nationwide CRP sign-up was in forestry or wildlife practices. Although tree planting is much more widespread on Virginia CRP land, little land was designated as wildlife habitat or foodplots. Few Virginia respondents ($n = 12$) indicated shrub plantings on their retired land.

The underdevelopment of wildlife habitat on CRP land is due to many reasons. The lack of information and education, landowner attitudes toward hunters, higher costs of wildlife cover and the physical limitations of CRP participants appear to be important constraints.

Enough farmers are interested in improving the wildlife habitat on their CRP land that a more concerted effort to inform and educate them about this potential would result in a probable increase in the populations of farm wildlife. Nowak (1988) has reported that information and education surrounding the conservation provisions of the Food Security Act appear to have a low priority and there is little consensus about who should inform whom about what. The indicated desire to improve wildlife habitat on CRP land and high response rate to the wildlife management questionnaire suggests a seizable opportunity. USDA administrators can act on this opportunity to realize the wildlife objectives of the CRP by targeting farmers who desire enhanced wildlife habitat on their retired land. Better cooperation and information exchange between state wildlife, forestry and USDA agencies can reduce the mixed signals that some CRP participants have received.

Publications that explain the options to enhance CRP land for wildlife may help persuade some farmers. However, publications should be supplemented by personal contact. Names and addresses of CRP participants are available at county ASCS offices. A letter to each CRP participant from a wildlife biologist could open avenues of communication that are evidently desired by farmers. This letter should invite one-on-one contact to elicit landowner objectives concerning farm wildlife, coupled with a strategy to achieve them. Personal contact is the best way to get landowners to state their objectives regarding wildlife on their farms, and is recommended early in the CRP participant's decision-making process to ensure cost-share for initial establishment of plants that will enhance wildlife habitat. Stated landowner objectives then become the basis of the planning process and measurement of success (Giles 1981). Even though farmers may have their plans adopted, they are amendable; wildlife enhancement can be added.

Mowing the entire CRP acreage is the most common method of weed control indicated. Mowing can have deleterious effects on wildlife populations if nests or cover are destroyed. There was no significant difference between those farmers who wanted to improve wildlife habitat on their CRP land and those who mowed their CRP land to control weeds. This behavior may be due to recommendations to farmers to mow their land biannually or an ingrained ''harvest or mow'' behavior pattern in farmers. Again, this reveals the need for improving information and education on wildlife management to CRP participants.

Hunters, particularly thoughtless hunters, are effective in reducing or discouraging wildlife habitat development (Ruff and Isaac 1987). Because the main reason farmers cited for not wanting improved wildlife habitat was the attraction of unwanted hunters, the consequences of unethical hunting are impacting wildlife habitat on private land. A Virginia hunter-access study found that hunting without permission, littering and vehicle damage to field roads were major hunter-related problems (Bromley and Hauser 1984). Continued pressure must be put on hunters to behave ethically. Hunter education efforts by state agencies should continue to be a priority.

Objections to more applications, regulations and red tape may hinder acceptance of a paying program to stimulate wildlife habitat improvement. Extra income from lease hunting is not a suitable option for most Virginia CRP participants. An additional payment for providing public hunting access to their CRP land stimulated little farmer interest. Farmers want to control who goes on their land and do not trust strangers with guns.

Although programs exist to aid farmers in enhancing CRP wildlife habitat, participation may be low because of the physical limitations of CRP participants. Older, retired farmers will probably require help and equipment to establish and maintain wildlife habitat.

Summary

Even though many state agencies and conservation organizations have implemented programs to enhance CRP wildlife habitat, they should examine how well they contact all CRP participants. Many farmers may be "fence sitting" and will not go out of their way to seek information on wildlife habitat. Close contact with a wildlife professional can motivate some farmers to enhance their CRP land for wildlife. With the passage of the 1990 Farm Bill, more farmland probably will be retired (Benbrook 1988). Wildlife and extension agencies must be aggressive in their information and education efforts if the positive impact of long-term land retirement on wildlife is to be maximized. As one farmer commented, "Wildlife practices are not fully appreciated by the ASCS-SCS; they have a full plate with farm plan compliance. Somebody with a wildlife mission needs to get the word out."

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Land-use Changes and Hunter Participation: The Case of the Conservation Reserve Program

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The Conservation Reserve Program (CRP) was authorized by the Conservation Title of the 1985 Food Security Act. The CRP allows farmers to set-aside highly erodible lands for a period of ten years, with the provision that these areas have a cover of grasses or trees. In addition to highly erodible lands, lands related to off-farm environmental threats and soil salinity are also eligible for inclusion in the CRP. The Secretary of Agriculture can modify the bid process so that establishment of shelterbelts and streambank protection is favored. Farmers are eligible for cost-sharing to establish cover on their CRP acres.

The CRP has seven primary objectives, with the primary one being decreasing soil erosion. The creation of better fish and wildlife habitat was one of the secondary objectives of the CRP. If the entire 45 million acres eventually are retired, over 10 percent of the nation's cropland will be converted to potential wildlife habitat. The conversion of cropland to grass, tree plantings and other special uses, such as wildlife plantings, will provide cover for nesting, escape and rearing of young, as well as providing food for some species. This improvement in habitat is expected to result in increases in wildlife populations of species that currently are constrained by a lack of such types of habitat.

Agricultural Land-use Change and Wildlife

A variety of wildlife species live in association with agricultural land. Cropland, grassland and remnant habitats such as hedgerows, woodlots and wetlands are used by wildlife species for nesting, food and escape cover. Many of these remant habitats, viewed as unproductive lands, have been converted to cropland production. Changes in agricultural technology between the 1950s and late 1970s resulted in losses of wildlife habitat formerly abundant on agricultural land. Fencerow-to-fencerow production eliminated hedgerows, windbreaks and grassy borders while wetlands were drained for agricultural production. National data on the proportion of agricultural land in row crops, small grains and hay during this period can be used to illustrate the changing patterns in agricultural land use. Data on acres planted in row crops (corn, sorghum, cotton, peanuts, soybeans, and tobacco), small grains (wheat, rye, oats, and barley) and hay were taken from *Agricultural Statistics* at five-year intervals, starting in 1950 and ending in 1985[1]. Nationally, the proportion of agricultural acres planted in row crops increased 12 percent, the proportion in small grains and hay decreased 9 percent and 4 percent, respectively (Figure 1). These changes varied by the ten farm production regions (Table 1) . All regions except the Southern Plains

[1]Tobacco and hay acres were reported as acres harvested rather than acres planted in the data.

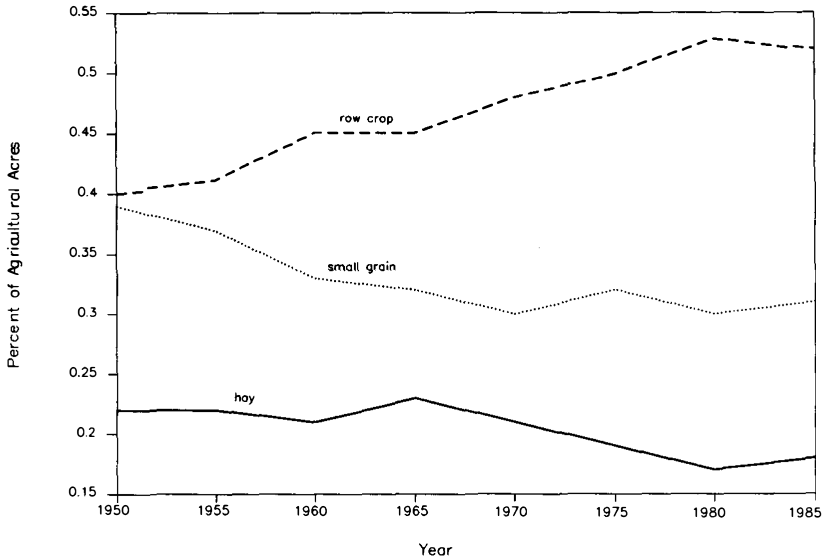

Figure 1. Percentage of agricultural acres by type of crop, U.S., 1950–1985.

had an increase in the proportion of row crops, ranging from 1 to 30 percent. The greatest increases in the proportion of acres planted to row crops occurred in the Corn Belt, Lake States, and Northeast regions, where the proportion of row crops increased 30, 25, and 25 percent, respectively (figures 2 and 3). In the Corn Belt and Lake States the total number of acres in agricultural production increased so that the change in proportion was a combination of replacement of small grain and hay acres with row crops and the conversion of other land to row crop production. In

Table 1. Definition of farm production regions.

Region	States
Appalachian	Kentucky, North Carolina, Tennessee, Virginia, West Virginia
Corn Belt	Illinois, Indiana, Iowa, Missouri, Ohio
Delta States	Arkansas, Louisiana, Mississippi
Lake States	Michigan, Minnesota, Wisconsin
Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
Northeast	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
Northern Plains	Kansas, Nebraska, North Dakota, South Dakota
Pacific	California, Oregon, Washington
Southeast	Alabama, Georgia, Florida, South Carolina
Southern Plains	Oklahoma, Texas

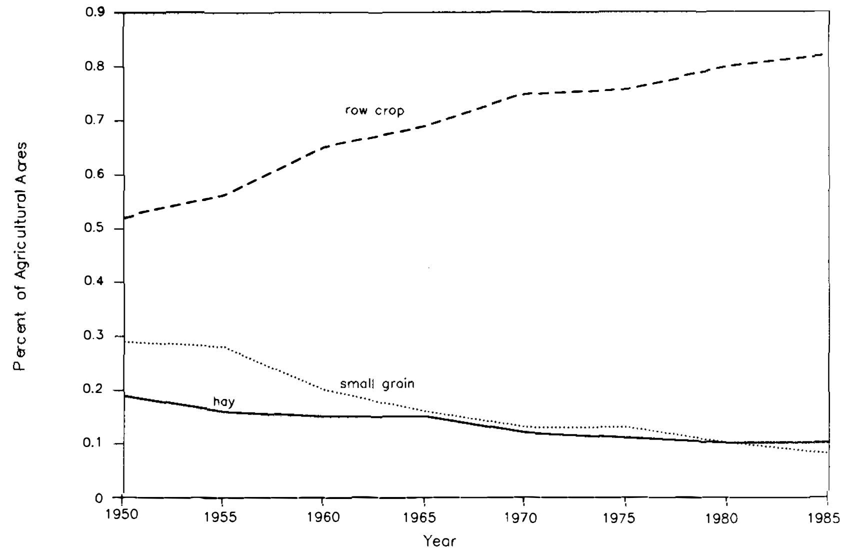

Figure 2. Percentage of agricultural acres by type of crop, Corn Belt, 1950–1985.

the Northeast, the number of acres in agricultural production decreased over the time period. Therefore, row crops may have replaced small grain and hay acres; but some of those acres also were converted to other uses.

Several state-level studies provide more detailed information on changes in the distribution of agricultural crops that have been detrimental to many farmland species. Warner and Etter (1985) estimated that since 1962 row crop production in Illinois has increased 48 percent, farm size has increased 37 percent, and hay and oat acreages have decreased 82 percent. Between 1960 and 1978 row crop acreage in Indiana increased 46 percent, acreage in small grain decreased 54 percent, hay acreage decreased 33 percent, and pastureland acreage decreased 29 percent (Cutler 1984). Taylor et.al. (1978) compared two areas in Nebraska in 1955, 1964, and 1976. Land-use changes in these areas areas followed the same trend as in the previous cited studies: row crop acreage increased while small grains, hay and pasture acreages decreased, with most of the changes occurring after 1964.

These agricultural shifts have also been correlated with changes in farmland species populations. In the Nebraska study (Taylor et al. 1978), decreases in pheasant densities paralleled the land use changes. In addition, the interspersion of different agricultural land uses was found to be significantly correlated with pheasant densities; the greater the interspersion index the higher the pheasant densities. Declining hunter harvest of cottontail rabbits, bobwhite quails, and pheasants (a proxy for population trends) was significantly correlated with both increasing row crop acreage and declining areas in hay and small grains between 1956 and 1983 in Illinois (Brady and Warner, unpublished). Cottontail populations have declined 90–95 percent in eastern Illinois, the most intensive agriculture area in the state; statewide populations have

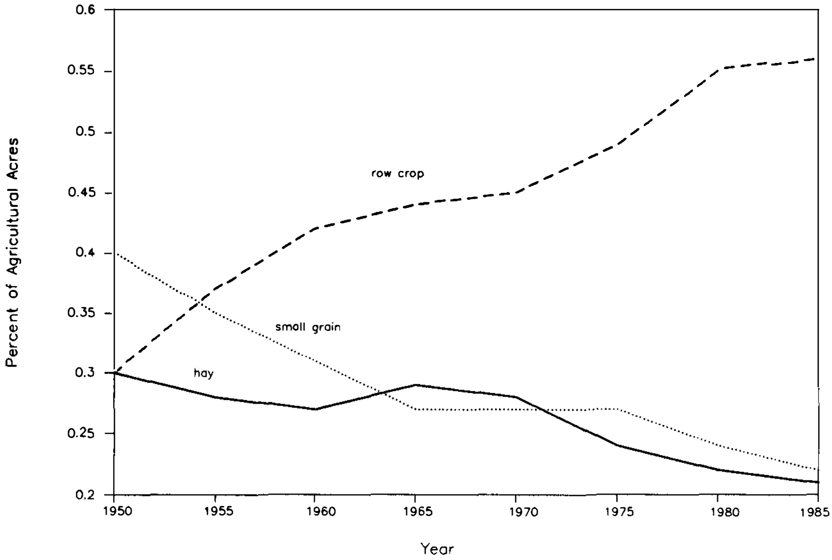

Figure 3. Percentage of agricultural acres by type of crop, Lake States, 1950–1985.

decreased 70 percent over 23 years (Edwards et.al. 1981). Key grassland bird species have declined 90 percent in Illinois since 1957 (Graber and Graber 1983).

Biologists from 14 states, primarily in the Midwest and Northern Plains, compared farmland wildlife populations of the late 1950s and early 1960s to the late 1970s. Pheasant population declines in 12 states ranged from 33 percent to 96 percent; cottontail populations in 4 states declined between 7 percent and 80 percent. All states had the same trends in land use: increasing acres in row crops; decreasing acres in small grains, hay and pasture; loss of wetlands, edge habitat and idleland (Farris and Cole 1981).

Wildlife Impacts from Land Retirement Programs

The United States Department of Agriculture began cropland set-aside programs in the 1930s to attempt to stabilize rural economies in the era of the Dust Bowl and Great Depression. Although benefiting wildlife has only become a goal of these programs in recent years, these programs have always had the potential to provide wildlife habitat. However, their usefulness to wildlife is largely a function of the cover provided on idled land and the length of time the land is retired. Requirements for cover establishment have varied among programs.

The Agricultural Conservation Program (ACP) was authorized in 1936 and continued through 1941. The program set up annual contracts, but grass or legume cover was required. At its peak, 42.6 million acres were retired under the ACP. Most of the land returned to production during World War II.

The Soil Bank Program was initiated in 1956 and is the prime example of benefits set-asides can provide for wildlife. The Soil Bank had two components: the Acreage

Reserve, which idled land under annual contracts with no cover requirements, and the Conservation Reserve, which idled land for 3 to 10 years and required permanent vegetative cover. The program lasted until 1972. The peak occurred in 1961, when 28.5 million acres were enrolled in the Conservation Reserve. Most of this land returned to production during the 1970s (Berner 1984).

The Feed Grain Program and Wheat Program were established in 1961. Both are annual programs with no cover requirements. These programs were responsible for most of the cropland idled through the early 1980s. In 1966, the Cropland Adjustment Program (CAP) was initiated. This was a long-term retirement program, with contracts ranging from 5 to 10 years. Because of limited funding, a maximum of 4 million acres was enrolled in the program over its 11-year lifespan (Berner 1984). The Payment-in-Kind an Acreage Adjustment Programs of 1983 set aside a record of over 80 million acres. The CRP is the most recent land retirement program. The cover requirements over a 10-year period should result in significant improvements in wildlife habitat.

The effects of these programs on wildlife populations have been documented in various studies. The best documentation of the wildlife impacts of set-aside programs is found for pheasants. Pheasant population increases have been related to the ACP, the Soil Bank Conservation Reserve, and the CAP (Berner 1984). Biologists in South Dakota estimated that pheasant populations doubled between the mid-1950s and the height of the Soil Bank. A positive relationship was found between pheasant populations and Soil Bank acres in South Dakota (Erickson and Wiebe 1973). In North Dakota, waterfowl production (ducklings/acre) was higher on CAP land than nonCAP land (Harmon and Nelson 1973). Hunter harvest of pheasants, rabbits, and quail was higher on CAP land in Indiana (Machan and Feldt 1972). Even annual set-asides can be beneficial if cover is established. An Illinois study of Feed Grain Program acres showed that the set-aside acres in unharvested hayfields had a higher proportion of successful pheasant nests than other agricultural lands. Other studies of waterfowl and pheasants showed similar results: higher nesting success and higher population densities on set-aside acres (Duebbert 1969).

Conservation Reserve Program Impacts on Wildlife Habitat

The overall impact of the CRP is expected to be increased populations of farmland-associated species, including upland game, ground-nesting birds, small mammals, and other grassland-dwelling species. Acres enrolled will add permanent cover around existing cropland. Waterfowl are also expected to benefit from increased nesting cover adjacent to wetlands.

Several factors will influence the extent of the effect on wildlife populations. A primary factor is the type of vegetation established. Native grasses and legumes are highly desirable. Acreage being established in trees provides cover for many species in the early years; species composition will alter as the trees mature. Another factor is the quality of the cover established, in terms of height and density, which is related to the chosen plant species mix. Finally, the juxtaposition of the idled lands with other land use types is important; for example, proximity to cropland used for food.

One group expected to benefit from increases in wildlife populations caused by CRP habitat is wildlife recreationists. All types of wildlife recreationists may benefit, including hunters, anglers and nonconsumptive users. Not all groups of wildlife recreationists are likely to be equally affected by the CRP. Fishing will be affected as a result of the water quality impacts of the CRP, but this analysis is restricted to terrestrial impacts. Estimates of the value of nonconsumptive use were not available.

Data Sources

The primary sources of data for the economic analysis are the 1980 and 1985 National Surveys of Fishing, Hunting, and Wildlife Associated Recreation conducted by the U.S. Bureau of the Census for the U.S. Fish and Wildlife Service. The surveys conducted in 1980 and 1985 consisted of two stages. The first is a screening survey that identified participants in wildlife recreation activities throughout the nation. The second stage samples participants identified in the screening survey for more detailed information about their fishing and hunting activities and/or their nonconsumptive recreation activities. The data collected includes socioeconomic information and detailed information about the location and duration of recreational activities. The 1980 survey data was used to estimate the participation equations; the national and regional participation rates from the 1985 data were used to solve the participation equations.[2] Supplemental data on state habitat availability and state demographic characteristics were obtained from the National Resources Inventory, Bureau of the Census, and federal reports of the Bureau of Land Management, Forest Service, and Fish and Wildlife Service.

Methodology

Acres enrolled in the CRP will create new grassland habitat for several game species, primarily small game.[3] Previous studies have shown that habitat availability affects the decision of whether or not to hunt (Miller and Hay 1981, Walsh et al. 1987). Habitat availability serves as a proxy for game populations. Habitat availability also affects the decision of what type of hunting a hunter will participate in. Therefore, hunter response to increases in habitat from CRP acreage is expected to occur at two levels. First, there should be new entrants into the existing hunter population as a result of more available habitat. Second, a higher proportion of existing hunters should participate in small game hunting, since the major population increases should occur in these species.

New entrants in hunter population. Walsh et.al. (1987) estimated a probability of participation equation for hunting based on habitat availability and socioeconomic variables. The habitat availability variable for all types of hunting was defined as the sum of forestland, pastureland and rangeland in a person's resident state. The coefficient from the Walsh study was used to estimate the change in hunter participation rates as a result of changes in habitat availability. Participation rates for hunters among the general population (over 16 years old) were derived from the 1985 survey for each of the ten farm production regions. The actual regional participation rates from the 1985 survey were used to solve for the first derivative of participation rate with respect to habitat availability. This derivative defines the

[2]The 1985 data tapes were not available at the time of analysis. Therefore, the coefficients for the participation equations are assumed to be stable over time. The 1985 participation rates used to solve the equations incorporated the impacts of decreased small game hunting participation.

[3]Small game in the Fish and Wildlife Service survey includes rabbits, hares, quail, grouse, prairie chicken, partridge, squirrel, and pheasant.

percentage change in participation that occurs for a one percent change in habitat availability.

CRP acres enrolled in each year of the program (1986–2000) were added to the habitat availability variable. A one-year lag between enrollment of acres and wildlife response was assumed. The change in participation rate in response to the increased habitat availability was calculated for each year of the program. The new rate was then used to estimate the number of new entrants who will participate because of habitat added by the CRP in that year. Each new hunter was assumed to hunt the average number of days other small game hunters hunted in the region of residence. Multiplying average days by number of new hunters resulted in total new days of hunting for each year of the CRP program.

Additional small game hunting by existing hunters. The general procedure for estimating additional small game hunting by existing hunters was similar to the procedure described above. In this case, the participation equation included a habitat availability variable that was limited to grassland in the resident state—the type of habitat primarily provided by CRP and most important for small game. The probability of a hunter being a small game hunter was estimated at the regional level using the 1980 survey data. The first derivative of the small game participation rate with respect to grassland availability was solved using 1985 regional small game participation rates. As above, changes in the participation rates were estimated as a result of adding CRP acres to the available habitat in each of the program years. The new participation rates were then used to estimate the number of additional small game hunters resulting from CRP acres being added to the habitat base. Each additional hunter was assumed to hunt the average number of small game hunting days. Average days were multipled by new small game hunters to obtain new small game hunting days from the existing hunter population.

Results

CRP had little impact on total habitat availability, and therefore there were few new entrants into the hunting population. The increase in grassland acres was not large in comparison to total acres in grassland and forestland. The majority of benefits resulted from additional days of small game hunting from existing hunters. Therefore, the primary factor affecting benefits was the change in percentage of grassland in a region. The largest percentage changes in grassland habitat occurred in the Corn Belt and Lake States regions, as did the greatest number of additional small game hunting days.

The estimated dollar value of the additional days was based on the consumer surplus value of a small game hunting day (Table 2). Sorg and Loomis (1982) summarized consumer surplus values for all types of hunting, including small game, found in the literature. Small game values ranged from $28 to $45 per day (in 1986 dollars). The average of the range, $36.50, was used to estimate the benefits of CRP for hunting. Benefits occurring after 1986 were discounted to 1986 using a discount rate of 4 percent. The total consumer surplus value of small game hunting benefits as a result of CRP was estimated to be $3.8 billion. Almost half the total benefits occurred in the Lake States region.

The present value of small game hunting benefits from the CRP is large. Other wildlife benefits exit, but are not easily estimated. The dollar benefits were calculated

Table 2. Net present value of hunting benefits from the Conservation Reserve Program, 1986–2000.

Region	Net present value (thousand dollars)
Pacific	$ 29,195
Mountain	17,459
Northern Plains	95,237
Southern Plains	76,955
Lake States	1,444,718
Corn Belt	820,572
Delta	257,434
Southeast	350,309
Appalachian	327,100
Northeast	373,614
Total	3,792,593

before the drought of 1988, which resulted in less achievement of cover than would have occurred otherwise. Therefore, some of the benefits will probably occur at a longer lag. Several adjustments are being considered for the CRP in the 1990 Farm Bill, including expanding the acreage and including wetlands and other environmentally sensitive areas. Such changes would further increase benefits to wildlife, and potentially extend the period over which the benefits accrue.

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Agriculture/Wildlife Enhancement in California: The Central Valley Habitat Joint Venture

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Introduction

Wetlands and agricultural habitats in the Central Valley of California support the largest single concentration (currently 4–5 million) of wintering waterfowl in North America (Bellrose 1980, Heitmeyer et al. 1989). These waterfowl represent more than 60 percent of all waterfowl (excluding sea ducks) wintering in the Pacific Flyway and more than 20 percent of all waterfowl wintering in North America (U.S. Fish and Wildlife Service 1978). California also supports a large population of breeding ducks, especially mallards (*Anas platyrhynchos*) (Heitmeyer et al. 1989). Despite the importance of the Central Valley, less than 300,000 acres (121,500 ha) of wetlands remain (Gilmer et al. 1982). Because of this wetland limitation, many waterfowl species are highly dependent on harvested grain fields for food in winter, and on wheat, hay and set-aside (lands removed from production under provisions of U.S. Department of Agriculture [USDA] crop allocation programs) lands for nesting sites in summer. The value of agricultural lands to waterfowl is greatly affected, however, by crop type, land management technique, weather and location (e.g., proximity to major waterfowl concentrations) (Miller 1987, Heitmeyer et al. 1989).

The newly established Central Valley Habitat Joint Venture (CVHJV) of the North American Waterfowl Management Plan (NAWMP) (Canadian Wildlife Service [CWS] and U.S. Fish and Wildlife Service [USFWS] 1986) recognizes the importance of agricultural lands to waterfowl in California, and includes an objective to enhance the resource values to waterfowl on 443,100 acres (179,456 ha) of agricultural lands. Other objectives of the CVHJV include: (1) protecting 80,000 additional acres (32,400 ha) of existing wetlands through fee or perpetual easement acquisition; (2) securing Central Valley Project power rates and water to provide a firm 403,050 acre-foot water supply for use by national wildlife refuges, state wildlife management areas and the Grasslands Resource Conservation District; (3) increasing wetland area by 120,000 acres (48,600 ha); and (4) enhancing habitat on 290,000 acres (117,450 ha) of existing public and private wetlands.

This paper describes the development of the objective to enhance waterfowl habitat on 443,100 acres (179,456 ha) of agricultural lands, including the biological basis for determining acreage goals, its integration with other CVHJV objectives, and strategies for implementation.

Biological Basis for Agricultural Land Objectives

Winter and Breeding Population Objectives

The NAWMP seeks to achieve and maintain the diversity, abundance and distribution of waterfowl that occurred during 1970–79 (CWS and USFWS 1986). Desired winter populations for the Central Valley include an average of 4.7 million ducks and 865,000 geese and swans (Table 1).

The number of ducks breeding in the Central Valley is unknown. The average number of total ducks and mallards estimated from aerial surveys in California during 1970–79 was 164,600 and 100,700, respectively, with approximately 60 percent of this total occurring in the Central Valley (Pacific Flyway Study Committee 1971–80). These surveys grossly underestimated breeding population sizes, however, because (1) surveys were limited to non-random transects in the Central Valley and "spot checks" of certain northern mountain valleys, (2) aerial estimates were not adjusted for visibility biases and (3) number of transects flow/year was variable and not statistically representative of various physiographic regions.

The NAWMP seeks a continental harvest of 20 million ducks annually (14.75 percent of desired fall flights) (CWS and USFWS 1986:6). The average number of mallards harvested in California during 1970–79 was 290,113 (USFWS, unpublished data); therefore a fall flight of 1.967 million mallards into California would be necessary to support that level of mallard harvest (at a 14.75 percent harvest rate). Banding data suggest that at least 51–58 percent (Munro and Kimball 1982, Trost 1985) of mallards harvested in California are locally derived. These values are probably low because of the aforementioned problems associated with breeding survey estimates used to calculate harvest derivation indices. If we assume that:

Table 1. Waterfowl population (× 1,000) objectives of the Central Valley Habitat Joint Venture relative to those of the total North American Waterfowl Management Plan[a]

Annual period and species	Central Valley	North America	Central Valley as % of total
Breeding			
Total ducks	490[b]	62,000	0.8
Mallards	300[b]	8,700	3.4
Fall flight[c]			
Total ducks	1,059	131,600	0.8
Mallards	648	18,792	3.4
Winter (peak)			
Total ducks	4,700	21,134	24.7
Total geese and swans[d]	875	5,701	15.3
Cackling Canada	200	250	80.0
Aleutian Canada	5	5	100.0
Lesser snow	320	1,760	18.2
Ross'	100	125	80.0
Tule whitefront	5	5	100.0
Pacific whitefront	200	300	66.7
Tundra swan	40	60	66.7

[a]Objectives for North America from Canadian Wildlife Service and U.S. Fish and Wildlife Service (1986).
[b]See text for assumptions and calculations.
[c]Fall flight index = average breeding population estimate + (average 1970–79 production rate [1.16] × average breeding population size).
[d]Reflects recent winter distribution patterns and adjusted for 25 percent annual recruitment (McLandress 1979, Woolington et al. 1979, Raveling and Zezulak 1988). Scientific names are: cackling Canada (*Branta canadensis minima*), Aleutian Canada (*B.c. leucopareia*), lesser snow (*Chen caerulescens*), Ross' (*Chen rossii*), tule whitefront (*Anser albifrons gambelli*), Pacific whitefront (*Anser albifrons frontalis*), tundra swan (*Cygnus columbianus*).

(1) 55 percent of the desired harvest of mallards in California originates in California, (2) 60 percent of mallards breeding in California nest in the Central Valley, and (3) average recruitment is 1.16 juveniles/breeding adult (1970–79 continent-wide average for mallards, USFWS, unpublished data), then the desired breeding mallard population for the Central Valley is approximately 300,000. Mallards comprised 61 percent of all ducks nesting in California during 1970–79 (Pacific Flyway Study Committee 1971–80), consequently, the desired breeding population for all ducks combined in the Central Valley is 490,000. If these breeding populations can be attained, the Central Valley will generate a fall flight of more than 1 million total ducks (Table 1).

Annual use-days of desired waterfowl populations in the Central Valley will be 112.5 million and 750 million for geese and ducks, respectively, if use-days are calculated as a linear function of gradual buildup in fall to desired peak winter populations (Table 1) followed by a gradual decline to desired summer breeding levels (based on migration chronologies in the Central Valley in Arend 1967, Bellrose 1980).

Energetic Requirements

If desired populations of waterfowl are to be supported in the Central Valley, nutritional (used in its broadest sense, Elkin 1987) and behavioral requirements must be met. Many nutritional requirements of waterfowl are poorly known, highly dynamic, or physiologically and biochemically complex (Elkin 1987), and behavioral requirements are difficult to quantify in terms of areas of specific habitats needed. In contrast, basal energy requirements of waterfowl can be easily estimated and are commonly used to estimate food requirements (e.g., Prince 1979:113). Herein, I use energy requirements to estimate food requirements of waterfowl in the Central Valley, and thus wetland and agricultural land needed to provide this food. Caveats of this approach are that requirements of waterfowl in California are not limited to energy (Heitmeyer et al. 1989) and that waste grains lack many essential nutrients (e.g., National Research Council 1982, Joyner et al. 1987). It is anticipated, however, that more than 75 percent of energy requirements of waterfowl in the Central Valley will be provided from foods consumed in wetlands (see below). Most wetlands produce a diversity of foods of varying nutrition qualities, consequently, waterfowl feeding in wetlands should be able to meet nutritional needs not provided by waste grains (Fredrickson and Reid 1988).

Energy requirements of waterfowl desired in the Central Valley were calculated using the following equation:

$$G = \sum_{k}^{j} \frac{U_k \text{ (BMR) (Multiple of BMR for EE)}}{\text{Metabolizable energy of foods consumed}} \tag{1}$$

where:

G = grams of food required,
U = annual use-days for each species,
K = 1,2,. . . . .j species,
BMR = basal metabolic rate in kcal/day, and
EE = existence energy in Kcal/day.

BMR was estimated using the equation of Ashoff and Pohl (1970) for non-passerines at rest, EE as 3x BMR (King 1974, Ricklefs 1974, Fredrickson and Drobney 1979, Prince 1979), and metabolizable energy of marsh foods and waste grains as 3 kcal/g (range of 2.5–3.5 kcal/g in Miller 1987). When these values are used, equation (1) becomes:

$$G = \sum_{k}^{j} \frac{U_k\,(73.5\ W^{0\ 734})(3)}{3} \tag{2}$$

and further reduced to:

$$G = \sum_{k}^{j} U_k\,(73.5\ W^{0\ 734}) \tag{3}$$

where:

W = body mass of species in kg calculated from Bellrose (1980).

Solving this equation using the desired use-days of all waterfowl species equals 351.8 million lbs. (159.7 million kg) of food required to support annual waterfowl populations in the Central Valley.

Area of wetlands and agricultural lands needed to provide the above food was calculated using certain broad assumptions about how much food is available to, and consumed by, waterfowl in each habitat type. Not all foods produced in wetlands, or left in fields following harvest, are available to waterfowl because of deterioration (Shearer et al. 1969), deposition in seed banks (Pederson and van der Valk 1984), and consumption by other wildlife (Fredrickson and Reid 1986), nor are all foods available to waterfowl consumed. The assumptions I use below only provide a basis for estimation and may change as future studies more clearly define food availability and consumption in specific habitats.

Harvested rice and corn fields are the primary agricultural lands used by wintering waterfowl in the Central Valley (Smith 1979, Miller 1987, Heitmeyer and Raveling 1988) and thus offer the greatest potential for enhancement that would directly benefit wintering waterfowl. Approximately 250 lbs. of waste rice are left per acre (280 kg/ha) in rice fields that are burned after harvest in the Sacramento Valley of California (M.R. Miller, unpublished data) along with unknown, but substantial amounts of natural foods such as graze, seeds from moist-soil plants, tubers and invertebrates. Recent studies of ducks (Miller 1987, Heitmeyer and Raveling 1988) and geese (Hobaugh 1985, Alisauskas et al. 1988) feeding in rice fields indicate that consumption of natural food may often exceed consumption of rice. Consequently, I assume that 250 lbs./acre (280 kg/ha) is a reasonable estimate of the combined amount of waste rice and natural foods consumed in an average rice field.

Wetlands provide more food/acre than harvested grain fields, and well managed marshes often produce more than 2,000 lbs. of combined seeds, tubers, graze and invertebrates/acre (2,242 kg/ha) (Fredrickson and Taylor 1982). Production of these foods in wetlands is extremely variable depending on the vegetation present, the length of time since disturbance of vegetation and soil, and management strategies (Fredrickson and Taylor 1982, Kelley 1986). Privately-owned duck clubs comprise more than 65 percent of all wetlands in California, and clubs typically manage for a combination of moist-soil foods (Heitmeyer et al. 1989). Production of a complex of these food in well-managed wetlands probably averages more than 1,500 lbs./

acre (1,681 kg/ha) (Kelley 1986, Severson 1987, Laubhan and Fredrickson 1989), and if it is assumed that waterfowl consume an average of 50 percent of foods available (averaged over all wetlands), then 750 lbs./acre (841 kg/ha) potentially consumed by waterfowl in wetlands can be used for calculations.

If the CVHJV objective to increase wetland area by 120,000 acres (48,600 ha) is achieved, 402,000 acres (162,810 ha) of wetlands will be present (Table 2). If wetlands provide an average of 750 lbs./acre (841 kg/ha) to waterfowl, then 78 percent of the energy requirements of waterfowl in the Central Valley will be met by wetlands; the remaining energy deficit could be met via 332,300 acres (134,481 ha) of managed harvested grain fields (providing an average of 250 lbs./acre [280 kg/ha] consumed by waterfowl).

Nesting Habitat

The amount of upland nesting cover needed to support the desired breeding population of 490,000 ducks in the Central Valley is unknown. Factors contributing to use and nesting density include species of duck, vegetation type and density, proximity to wetlands, and relative disturbance by predators. In the Central Valley, waterfowl nest primarily in wheat fields, hay and pasturelands, and scattered idle vegetated lands, such as set-aside lands (e.g., Mayhew 1955, Anderson 1956, 1957, 1960, and others); little upland area currently exists that is managed specifically for nesting waterfowl. Opportunities to enhance nesting habitat over large areas are greatest on set-aside and pasture lands because of commercial harvest constraints on wheat and hay lands, and the relatively small area of managed uplands in public

Table 2. Estimated acreage (hectares in parentheses) of agricultural lands needed to meet energy needs of waterfowl in the nine drainage basins of the Central Valley of California.[a]

Basin	Percentage distribution waterfowl[b]	Current wetland acreage × 1,000[c]	Proposed wetland acreage × 1,000[d]	Supplemental agricultural acreage needed × 1,000[e]
Butte	23	26 (10.5)	60 (24.3)	128.7 (52.1)
Sutter	7	4 (1.6)	15 (6.1)	48.9 (19.8)
American	5	4 (1.6)	14 (5.7)	25.1 (10.2)
Colusa	15	27 (10.9)	42 (17.0)	75.3 (30.5)
Yolo	5	9 (3.6)	19 (7.7)	10.1 (4.1)
Suisun	5	45 (18.2)	45 (18.2)	—
Delta	10	10 (4.0)	30 (12.2)	44.2 (17.9)
San Joaquin	25	121 (49.0)	141 (57.1)	—
Tulare	5	36 (14.6)	36 (14.6)	—
Total	100	282 (114.2)	402 (162.8)	332.3 (134.6)

[a]See text for assumptions and calculation methodology.
[b]Adjusted from U.S. Fish and Wildlife Service (1978:11) to reflect present and desired future distribution.
[c]Adjusted from U.S. Fish and Wildlife Service (1978, 1987) as determined from Heitmeyer et al. (1989), ground truths, and U.S. Fish and Wildlife Service National Wetland Inventory maps.
[d]Adjusted from U.S. Fish and Wildlife Service (1987:13) as determined by the Wetland Restoration Workgroup of the Central Valley Joint Venture.
[e]Includes rice, corn, milo, and barley croplands used by waterfowl, but does not include set-aside, wheat or other croplands.

wildlife areas. In 1987, more than 790,000 acres (319,950 ha) of croplands were in set-aside; 392,000 acres (158,760 ha) of this set-aside was in wheat and rice lands, mostly in the Central Valley (California Agriculture Statistics Service 1988). Given the above considerations, the CVHJV set a goal of enhancing 110,800 acres (44,874 ha) of set-aside for nesting habitat.

Strategies to Meet Agricultural Land Objectives

An Agriculture—Wildlife Enhancement Committee (AWEC) of the CVHJV was formed to identify and recommend programs that would enhance the 332,300 acres (134,581 ha) of harvested grain fields and 110,800 acres (44,874 ha) of set-aside lands determined above to be necessary to support wintering and breeding waterfowl in the Central Valley. The AWEC was an inter-organizational alliance comprised of representatives from the Agriculture Stabilization and Conservation Service (ASCS), Soil Conservation Service (SCS), California Rice Industry Association, rice farmers from the Sacramento Valley, California Department of Fish and Game (CDFG), California Waterfowl Association (CWA), California Department of Water Resources, U.S. Bureau of Reclamation, University of California Cooperative Extension and the USFWS. The AWEC developed implementation strategies to: (1) create policy changes in existing USDA farm programs, (2) support legislation to impose multi-year contracts for set-aside lands, (3) establish incentive programs for landowners who manage harvested grain fields and set-aside lands for the benefit of waterfowl and (4) formally coordinate extension/education activities to inform and assist landowners interested in enhancing their lands for waterfowl. The specifics of these implementation strategies are discussed below.

Use of Existing Programs

Prior to 1988, many local county ASCS committees require that set-aside lands be annually burned, tilled, or mowed to control noxious weeds. Additionally, many counties stipulated that set-aside lands could not be flooded because flooding was perceived to violate "Swampbuster" provisions of the 1985 Food Security Act.

In February 1988, the AWEC suggested changes in California ASCS policy that would enhance the value of set-aside lands for wildlife. The California State ASCS Committee accepted these suggestions and revised its policy for set-aside lands. It now encourages: (1) seasonal flooding and/or other irrigation for periods of less than 6 months; (2) planting small grains for wildlife consumption; (3) planting cover crops and trees; (4) not tilling, burning or mowing; (5) leaving lands fallow; (6) leasing lands for hunting; (7) leaving the same tracts of land in set-aside for more than one consecutive year; and (8) receiving compensation from non-ASCS sources for efforts expended for wildlife benefit. All of the above practices are currently voluntary, and engagement in these activities does not impose penalties or affect base acreage allocations. The AWEC recommended that in the future these changes in policies on set-aside lands be mandatory for participation in government subsidy programs.

New Programs

Incentive payments. The AWEC recommended incentive payments to farmers who: (1) defer tillage of harvested croplands in fall and winter, (2) flood harvested fields in winter and (3) encourage dense nesting cover on set-aside lands. These incentive programs were determined to be feasible and acceptable to rice farmers in the Sacramento Valley based on their responses to a questionnaire asking about payment rates and willingness to participate (Appendix A). State and federal farm organizations and agencies and local farmers participating in the AWEC also presented incentive proposals to their constituents, members and neighbors, and their comments, along with questionnaire results, were used to develop a pilot program to encompass approximately 6,000 acres (2,430 ha) beginning in July 1989. This pilot program will include all of the above incentives in five demonstration areas of approximately 1,200 acres (486 ha) each, in Colusa, Butte, American, and Sutter Basins and in the Sacramento-San Joaquin River Delta. Implementation plans of incentive programs encompassing the entire recommended 443,100 acres (179,456 ha) will be finalized subject to review of the 1989 pilot program and funding availability. Details of pilot and fully implemented programs are below.

Incentive program #1 (deferred fall tillage) sets an incentive payment of $10/acre ($24.7/ha) to landowners who defer tillage of harvested grain fields, specifically rice and corn, until at least 15 February. Participating landowners will be allowed to burn fields in conjunction with county and state burning regulations. Full implementation of program #1 would encompass 83,075 acres (33,645 ha) distributed among nine basins relative to waterfowl distribution (Table 2). Sites chosen within a basin would be determined by proximity to existing and future planned wetlands and waterfowl concentration sites, traditional use by geese, and past history of fall tillage. Management of 83,075 acres (33,645 ha) represent 25 percent of the agricultural land needed to secure food requirements of waterfowl and would offset the approximately 75,000 acres (30,375 ha) of harvested rice fields that are currently fall tilled (M.R. Miller and USFWS, unpublished data).

Incentive program #2 (flooding after harvest) sets payments of $10/acre ($24.7/ha) for land with a history (three of the past five years) of fall and winter flooding, and cost of water plus $10/acre ($24.7/ha) (maximum payment of $30/acre ($74.1/ha)) for lands without a history of winter flooding. The goal of full implementation of program #2 is to maintain 249,225 acres (100,936 ha) of harvested grain fields in deferred tillage plus winter flooding, and to encourage farmers who have not traditionally flooded harvested fields to do so. The "three of the past five years" language would require that once a newly flooded property was flooded for three winters, it would be classified as traditional and then receive a lower payment. Creation of two payment rates assumes that farmers with a tradition of flooded lands will attract leases from duck hunters, thereby offsetting lower incentive rates. In 1988, approximately 60,000 acres (24,300 ha) of harvested grain fields were flooded. Consequently, program #2 would include these 60,000 acres (24,300 ha) and an additional 189,225 acres (76,636 ha) not currently flooded. The distribution of newly flooded lands chosen for incentive payments within each basin will be based on landowner participation, location of historically flooded fields and proximity to existing and planned wetlands and waterfowl concentration sites.

Landowners participating in program #2 will be required to flood harvested fields as soon after harvest as possible, maintain a required water level in enrolled fields until 1 January and not purposefully drain fields until 15 February. Stubble in harvested fields may be burned, but not tilled, prior to flood-up. Maintenance of a specified water level in fields until 1 January will be contingent upon availability of water and its deliverability by water districts serving enrolled properties. Water may be purposefully drained from enrolled fields under special circumstances (e.g., a major disease outbreak). The pilot 1989 program will require that at least 200 acres (81 ha) of flooded rice land in each of the five demonstration areas be maintained as a sanctuary where no hunting is allowed Landowners will be allowed to hunt and/or lease hunting rights on other flooded non-sanctuary lands as desired.

Incentive #3 (vegetated set-aside) sets a payment rate of $10/acre ($24.7/ha) for encouraging dense nesting cover on set-aside lands. Full implementation of this incentive program would result in the enhancement of 110,800 acres (44,874 ha). The distribution of this managed set-aside among basins will be based on the distribution of rice and wheat set-aside acreage in the Central Valley. Distribution of 1989 pilot set-aside lands within basins will be based on landowner participation and proximity to wetlands where pre-breeding and brood-rearing food and cover are provided. Eventually, it is hoped that spring surveys of breeding ducks will be updated, and that distribution of set-aside incentive lands could be based according to the density of breeding ducks. Contracts issued in the 1989 pilot program will only require participation in 1989, but will contain an annual option to renew for two additional years beginning in 1990 if the incentive program is continued. When fully implemented, contracts will require participation for a three-year period. Tilling, burning, mowing and other non-approved land uses will be prohibited. Spot spraying to control noxious weeds will be allowed consistent with local and state ASCS requirements. Participation will be flexible to accommodate changes in annual set-aside required by the USDA. The 1989 pilot program allows participating landowners to receive an additional $5/acre ($12.35/ha) on designated set-aside areas if they allow controlled public hunting access, mutually agreed upon by the landowner and CDFG.

Outreach extension/education. In addition to incentive payments to farmers, the AWEC recommended that an extension/education program be formally developed. This extension program would interface and be coordinated with extension programs proposed for other CVHJV objectives and with existing activities of CDFG, USFWS, CWA, University of California Cooperative Extension, and USDA. The intent of this new outreach effort is to enhance and create many acres of wildlife habitat on private lands without involving public dollars for acquisition, easement or management. Educational tasks included in this outreach effort include preparation and dissemination of information on current or new land management techniques that benefit both farmers and wildlife, and identification of financial assistance available to farmers who use conservation land management. In addition, personnel will be hired to provide technical assistance, develop farm and wildlife management plans, and act as liaisons between agricultural and conservation interests within counties.

Administration

Administrative/coordination strategies for the agriculture-wildlife enhancement initiatives are currently envisioned as follows.

Policy changes. Changes in USDA farm program policy will involve providing information to local, state and national ASCS committees; county and state SCS personnel; farm-related organizations; and appropriate state and federal legislators. The AWEC will collate necessary data and assist in writing language for potential changes in policy.

Legislation. The AWEC will identify and review new legislative proposals concerning integrated conservation/agricultural issues relevant to the Central Valley. Upon recommendation by the AWEC, the Implementation Committee and participating organizations of the CVHJV will lobby for support and passage of favorable legislation.

Incentive payments. Funds for the 1989 pilot incentive program are provided by CDFG. The CVHJV will evaluate the 1989 pilot program and recommend changes or continuation-expansion for subsequent years. Full implementation of incentive programs would cost approximately $7.2 million annually. Presently, the AWEC envisions funds for landowner payments in this incentive program to be made available by CDFG and the California State Department of Food and Agriculture. Staff, logistical and other financial support would be supplied by organizations participating in the CVHJV. Eventually, administration of payments from county ASCS offices is desired.

Outreach. Formal wetland/waterfowl technical assistance groups will be established in various regions of the Central Valley and include appropriate members from CDFG, USFWS, CWA, SCS, Ducks Unlimited and county resource conservation districts. Funds for staff participation should come from internal sources of the respective organizations and from private foundations.

Evaluation of Agricultural Enhancement Programs

Evaluation of all agricultural enhancement programs is essential. Key elements of evaluation will include recording the compliance and specific management techniques of participating landowners, vegetative responses on set-aside lands and waterfowl use of enrolled lands. The 1989 pilot program will be evaluated by searching set-aside fields for nests at least three times during spring 1990 to document nesting efforts, density and success. Data will also be obtained on vegetation composition of fields; time of harvest, burning and flood-up of lands enrolled under deferred tillage and winter flooding programs; and water levels in flooded fields. Finally, aerial and ground censuses of waterfowl using flooded fields and designated sanctuary areas will be conducted. Additionally, the USFWS and CWA are currently conducting radio-telemetry research on northern pintails (*Anas acuta*) and mallards. These research studies will help identify patterns of use of agricultural lands and wetlands and indicate appropriate spatial relationships among private and public wetlands, sanctuaries and harvested rice fields. Additional monitoring and research efforts will accompany full implementation of agricultural programs. This evaluation and research will be coordinated and funded by organizations and agencies participating in the CVHJV and local universities.

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Appendix A. Responses to a questionnaire mailed to rice farmers in the Sacramento Valley, California[a].

	Yes	No	Maybe	Sometimes
Currently farmed rice acreage				
1. If you were offered $5/acre would you not disk or plow up your rice stubble in fall? (Only those lands not scheduled to be flooded in fall would be eligible. Acreage limits would be established in each county).	31	13		
2. If you were offered $10/acre would you flood harvested rice fields from fall (after burning) through 1 March? (As above, acreage limits would be established in each county).	15	29		
Set-aside acreage				
3. If you were offered $5/acre would you leave your set-aside lands fallow (i.e., not burn, mow, or disk—therefore letting native vegetation grow up) year round?	17	26	1	
4. If you were offered to cost-share 50% of costs associated with planting, would you plant a cover crop on your set-aside lands? (50% cost-share would include ground preparation and seed. Choice of cover crops would include vetch, tall wheat grass, rye grass, etc. Enrollment would require a minimum of 20 acres. These cover crops would provide valuable nesting habitats for pheasants and ducks.)	31	12	1	
Current involvement				
5. Do you presently:				
a. Fall plow rice fields?	15	22		9
b. Flood rice lands following harvest for duck hunting?	23	20		
c. Plow or disk set-aside lands?	33	5		1
d. Plant cover crops on set-aside lands?	3	40		

[a]Questionnaires were sent to 80 rice growers. These 80 rice growers were selected by the California Rice Industry Association because of their control of acreage (10% of all rice grown in California), representativeness of geographical regions where rice was grown, and influence among peers. A total of 44 surveys were returned completed.

Wildlife Extension: A New Face on an Old Frontier

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Introduction

North Dakota lies within the 300,000 square mile (780,000 km^2) Prairie Pothole Region of North America. This region accounts for 50 percent or more of the continent's annual waterfowl production for several species (Smith et al. 1964, Stewart and Kantrud 1973, 1974). About 36 percent of this area is located in the north-central United States.

Sixty percent of North Dakota's original 5 million acres (2 million ha) of prairie pothole wetlands have been lost (Tiner 1984). Until recently an estimated 20,000 acres (8,000 ha) of wetland were lost annually (Herbst 1978). Agricultural development accounts for nearly 99 percent of prairie pothole losses (Wittmeier 1985). Political conflicts among agricultural, water development and wildlife programs, particularly those involving the U.S. Fish and Wildlife Service, over the fate of the remaining 2 million acres (800,000 ha) are well documented (Seabloom 1980, Sayler et al. 1984, Sidle and Harmon 1987). Occurrences of new wetland drainage, however, appear to have dropped significantly in the past two years in part as a result of the Swampbuster provision of the 1985 Food Security Act and passage of the state no-net-loss of wetlands legislation in 1987 (L. Jones, pers. comm. 1989).

In addition to wetland losses, agricultural practices on uplands adjacent to wetlands have adversely impacted waterfowl production. Grasslands, hayed and grazed for livestock production, provide upland nesting cover for mallards (*Anas platyrhynchos*), pintails (*Anas acuta*), and other dabbling ducks. Approximately one-half of the grasslands in the Missouri Coteau of North Dakota were converted to cropland between 1965 and 1975 (U.S. Fish and Wildlife Service 1984).

Population levels of several North American waterfowl species have significantly declined since 1972 (Anonymous 1987). Reductions in duck recruitment have been linked primarily to habitat loss, increased predation related to reduced habitat quantity, and impacts of chemical use in agriculture (Higgins 1977, Anonymous 1986, Grue et al. 1988).

The U.S. Fish and Wildlife Service owns and manages less than one percent of the North Dakota land base. This land produces less than five percent of the ducks produced in the state (D. Henry, pers. comm. 1988). In response to a need to help address the wetland drainage conflicts, habitat losses and low duck-production issues, the U.S. Fish and Wildlife Service initiated, as a pilot program, the North Dakota Wildlife Extension Program in 1987 to promote improved land stewardship and duck production on privately owned land.

This concept is not new. Deknatel (1979) reported that 44 states have programs for habitat development on private lands. It was, however, the first U.S. Fish and

Wildlife Service initiative to attempt a multitude of duck production strategies on private lands.

Objectives

The program was established with four basic goals.

1. Improve waterfowl production on privately owned land.
2. Improve land stewardship.
3. Increase public knowledge of wildlife and their habitat requirements.
4. Build an improved working relationship between North Dakota landowners and the U.S. Fish and Wildlife Service.

Methods

The program employs several methods to achieve program goals.

1. Provide small financial incentives to landowners who implement strategies on their land to improve waterfowl production.
2. Provide technical expertise.
3. Serve as a ''broker'' between landowners and the proper wildlife or cost-sharing program to meet the landowners' needs.
4. Acquire and produce educational and promotional materials for public distribution.

Results

Over 340 wildlife extension agreements were signed with landowners in 1987 and 1988. A variety of management strategies were implemented at an annual operating budget of approximately $345,000. A summary of project types follows.

Conservation Reserve Program (CRP) Wildlife Management Agreements

The CRP offers many unique opportunities. The U.S. Fish and Wildlife Service offices in the north-central states secured agreements with landowners for limited wildlife management on their CRP acres, including wetland restoration, nest structure installation, predator management and proper grass seed selection. In North Dakota these ''piggyback'' leases were limited to land covered by a U.S. Fish and Wildlife Service wetland easement. With a one-time payment, these perpetual easements protect the wetlands from burning, draining or filling. However, easement wetlands and adjacent uplands can be farmed and in many cases, upland nesting cover is limited. The ''piggyback'' payment was an incentive for landowners to enroll easement land with potentially limited upland cover into the CRP. This wetland easement requirement enticed over 45 landowners to enroll in the perpetual easement program. The 179 participating landowners annually receive $5 per acre on their 31,396 acres (12,715.4 ha) of CRP enrolled. Currently, due to funding and administrative constraints, management has been limited to wetland restoration and nest structure installation.

Wetland Restoration and Development

Restoration of drained wetlands, or development of new wetlands, was virtually unheard of in North Dakota two years ago. Wetland drainage ditches, primarily on CRP land, were closed by constructing small ditch plugs with U.S. Fish and Wildlife Service equipment, small contractors, and private landowners. Cash bonus payments of $10 per restored acre ($50 per basin minimum) are paid as an enticement to restore. Due to landowner acceptance of this aspect of the program, contributions from public and private organizations were generated and include $40,000 from the North Dakota Game and Fish Department, $29,000 from Ducks Unlimited, Inc., and $10,000 from the Dakota Wildlife Trust.

Most wetlands are restored under a ten-year agreement, although 84 basins covering 200.6 acres (81.2 ha) have been permanently protected. In several instances entire wetland complexes (40^{+} basins) are being restored on single farm units.

To date, 98 landowners have signed agreements to restore or develop 746 basins covering 1,755.2 acres (710.9 ha). Restoration costs average $107 per acre ($264.29 per ha), or $24.75 per basin when annualized over the ten-year term of agreements. This compares to an average of $500 per acre ($1,235 per ha) the U.S. Bureau of Reclamation estimates it costs to restore wetlands as part of the mitigation plan for the Garrison Diversion Project (R. McCabe, pers. comm. 1989).

Predator Management

Two approaches to predator management were used to affect a minimum number of predators and result in the most economically efficient duck recruitment. Predator management was conducted through an interagency agreement with USDA's Animal Damage Control, by National Wildlife Refuge employees, or hiring local trappers.

Predator management of small islands. Several studies have shown that island-nesting populations exemplify the high biotic potential of waterfowl in a predator-free situation (Duebbert et al. 1983, Duebbert 1966, Hammond and Mann 1956, Drewien and Fredrickson 1970). Landowner agreements provide access for trappers to remove predators on islands ranging from 1 to 40 acres (0.4 to 16.2 ha). Twenty-four islands received predator management. Nest density and success varied, the most successful being a one-acre (0.4 ha) island with 35 nests and 100 percent nest success. Homing by successful hens should cause nest densities to increase over time.

Predator barrier fences. Use of electric predator barrier fences to mimic the biotic potential of predator-free islands was explained by Lokemoen et al. (1982). Agreements with landowners allow construction, maintenance and predator management on six peninsulas protected by predator barrier fences. The landowners were compensated for loss of haying or grazing on the property. One hundred eighty four acres (74.5 ha) of upland nesting habitat were protected from predation. In two instances local wildlife clubs agreed to provide the labor for fence construction. An additional three fences protecting 65 acres (26.3 ha) are approved for construction in 1989.

Alternative Agricultural Practices

The effects of land use practices, such as conventional tillage, grazing and haying, on habitat quality and quantity, with subsequent impacts on waterfowl nest density and success are well documented (Miller 1971, Higgins 1977, Milonski 1958, Kirsch 1969, Kirsch et al. 1978). The North Dakota Wildlife Extension Program attempts to modify land use practices to be less harmful to upland nesting birds. When implemented, some of these modified practices will reduce soil erosion and improve surface water quality, in addition to providing benefits to nongame wildlife species.

Grazing systems. Although additional studies are needed, some grazing system have been shown to improve both beef production and upland bird nest density and success (T. Messmer, pers. comm., 1989) Landowners who agreed to implement the twice-over, deferred rotation system for a period of ten years received free cross-fencing materials from the program. Agreements implementing 14 grazing systems on 6,671 acres (2,738.2 ha) have been developed. Annualized cost of these agreements for the ten-year period is $.40 per acre ($.99 per ha).

Delayed haying incentives. Landowners received from $3 to $7 per acre ($7.41 to $17.29 per ha) to delay their haying operation until after most duck nests hatched (July 15). Agreements have been made with 12 landowners to delay haying on 1442.8 acres (584.3 ha). This aspect of the program is under close scrutiny, due to the difficulty in predicting nest densities in specific hay fields.

Nesting habitat set-asides. Payments of $3 to $10 per acre ($7.41 to $24.70 per ha) on upland nesting cover and wetland habitat have been made to idle land from any agricultural use. Leased tracts range from 40 to over 1,000 acres (16.2 to 405 ha), and are in effect for one to ten years. A total of 6,565.9 acres (2,659.2 ha) was idled from agricultural use through 18 agreements. Landowner demand for this portion of the program is much higher than current funding levels allow.

No-till farming. No-till winter wheat fields had significantly higher upland bird nesting density and success than did fields under conventional tillage (Higgins 1977, Duebbert and Kantrud 1987). One agreement has been developed that pays for no-till drill rental for the cooperator to try no-till on 325 acres (131.6 ha) of his farm operation. Promotion of no-till and minimum tillage techniques can potentially improve large areas for waterfowl production. However, the high amount of agricultural chemical use associated with no-till may be serious cause for concern.

Nesting structures. The Extension Program provides free mallard, Canada goose (*Branta canadensis*), and wood duck (*Aix sponsa*) nest structures to landowners and wildlife clubs who agree to install and maintain them for a period of ten years. Almost 1,200 nest structures of various types have been distributed to date. An innovative nest structure project initiated under the program in 1988 salvaged concrete culverts, each a minimum of five feet tall (1.53 m) and 30 inches (76.2 cm) in diameter, then placed on end in dry wetlands. The culverts were filled with dirt to support vegetation for nesting waterfowl. The concrete culvert concept was discussed by Higgins et al. (1986).

Additional waterfowl projects. Several other types of projects have been completed, such as facilitation of four Ducks Unlimited, Inc. wetland enhancement projects on private land, development of a waterfowl management agreement on a 1,700 acre (688.5 ha) National Audubon Society sanctuary, and assisting with a private Canada goose restoration project.

Educational and promotional materials. Promotional and educational materials include free wildlife theme placemats for restaurants, ''Protect North Dakota Wetlands'' t-shirts, caps, bumper and window stickers, windshield shades, brochures, bulletins and videos. North Dakota's low human population density probably allows for a greater proportion of the residents being exposed to these materials than more heavily populated areas.

Discussion

North Dakota is a key state to the successful implementation of the North American Waterfowl Management Plan's Prairie Pothole Joint Venture. It is politically impossible to achieve the habitat protection goals of the North American Waterfowl Management Plan through fee title and easement acquisition alone. We also need to apply enhancement techniques on privately-owned land. If approached properly, we now believe that many landowners are willing to help achieve our goals. The North Dakota Wildlife Extension Program has received strong support from water development, agricultural, wildlife conservation and political interests. A successful private land enhancement program can help pave the way for public support of other public wildlife programs, such as land acquisition. The concept of private land enhancement should be adopted wherever practical and possible, but most emphatically endorse its expansion throughout the Prairie Pothole Region.

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The 1985 Farm Act and Wildlife Conservation: Outlook for 1990

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Introduction

The Conservation Title (Title XII) of the Food Security Act of 1985 (public Law 99-198) represented a significant step forward in integrating wildlife conservation concerns with mainstream agricultural policy. A wide range of wildlife interests participated in the formulation and passage of Title XII, including wildlife managers, professional wildlife activists and hundreds of members of wildlife and environmental groups.[1] Reauthorization of basic farm legislation, scheduled for 1990, offers an opportunity to further promote wildlife conservation through reform of agricultural policies. This paper briefly reviews some lessons for wildlife conservation that can be gleaned from experience to date with implementation of the Conservation Reserve Program (CRP). It also outlines some wildlife conservation issues relevant to the 1990 debate. My general thesis is that Title XII, impressive though it is compared to what came before, should be viewed as a point of departure for the task ahead—a broad and enduring integration of farm policy and practice with the conservation of biological diversity.

The Conservation Reserve Program

Wildlife interest voiced strong and persuasive support for the concept of the CRP in the years leading up to the 1985 debate. They convincingly argued that long-term land retirement programs would be far superior to annual acreage adjustment programs in their potential to conserve wildlife.[2] Findings from field evaluations of CRP

[1]A sampling of views on wildlife conservation expressed during the 1985 farm bill debate can be found in "Reauthorization of the Agriculture and Food Act of 1981," Hearings before the Committee on Agriculture, Nutrition, and Forestry, United States Senate (S.Hrg 99-115, Part II). In particular, see the very thoughtful arguments on behalf of wildlife conservation presented at the hearing of Monday, April 15, 1985, by (in order to appearance) Allen Farris (International Association of Fish and Wildlife Agencies), Ron Ellermeier (Sierra Club), Maureen K. Hinkle (National Audubon Society), Justin R. Ward (Natural Resources Defense Council), Laurence R. Jahn (Wildlife Management Institute), and Michael J. Budzik (Ohio Wildlife Management Association). The April 15 hearing ended up having a major impact on the 1985 farm bill's conservation title. Impressed at its conclusion by the general unanimity of views on a range of conservation issues, Senator Richard Lugar (R-Indiana), who had chaired the session, instructed his staff member, Chuck Conner, to prepare a legislation incorporating the CRP, sodbuster, and swampbuster concepts. The bill became one of the principal legislative vehicles for Title XII in the Senate debate, and both Lugar and Conner were effective advocates for its passage. Agriculture Secretary John Block announced USDA support for a 20-million-acre CRP at Senator Lugar's Indiana farm the following month.

[2]Like most conservationists, the author found arguments put forth by Laurence Jahn (Wildlife Management Institute), Jack Berryman (International Association of Fish and Wildlife Agencies), Alan Wentz (National Wildlife Federation) and other wildlife professionals particularly persuasive on this point. The most widely cited and influential research on the wildlife conservation potential of long-term programs for production adjustment is found in the work of Alfred Berner of the Minnesota Department of Natural Resources. See, for example, his "Federal Land Retirement Programs: A Land Management Albatross," in *Transactions of the North American Wildlife and Natural Resources Conference* (1984). For a popularized treatment of the issue and Berner's research, see: Kenneth A. Cook, *Eroding Eden: What U.S. Agricultural Policy is Doing to Our Natural Resources and What Can Be Done About It.* Roosevelt Center for American Policy Studies, Washington, D.C. September, 1985.

impact on wildlife are presented elsewhere in these proceedings; in any case, such evaluations are at a fairly early stage (e.g., field reviews supported by the U.S. Fish and Wildlife Service and undertaken by the Soil and Water Conservation Society of America). It seems beyond question, however, that implementation of the CRP has had significant, short-term impacts on wildlife conservation by virtue of the sheer scale of land-use change alone. As of February, 1989, about 28 million acres had been enrolled (through the seventh sign-up), and enrollment in the eighth sign-up may well push the CRP above 30 million acres.

What can be questioned, however, is what could have been done legislatively in 1985, or what can be done in the next farm bill, to improve the CRP's wildlife conservation performance. With the CRP, are we really integrating wildlife conservation with farm policy and practices? Or are we setting up a mosaic of relatively small, largely unmanaged, arbitrarily selected protected areas that may well vanish, or undergo changes inimical to wildlife conservation, as the 10-year contracts, expire, and after billions of dollars in outlays?

Three broad issues arise: (1) improvement of current and future contract features to enhance wildlife; (2) targeting of CRP enrollment to areas of special wildlife significance; (3) evolution to longer term land retirement instruments, notably conservation easements.

Improvement of Contracts

While wildlife generally will benefit from the massive land use change associated with the CRP,[3] much greater benefits might have been possible, and might yet be possible. For example, less than 4 percent of the CRP acres enrolled to date has been devoted formally to "wildlife habitat" practices, defined by USDA broadly to mean plantings of native grasses and herbaceous species to provide wildlife cover and food, and creation of small ponds (usually one acre of less in size). The U.S. Fish and Wildlife Service and a number of state and private groups have tried to encourage wildlife plantings, with limited success. And the "wildlife habitat" establishment costs are competitive with other practices, an important factor to enrollees, who must bear half the cost of cover establishment. Another likely factor in farmer choices about cover type is their future plan for CRP ground after the contract expires. Why build a wildlife pond or plant native grasses if reconversion to cropland is contemplated?

These circumstances argue for consideration of special incentive payments for establishment of wildlife practices in existing or future contracts.

Targeting CRP Enrollment

Can CRP enrollment be targeted on the basis of wildlife criteria, not just soil erosion and three planting criteria? The working assumption during the 1985 debate was that erosion control and, as the debate progressed, a goal of planting 12 percent

[3]A fairly wide range of species have been shown to respond favorably to provision of undisturbed cover in intensively farmed areas. This the CRP provides everywhere once plantings are established, though quality of cover may vary. Provision of wildlife food is a different matter. Many cover types planted under CRP contract provide very modest amounts of wildlife food, and unfortunately these cover types, being less expensive than, say, native grass, have been more popular with producers. It is also possible that conversion of cropland to plantation-type plantings of pine trees in the South will create food stress on wildlife, particularly as the tree stands mature.

of enrolled land to trees, should generally define CRP objectives. The informal "conservation coalition" that pressed for passage of Title XII discussed the merits of explicitly making wetlands eligible for the program, but in the end few groups pressed actively for the idea for two reasons: (1) Questions of cost—how much would recovery of cropped wetlands cost nationwide? How would enrollment of noncropped wetlands affect program outlays, considering such enrollment would not reduce surplus production? (2) Questions of political dilution—if the CRP is opened to wetlands generally, why not use it to deal with critical rangeland conservation needs? Or to compensate farmers whose land is suffering from soil salinity? Or to reclaim areas that have been damaged by mining or other activities?

These and related issues raised during the debate dissuaded conservationists from pressing for wetlands eligibility under the CRP. However, with a CRP of more than 28 million acres, it makes sense to look for high priority, if small-scale, cropland areas that should be enrolled for wildlife value alone. Wetlands are of course a prime candidate. In January, 1989, citing authority in the 1985 FSA for using the CRP to deal with water quality problems, the Department of Agriculture proposed an interim rule allowing a wide range of cropped wetlands to be enrolled in the CRP. It is too early to evaluate the impact of this decision, but not too early to begin developing analyses and policy options for a wildlife targeting component to land retirement programs in 1990.

A hybrid proposal between enrollment targeting and improving CRP contract performance would be to target special incentive payments to existing CRP contracts for land that has special potential as wildlife habitat.

Long-term Land Retirement Instruments

What happens when the contracts expire? That question is relevant no matter what perspective one has on the CRP, and answers do not come easily no matter who attempt them. Some of the land will come back into crop production, of that we can be fairly certain. But can a case be made to offer longer term, perhaps permanent protection to lands of special conservation significance within the land already enrolled? Probably so. The National Wetlands Policy Forum, convened by The Conservation Foundation, proposed late in 1988 an Agricultural Wetlands Reserve that would enroll up to 7 million acres of wetlands of various types under permanent easements. This idea and others aimed at other wildlife habitats of special significance deserve further analysis. Ironically, the USDA decision to open CRP enrollment to cropped wetlands may have the effect of undermining interest among farmers in any longer term wetlands conservation programs that might be developed unless the new programs have more favorable terms (i.e., pay farmers more, at a higher cost to the government, of course). After all, why would a producer tie himself to a perpetual wetlands easement if through the CRP he could obtain a comparable rate of compensation over a ten-year period, after which his land would be unencumbered by restrictions on wetlands use?

Policy Issues for the Next Farm Bill

Several categories of policy reform have already emerged in the nascent debate over the next omnibus farm bill, which is likely (but not certain) to be reauthorized in 1990. The preceding discussion suggested several ways in which the CRP might be reformed. What follows is a brief discussion of topics of related concern for wildlife conservation and farm policy.

Policy Goals for Agriculture and Wildlife

What exactly do wildlife interests need or expect of the agricultural sector in order for the nation to protect its biological diversity? How much of the burden of wildlife conservation can rightfully be placed on farmers, and to what degree will society help farmers with that burden? Can we quantify the contribution agriculture could or should make?

These questions and related ones challenge wildlife conservationists to make their objectives more explicit for the next round of farm policy. Soil and wetlands conservation may no longer be as peripheral to mainstream agriculture as they were prior to 1985; but it might be argued that wildlife conservation remains peripheral to the overriding emphasis of the 1985 provisions—controlling soil erosion. Naturally, it is a mistake to draw overly sharp distinctions between conservation of wildlife and biological diversity and conservation of other resources. And indeed, it was the unified voice of conservationists of all stripes that made the 1985 effort as rewarding as it was. Nevertheless, the more explicit and creative wildlife conservationists can be in stating policy goals and, perhaps, specific programs and policies for achieving those goals, the better for conservation generally. What can be done, for instance, to quantify wildlife conservation goals for specific geographic areas, important ecosystems, indicator or "flagship" species? Soil conservation analysts were able to argue that a CRP of a given size, comprised of certain land, would reduce overall cropland erosion by an impressive degree. Are analytical constructs of this kind available or feasible to inform wildlife conservation goals for U.S. agricultural policy?

Production Adjustment Programs

The CRP appealed to the budget-conscious within the agricultural policy world because it appeared to reduce the need for annual production control/adjustment programs: investments in the CRP, it was assumed, would mean lower outlays for annual programs. Had conservationists not been able to make this argument, the CRP would not exist today. Proposals linking resource conservation and environmental protection to production adjustment programs must be able to demonstrate the capacity to adjust production without imposing an unacceptable cost on producers and the government. Otherwise, these proposals just won't fly.

Multi-year set-asides are a case in point. Conservationists have long argued that setting aside fields for one year at a time frustrates efforts to use set-asides to enhance wildlife or control erosion. A number of wildlife conservationists have proposed multi-year set-asides as a remedy. The Secretary of Agriculture is authorized by law to establish multi-year set-aside requirements, and has been for some time; but the authority has never been used. The central problem is that set-aside requirements can fluctuate dramatically from year to year. Consider the case of wheat: in the 1987–88 crop year the set-aside requirement was 27.5 percent; in the current (1988–89) crop year, farmers need only idle 10 percent of their acreage to qualify for commodity program benefits. Obviously, year-to-year increases in set-aside requirements pose less of a problem for an individual producer and for USDA planners than year-to year decreases.

The problem might be surmounted in several ways. First, it is important to develop reasonable objectives for multi-year set-asides in terms of acreage enrolled—the smaller the acreage the more feasible the ideal is in the current policy framework. Certainly any multi-year set-aside program will have to be elective (voluntary) for producers, and this should be taken into account in setting goals. A 5 percent goal, for example, may seem modest in light of recent set-aside history, but it would likely endure periods of commodity price increases and reduced set-aside requirements; and 5 percent of several hundred million acres is a significant area. Second, it is probably necessary to consider a payment mechanism for producers who enroll in a multi-year program so that their participation can be compensated in years when their set-aside requirements exceed those of participants in the regular commodity programs.

A final consideration may mitigate against multi-year set-asides altogether: will they out-compete the CRP or other longer-term conservation programs that may emerge, such as the proposed Agricultural Wetlands Reserve Program? Conservation will gain if multi-year set-asides substitute for annual acreage retirement programs, but will suffer if longer term programs are replaced by three to five year set-asides.

Swampbuster

As in the case of the CRP, evaluations of the effectiveness of swampbuster are underway and may indicate the need for modification of this provision in the next farm bill. Several issues clearly need to be addressed:

1. The definition and determination of wetlands. Is the definition and procedure practical and effective as implemented in the field for purposes of swampbuster?
2. Is the drop dead penalty—loss of all USDA benefits for any amount of swampbusting—causing reluctance on the part of local program administrators to cite swampbuster violations? Or is it effectively detering swampbusting? What changes make sense, if any?
3. Should alteration of wetlands for any type of agriculture be sufficient to trigger swampbuster, or should the requirement ''planted to an agricultural commodity'' be retained? And should alteration trigger a penalty for a number of years into the future, in order to discourage swampbusting in years when commodity programs are less attractive to producers?

Special Session 8. *Human Dimensions in Future Natural Resource Management*

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The Future of Human Dimensions of Wildlife Management: Can We Fulfill the Promise?

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INTRODUCTION

The term "human dimensions of wildlife management" has been used to refer to a variety of people-oriented management considerations and a broad area of inquiry. We believe that such dimensions are critical to the process of wildlife management in ways depicted recently by Krueger et al. (1987). Development of management goals, objectives and actions, as well as identification and solution of problems, relies on understanding human preferences and anticipating human responses to management actions. Most often the key action in a particular management program will influence people in some way.

It has been argued recently that wildlife management needs to be reexamined and redefined to apply more fully better understandings of the human dimensions of contemporary management (Decker et al. 1988). Wildlife professionals besides those specializing in the human dimensions have suggested that the effectiveness of wildlife management in the future will rest on the extent that human dimensions are incorporated (Berryman 1987, Doig 1987).

Wider recognition of the ''people aspects'' of management have fueled 20 years of growth in human dimensions research. A paper presented at the 1984 North American Wildlife and Natural Resources Conference offered one characterization of that growth (Mattfeld et al. 1984). That same year, people working in this area of research and management who had been meeting and communicating as The Human Dimensions in Wildlife Study Group created a formal professional organization complete with officers, bylaws, annual meetings and newsletter. Despite this growth in interest and more focused identity, many respected state and national leaders in the wildlife profession have expressed concern that the ''human dimensions'' of wildlife management have not been applied to produce programs that use human inputs and affect human actions (Berryman 1987, Doig 1987). They acknowledge the promise that the human dimensions specialization holds for wildlife management, but question whether the specialization can fulfill the promise. We will explore this question by first describing the specialization from a developmental standpoint, and then indicating the challenges in applying human dimensions knowledge in management decision making and implementation.

The Genesis of a Wildlife Specialization

The body of knowledge known as the human dimensions of wildlife management has been derived from empirical studies and has drawn heavily from social sciences for its theoretical grounding. By synthesizing selected social science theory, knowledge and methodology with empirical data, new understandings of the ''people aspects'' of wildlife management developed and a new interest area emerged. Understandings developed for some of these aspects have shown promise for improving management and have been applied in program planning and implementation. Thus, inquiry on various human dimensions aspects of wildlife management have been through one to all of three general stages: *exploring* human dimensions problems, *synthesizing* information from human dimensions inquiry with knowledge from the social sciences and *applying* the results of this synthesis to management. Over the last 20 years human dimensions has become an interest area of broad scope, encompassing basic human behavioral research and theory development; applied behavioral research; application of socially-based information and knowledge to programs; and evaluation of human responses to management actions and institutions. Furthermore, the number of aspects that have gained attention as topics of inquiry has grown.

Many people share a keen professional interest in the human dimensions of wildlife management. Increasingly, evidence can be found that these people view themselves as members of an emerging specialization. The Human Dimensions in Wildlife Study Group described above is one such indicator. Another is the number of conferences and symposia addressing the topic (e.g., Social Science in Resource Management series, the Economic and Social Values of the Wildlife Resource symposium, and special sessions at the North American Wildlife and Natural Resources Conference). Publications also show evidence of an emerging specialization; the *Wildlife Society Bulletin* has an associate editor for human dimensions papers, the new journal *Society and Natural Resources* features human dimensions topics and wildlife textbooks published recently have included human dimensions topics (Bailey 1984, Peek 1986, Robinson and Bolen 1984, Shaw 1985). Academia has responded with undergraduate courses and graduate research programs in human dimensions (e.g., Cornell University, Yale University, Texas A&M University, University of Wisconsin, Michigan State University, University of Arizona). The kinds of human dimensions inquiry being undertaken also reflect a degree of maturation of the interest area toward a specialization. More theory development research is being conducted by universities and more applications research is being undertaken by wildlife agencies. In addition, significant social science knowledge developed outside the domain of wildlife management is constantly being examined and incorporated with existing human dimensions knowledge (i.e., synthesis).

During the development of interest in human dimensions described above some important contributions have been made to wildlife management. However, we believe that the continued maturation of a human dimensions specialization will be vital to the evolution of wildlife management to meet future societal needs for the wildlife resource. Many potentials to improve wildlife management will not be realized until human dimensions knowledge is carefully applied and systematically evaluated in actual management programs. These actions are frequently thought of as indicators that an area of academic interest has developed to the point of becoming a specialization. The human dimensions of wildlife management may be thought of as emerging from adolescence—an era of knowledge exploration and interest definition—and entering early adulthood—an era of knowledge synthesis and application to management. Characterizing our stage of development can be useful for human dimensions specialists as well as other wildlife professionals because mutual expectations are involved in realizing a promise of improved management.

The following section describes a conceptual model we believe identifies a process that various topics of inquiry in the broad human dimensions specialization move through. The importance of including a new topic of inquiry, of accelerating progress in all topics and of remaining open to developments outside the specialization will be argued. These considerations will be discussed in light of the question posed as the theme of this paper, "Can we fulfill the promise?"

Developing the Human Dimensions Specialization: A Model of the Process

A model of the process that a topic of inquiry and management interest in the human dimensions specialization moves through as it "matures" can be conceptualized as having eight elements. The model should not be interpreted as implying that all topics of interest in the specialization are at the same place at the same time. Rather, some topics are considerably more mature than others. Some may be at the stage of being principles because they have been well developed conceptually and applied and tested many times, whereas others may only be recent innovations in thinking based on new phenomena observed or recognized in the "people aspects" of management. The process is illustrated in Figure 1; elements of the process are described below:

Exploring Human Dimensions Problems

1. EXPLORATION of specific situations or phenomena of management interest (e.g., hunter attitudes toward a program, public preferences for nongame management, farmer attitudes toward crop damage by deer).

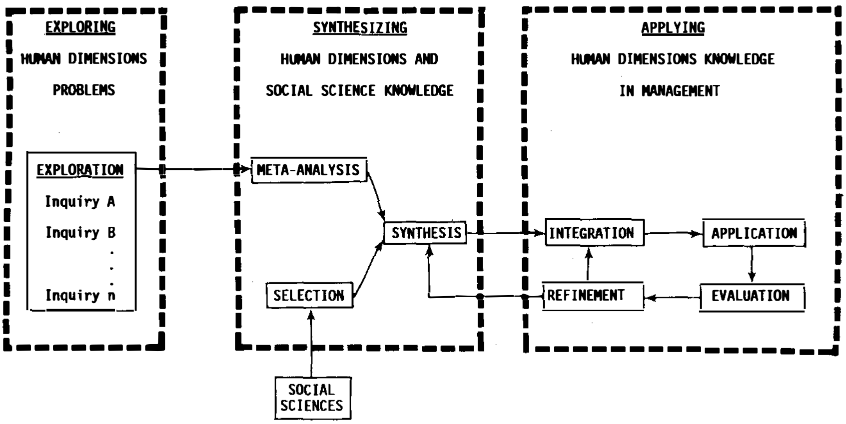

Figure 1. A conceptualization of the process by which topics of interest in human dimensions mature.

Synthesizing Human Dimensions and Social Science Knowledge

2. META-ANALYSIS of information obtained from exploration stage (specific human dimensions studies) to identify trends and patterns of behavior, and to develop general principles, conceptual frameworks and theories useful for wildlife management and policy purposes.
3. SELECTION of concepts, theories of human behavior, methods of inquiry, etc. from the social sciences relevant to wildlife management issues and concerns (e.g., social learning theory, theory of reasoned action, adoption/diffusion theory).
4. SYNTHESIS of knowledge from selected social science concepts, theories, etc. and information from meta-analysis of empirical studies into general understandings of human dimensions of wildlife management that allow a greater degree of inferential power and therefore a broader range of application of that knowledge.

Applying Human Dimensions Knowledge in Management

5. INTEGRATION of synthesized human dimensions and social sciences knowledge into the wildlife management process itself, sometimes requiring sustained interaction of the human dimensions specialist with the wildlife biologist, and both with wildlife planners, to ensure appropriate combination of human dimensions and biological perspectives.
6. APPLICATION of human dimensions knowledge in the planning, decision making and implementation of achieve wildlife management objectives.
7. EVALUATION of the applicability of human dimensions knowledge in management programs, both in terms of validity and value in meeting management objectives.
8. REFINEMENT of understandings based on new insights resulting from evaluation of actual field experience in the application of human dimensions knowledge.

The process described is a generalization and simplification of the real world. A colleague of ours, Professor Alan Hahn, describes process models like this one as ". . . lies that help us see the truth." The truth that can be seen through this model is that the payoff to wildlife management for the time, money and intellectual effort that have been devoted to topics of human dimensions inquiry comes when we enter the integration-application-evaluation-refinement-integration loop that is represented generally as the third stage of "Applying . . . ." If little or no activity is occurring in the applying mode, then it is debatable whether a functional specialization exists or merely an active interest area.

Status and Future

We propose that the human dimensions of wildlife management specialization is currently bridging between the synthesizing and applying stages in a general development sense. Over the past few years an increasing number of conference papers and journal articles have focused on the examination of trends and patterns revealed across empirical studies in human dimensions and the linking of them with social science theory. Through this synthesis, human dimensions specialists have provided some useful insights about how people relate to wildlife and wildlife management. These insights have been applied in management, but continued progress is essential, especially in the integration-application-evaluation-refinement-integration loop mentioned earlier.

Significant challenges lie ahead for the human dimensions specialization and for wildlife management generally (Decker et al. 1987). Continued evolution of wildlife management as a responsive-adaptive natural resource management profession will rely on active collaboration between human dimensions specialists, wildlife planners, and other, more traditional specialists working in wildlife management. It seems inconceivable that integration will occur satisfactorily or at all without teamwork involving the full complement of these specialties. Human dimensions specialists will be challenged to focus social science knowledge developed outside the wildlife management context on the problems faced by management such that it can be used as input for decision making. To facilitate cooperation, all wildlife management specialists need a common understanding of the process that leads to management significance for human dimensions knowledge. The elements of this process are discussed in the following subsections.

Synthesis

Several human dimensions researchers have demonstrated the value of using social science theory to provide a theoretical framework for analyzing the results of human dimensions research. This has led to the increased use of social science theory as the conceptual foundation for developing human dimensions inquiry. In so doing, otherwise descriptive research results gain greater inferential "power." This increases their value because concepts and relationships can be transferred to new situations with less risk and frequently less cost. Common recognition of conceptual tools for management planning is getting closer to reality. Some examples include the following: multiple satisfactions for hunting (Potter et al. 1973, Hendee 1974, Brown et al. 1977, Hautaluoma and Brown 1979, Decker et al. 1980, Lounsbury and Hoopes 1985), motivational orientations for hunting (Jackson et al. 1979, Decker and Mattfeld

1988), wildlife attitude orientation (Kellert 1987, Purdy and Decker 1989), and wildlife acceptance capacity (Decker and Purdy 1988).

The importance of continuing to monitor developments in social science fields outside the context of human dimensions of wildlife management and to screen and select those of value to wildlife management cannot be overemphasized. We need to be sure that further progress is not inadvertently stymied by acceptance of favorite theories that seem to work well enough. We must avoid becoming content with our hybrid theories tailored for wildlife management application at the expense of breakthroughs to higher levels of understanding. Applying new theory to wildlife management should be viewed as a test that will result in an evaluation of the value of the theory or the effectiveness of its application.

Integration

Several barriers exist to integration of human dimensions knowledge in wildlife management (Decker et al. 1987); two will be mentioned here. First, better integration of economic and other social science theory (Brown and Manfredo 1987, Cocheba 1987). The magnitude of the philosophical aspects of this problem may be unique with respect to wildlife management application. Differences in the approach of these disciplines to valuing and research methods are significant. Incentives to overcome this barrier will have to be offered to representatives of the respective specializations. Some attempts have been made to develop collaboration between economists and other social scientists with wildlife interests and to facilitate understanding between both groups of social scientists and wildlife management professionals. More are needed. Symposia have featured both social and economic values of wildlife and have invited both types of social scientists to speak and participate (e.g., Shaw and Zube 1980, Decker and Goff 1987).

The more important barrier to integration of human dimensions knowledge in broad wildlife management planning is the role uncertainty that seems to exist between the people who have been involved in management for a long time (e.g., wildlife biologists, biometricians, field ecologists, ecological and biological researchers, wildlife science educators, etc.) and human dimensions specialists. Essentially, the latter group is carving out a key niche in the traditional domain of a former group of collaborators who have the vast majority of on-the-ground experience in developing wildlife management programs. The concept of team approaches to natural resource management, such as that advocated by Krueger et al. (1987), has seldom been operationalized successfully in the management of wildlife or any other natural resource. That is, there is a paucity of experience, models or rules for guiding various specialists in the kind of cooperative work needed to combine the biological and human dimensions of wildlife management planning. An impediment to overcoming this problem is the inability of most wildlife management agencies to hire human dimensions specialists; by and large the state agencies select for biologists. There is potential for facilitating team approaches by shaping the functions, method and authority of wildlife planners. These specialists, by the nature of their assignments, are constantly integrating various kinds of information and working with people of diverse specialties.

Education will play a significant role in accelerating integration. Through preservice education of aspiring wildlife professionals we can lay the groundwork for understanding and communication, and therefore cooperation, among future wildlife professionals. We can expect that students interested in wildlife management will become increasingly diverse in their selection of technical emphasis, some choosing to develop as specialists aligned biologically and others choosing to develop human dimensions competency. Inservice education for practicing wildlife professionals can also help improve communication and understanding between people representing the various specialization involved in contemporary wildlife management. Continuing education efforts could be designed with such communication the objective, not simply a side effect.

Application

After integration is achieved, turning to application of human dimensions knowledge is natural and will occur rapidly. Payoffs will become evident only through application.

Converting theory to action is difficult and probably the greatest barrier to application. Conversion is difficult on two fronts, conceptual and practical. The people charged with applying the human dimensions knowledge are typically trained with a biological orientation. Although frequently interested, they have little background to help them understand concepts being offered as explanations for human dimension outcomes. To compound the problem, they must understand social science theory well enough to convert theory to operation in on-the-ground program actions, usually when application has *not* been tried by social scientists. Often human dimensions specialists are not a great help to managers because they lack the program implementation experience. Human dimensions specialists are most often academics. This difficult situation can improve if new professionals are products of a more comprehensive educational system and inservice education broadens the ability of existing wildlife management professionals to deal with human dimensions aspects of management. However, for the foreseeable future considerable frustration will be experienced by those with application responsibility.

The importance of sound application of human dimensions knowledge through program actions cannot be overstated. In a responsive-adaptive approach to wildlife management, every action is an "experiment" from which information to improve program actions in the future can be obtained and added to the overall knowledge base for management. This concern naturally leads to the next stage in the development of the human dimensions specialization—evaluation.

Evaluation

A systematic and comprehensive approach to evaluation of the application of human dimensions knowledge in wildlife management will lead to several important outcomes: refinement of human dimensions knowledge, fine-tuning of wildlife programs and assessment of program achievement. The first outcome is most important to the continued development of the human dimensions specialization, whereas the latter two outcomes are of more immediate practical importance to agency programs. Mutually advantageous evaluation efforts require a rigorous team approach by human dimensions and other wildlife management specialists.

Comprehensive evaluation of management actions incorporating or based on human dimensions knowledge should focus on four aspects of the action. First, the conceptual basis of the proposed action should be examined. We must answer the question, "Is the conceptual basis for the action right for the situation or problem?" This is to safeguard against the problem addressed earlier in the application section. Applying the wrong concept to a management problem will not yield satisfactory results.

Second, the action proposed to operationalize the human dimensions concept needs to be scrutinized. A conceptually sound plan cannot be expected to work if executed outside the range of reasonable application of that concept. This problem commonly stems from incomplete understanding of the concepts, leading to action that is frequently incomplete. Inadequate planning of time and resources typically result. Full application of human dimensions knowledge often suggests time commitments that seem unrealistic to program managers who are more attuned to trying actions with short response times than those with assured results.

Third, the implementation of the program action needs to be monitored so adjustments can be made to fine-tune the action and improve the probability of achieving program objectives. This is characteristic of responsive-adaptive management and improves efficiency. Evaluation is an on-going part of management and is also the means to verify or refute the human dimensions knowledge used to formulate the action.

Evaluation of the management action impact is the fourth kind of evaluation activity and the one most people think of when they consider evaluation. Evidence is collected to assess the degree to which the action led to the achievement of management objectives. The contribution of human dimensions knowledge may be confirmed or refuted at this stage, but such information often seems less valuable since it is too late to be used in that action.

Evaluation may have long strings of application and refinement episodes. The strings may be shortened if the process proposed is followed. However, it should not be expected that a single application of theory accompanied by a single evaluation survey will suffice. Purposefully evaluated iterations may be needed. The continued development of the human dimensions specialization and its benefits rely on the new knowledge obtained from evaluation. It must be used to *refine* concepts, relationships, theories and other understandings. This topic is discussed briefly in the next section.

Refinement

The *validity* of any specialization is determined by the degree to which its assumptions, concepts, proposed relationships and theories are tested and refined. The *value* of the specialization is determined by the degree to which the refinements are applied in practice to achieve management objectives. The progress or maturation of a specialization involves both of these factors. A specialization that has arrived and not stagnated will move into a loop. In that loop integration, application, evaluation and refinement are continuous. In addition, the vitality of the loop creates a pressure such that new knowledge and theory are channeled by the specialization into the problem-solving arena it serves.

Another Human Dimension

The vast majority of human dimensions inquiry has had a consumer orientation. Most lines of inquiry have examined various aspects of user attitudes, values, preferences and behaviors or the impact of wildlife and its management on some group of stakeholders. The need exists for the initiation of a new line of inquiry into the organizational behavior and management of wildlife agencies. Here is another area where the human dimensions specialization may have great promise to facilitate the continued evolution of the wildlife management profession. To date little effort has been expended in either exploratory research or in selecting relevant pieces of knowledge on organizational behavior and management theory. Paradoxically, innovations in this area of wildlife management may be essential to overcoming the barriers to integration of other human dimensions knowledge identified earlier. A few human dimensions specialists have begun to address this important aspect of management. Their success in moving the development of that topic into the application phase is critical. The alliances formed with the specializations serving other organizations, primarily business organizations, will be important to the effective management of the wildlife agencies of the future, which almost certainly will be more complex.

Conclusions

Progress in the further development of the human dimensions specialization is important for the future of wildlife management. The ability of the wildlife management community to respond to varied social interests in the wildlife resource and to protect that resource for future generations depends on how quickly and how well the specialization develops and is applied. All wildlife management specialists have a great stake in this development. Two basic orientations of wildlife professionals—biological/ecological and social—need to cooperate. Collaboration will accelerate the maturation of the human dimensions specialization to the integration stage and ensure better management actions by application of better human dimensions knowledge.

Professionals in wildlife management have an exciting time ahead. To maximize the rewards, we must apply ourselves to the tasks of creative integration, focussed application, careful evaluation and selective refinement. Gaining experience with the application of social insights will yield new and possibly even more useful insights, encouraging further cooperation.[1]

Can we fulfill the promise that the human dimensions specialization offers to wildlife management? An answer to that question lies in a collective commitment to move topics of inquiry in the specialization completely through a maturation process. Getting hung up at the earlier stages, a pitfall that is attractive because it means exploring new problems of immediate interest and continuing to ''fish for new facts'' (i.e., exploring) or to engage in academic conceptualization ''exercises'' (i.e., synthesizing), must be avoided. Rather we must continue working at synthesis with and eye to bridging the integration, application, evaluation and refinement elements of the process. Contributions to the development of the specialization need to be made by human dimensions specialists through inquiry, by those involved in wildlife management through application and by all through increasingly higher levels of teamwork.

Acknowledgments

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[1]The wildlife profession is not alone in recognizing this need. Fisheries and forest managers are also addressing it. See Wenner's (1987) discussion of ''The Practice and Promise of Social Science in the U.S. Forest Service.''

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Thinking Together: Uniting the Human-Dimension Responsibilities of Universities and Agencies

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The fisheries and wildlife professions are often described as combinations of science and art. For some aspects, such as setting migratory waterfowl harvests, science predominates; for others, such as setting season openings and closings, art is still the dominant force. Whereas the gulf between science and art has diminished for most of fisheries and wildlife, it still seems very evident in our management of the human dimension.

The differences are exaggerated because our approaches are segregated in two major institutions—universities and management agencies. University faculty tend to treat topics objectively and distantly; their interests in people are generally theoretical or experimental. Agency managers and administrators, however, must live with the human dimension, intimately and constantly. They are human-dimension artists, relying on intuition and experience to guide their decisions.

This situation is certainly undesirable. If scientists are to understand human-dimension issues accurately, they must experience the frustrations of resource managers and resource users. If agencies are to improve as people-managers, they must learn better and quicker than their personal experience can teach. A positive future for our professions will occur when we merge these approaches, taking the best from each. Our paper has that purpose. We first describe a conceptual model that explains the different ways people think. Then we offer suggestions for uniting our different thinking styles, including specific examples that are already succeeding in universities and agencies.

A Model of Thinking Styles

Kenneth Hammond suggests that people think in six different styles (Hammond 1978, Nielsen 1988). These six styles vary along five gradients (Figure 1). Degree of openness ranges from completely overt to completely covert. Style of cognition

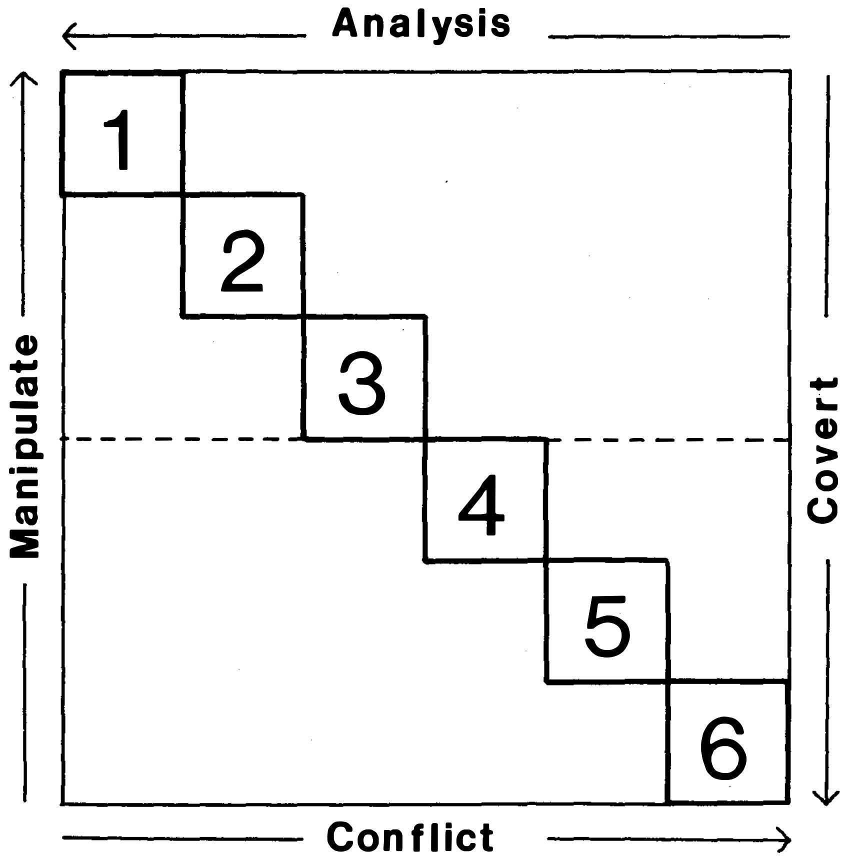

Figure 1. Hammond's model for different styles of thinking and decision making. See text for complete description.

ranges from intuitive to analytic. Manipulation of the decision environment ranges from passive to active. Approach to conflict ranges from conflict-reducing to conflict-producing. Frame of reference ranges from focusing on objects to focusing on processes.

Scientists use Modes 1–3. Mode-1 thinking (strong analytical experimentation) uses the strictest scientific methods, common to physical experiments. Mode-2 thinking (moderately strong analytical experimentation) involves true statistical experiments, in which treatments and subjects are assigned randomly. Mode-3 thinking (weak analytical experimentation) is really quasi-scientific, in that external considerations affect the experimental design. For example, a study comparing hunting accidents in states with and without blaze-orange laws is Mode-3 because the presence or absence of the law determines which states have the "treatment."

Managers use Modes 4–6. These are more covert, passive, intuitive, conflict-producing and object-oriented than the styles used by scientists. Mode-6 thinking (weak quasi-rational thought) occurs entirely within the mind of the decision maker.

We use this commonly for most personal and administrative decisions. Mode-5 (moderately strong quasi-rational thought) improves on Mode-6 by using a clearly defined set of data to inform the decision maker. Physicians, for example, use Mode-5 in clinical practice. Mode-4 (strong quasi-rational thought) improves on Mode-5 by making both the decision-making criteria and data explicit. It incorporates many types of aids, including statistical analyses, simulation modeling and decision analysis.

Hammond's model clearly reveals the way to bring the human-dimension work of agencies and universities closer together. Scientists and managers must move towards each other, focusing on the middle of the range—Modes-3 and -4—rather than on the ends.

The Role of Universities

Most university faculty imagine themselves as true scientists, devoted to Mode-1 research (Edwards 1981). In fisheries and wildlife, we have generally contented ourselves with Mode-2 work. If useful human-dimension research is to prosper in universities, however, fisheries and wildlife departments must accept the Mode-3 style that characterizes sociological and planning disciplines.

Mode-3 studies are inherently applied (why study a topic driven by external forces unless changing those external forces is of interest?). Consequently, universities must emphasize not only theory development, but practical results that can be used by agencies. A close working relationship between agencies and researchers is essential (Knuth 1987). The success of the Human Dimensions Unit at Cornell, for example, is founded on its interactive relationship with the New York Department of Environmental Conservation, which regularly supplies PR funds for its work.

Human-dimension studies are best when cross-disciplinary. Because few of us can master all the needed skills or accumulate all the relevant experiences, the contributions of sociological specialists, fisheries and wildlife specialists, practicing managers and the public are all valuable. The Cornell Angling Research Program (CARP) integrates across academic disciplines, involving social and natural scientists with fisheries resource expertise. Agency administrators and managers from the New York Bureau of Fisheries and extension personnel from the New York Sea Grant Institute combine with researchers to identify and conduct practical research projects focused on immediate management dilemmas as well as the theoretical bases of angler interest and involvement.

Human-dimension studies also seem most likely to succeed within a perspective that views fisheries and wildlife as ''systems'' (Adams 1988). Isolated studies of people are interesting, but their integration into comprehensive analyses will make human-dimension results much more useful. The Virginia Department of Game and Inland Fisheries, for example, is currently supporting a major project to describe the James River system. The project includes biological, habitat, human-dimension and comprehensive modelling segments; as part of this large project, the human-dimension component will be fully integrated into the system model and into subsequent management actions.

As human-dimension researchers add Mode-3 science to their methodologies, professional and scientific societies must be consciously supportive. They must make their organization and their journals friendlier to the human dimension. In an effort to recognize the human dimension, the American Fisheries Society has recently reconstituted its Economic Section as a Socio-economic Section. The Wildlife Society should follow suit, for example, by adding a ''human dimensions'' category to the interest-area section of their membership application (that interest is now subsumed under ''hunting''). Editors and reviewers must accept Mode-3 studies as appropriate for our primary journals, even though they don't follow traditional Mode-2 designs. Human-dimension articles are increasing in technical journals, but more ''affirmative action'' is needed to solicit, appropriately review, and expeditiously publish human-dimension papers.

The instructional mission also must embrace the human dimension, even at the cost of some biology. Undergraduate courses should place fisheries and wildlife in a management context that gives biology, habitat and the human dimension equal weight. Because most fisheries and wildlife instructors are biologists, they feel uncomfortable teaching sociological subjects (Bromley 1988). A task force of the Organization of Wildlife Planners is attempting to change this by making their experience available to universities. One activity is the production of a teaching module on comprehensive planning; it includes lecture outlines, visual aids, references, and complete texts of essential readings.

Graduate students need even more exposure to the human dimension, even at the cost of some research experience (Nielsen 1987). Most M.S. graduates will move directly into positions of management authority and responsibility. They must learn the principles of human-dimension disciplines so they can use them later in unexpected settings (Romm 1984). They must also learn the practical realities of their work; graduate courses at Virginia Tech and New Mexico State, for example, include agency staff who can breathe life into the concepts. In fact, students in the ''Fisheries and Wildlife Planning'' course at Virginia Tech have attended this conference and had working lunches with federal and state planners. Students at Cornell study the federal environmental policy process during special intersession courses in Washington (Wilkins et al. 1989).

We must address also the continuing education of practicing professionals (Cross 1987). Continuing education about the human dimension is especially important because careers evolve rapidly from technical to policy and supervisory stages. The human-dimension skills learned by students will soon be insufficient for their work as full-time administrators, planners or policy-makers. Courses similar to those offered by Pennsylvania State University for natural resource executives and by Virginia Tech for Forest Service managers need to be available to state and federal agency staff at all levels (Nielsen 1989).

The Role of Agencies

Agencies treat the human dimension at the opposite end of Hammond's model. Agencies tend to use Mode-6, relying on intuition to make judgments about human needs and desires. If they are to profit from the human dimension research and teaching in universities, they must march purposefully into Modes-4 and -5.

The first step is for agencies to acquire meaningful data about the human dimension. Kellert's study of American attitudes towards animals (Kellert 1980), funded by the U.S. Fish and Wildlife Service, is a useful model for sociological analyses. Such studies must become a standard part of agency monitoring, just like breeding waterfowl surveys or Christmas bird counts. The range of items that can and should be monitored is long (Knuth 1986), but many of the data are collected already in various forms. Similarly, projects which attempt to link human-dimension data with decision making, such as the current "Responsive Management" project sponsored by the Western Association of Fish and Wildlife Agencies, need to be incorporated in the operations of all agencies.

The state of Wisconsin has institutionalized opinion-monitoring in a unique way, through its Conservation Congress (Nelson 1984). The Congress is composed of laypersons, elected from each county, who represent their county at an annual meeting to advise the Wisconsin Department of Natural Resources (DNR). Each year before the convention, a questionnaire is developed by the DNR, based on input from congressional committees and DNR staff. Those questions are voted on at public meetings held in each county. The results guide later voting by delegates at the annual meeting and future decisions by the DNR.

The step to Mode-4 is the step to comprehensive planning—the explicit designation of objectives and ways to measure them. The human dimension must become a part of the comprehensive planning process. Objectives for management of the human component can be as quantitative and substantive as those for habitat or animal management. The Maryland Forest, Park and Wildlife Service, for example, has set specific objectives for distributing the popular version of their comprehensive wildlife plan to schools, and it conducts quantitative evaluation of the extent and nature of its use.

Mode-4 thinking also involves using many aids to inform decision makers. Many different approaches to public participation are available, variously suited to different situations, audiences and schedules (Wambach 1979). Research conducted by universities and specialists obviously provides the next generation of practical tools. In the future, more agencies also will be able to employ their own social scientists, developing the needed information and techniques in concert with outside specialists. Agencies will work most successfully with the public when they take advantage of the knowledge and skills of their technical staff, university faculty and consultants.

There is another side to the human dimension—the inside. As Jim Remington, Executive Director of the Virginia Department of Game and Inland Fisheries, has remarked, he too is a habitat manager. He manages the habitat of his staff. Paying attention to the attitudes, behaviors and needs of natural resource managers is an essential part of the human dimension of fisheries and wildlife resources.

Our attention to the personality and cultures of our agencies is still rudimentary. We need much more information about the way fisheries and wildlife managers view their jobs and their employing agencies (Kennedy 1986). These topics are much more critical to our professions than they are to most, because personal ideals and subsequent ideas are so important in drawing people to and retaining them in natural resources careers.

As we learn more about ourselves, we can then create environments for success. The U.S. Forest Service's PROJECT SPIRIT is one such program; it encourages professionals to use their creativity to improve the agency from the bottom up (USFS 1987). Similarly, the Wisconsin DNR's "I'm Proud That . . ." program allowed hundreds of DNR personnel to voice their good feelings about their work (Wisconsin DNR 1988).

The Upshot

Aldo Leopold's vision for a better future depended on the evolution of a conservation ethic—a feeling among all people that the land and water deserved kind and respectful treatment. Today that vision depends as much on our understanding of the human dimension of fisheries and wildlife as it does on traditional skills and knowledge. University faculty and agency staffs working on the human dimension have already contributed greatly to the coming of Leopold's ethic. But, as in all fields of human endeavor, progress will occur most effectively and efficiently when persons of thought and action work together. Uniting our approaches by thinking together will lead to more integrated resource management, a professional willingness to accept change as a desirable part of management, commitment to common goals, and a recognition of our essential role as stewards of the public good.

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Status of and Need for Career Development Research in Natural Resource Agencies: A Forest Service Example[1]

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Student transition from academic life to the "real-world" of natural resource bureaucracies is often a subject of agency jokes and folklore. It's rarely the subject of research. This persists despite recognition that serious agency-recruit conflicts occur that might be avoided with better information and training–especially for new types of specialists and women recruits who can easily feel alienated in traditional natural resource agencies. The results of such unintended career problems are often reduced productivity, lower job satisfaction or increased interdisciplinary conflict. In addition, natural resources are likely to be less well managed.

This paper examines the entry-stages of career development and focuses on the dominant professionals in the USDA-Forest Service (USFS): foresters, range-conservationists (range-cons) and wildlife/fisheries biologists (WL/F-biologists). Two recent studies (Kennedy and Mincolla 1982, 1985a) illustrate the need for and benefits of research to diagnose career needs and the development of training/education programs in the USFS.

We begin by considering why career development of its employees is rarely the subject of research by the USFS and other natural resource agencies.

The Traditions and Status of USFS Career Development Research

The USFS is a proud, successful, professional organization (Gold 1982, Clarke and McCool 1985). Its professionalism is illustrated in a multi-million dollar research program to test theories and provide empirical information on forest environments and the people who use them. Like most other natural resource agencies, however, the USFS has no research program to learn why its employees succeed or fail to find satisfying, productive roles at various stages of their careers.

Perhaps the dominance of the social sciences in studying employee career development has inhibited this type of research. As hard-science professionals, USFS managers and researchers traditionally perceived social sciences as having lower status and being less relevant than fields such as hydrology or entomology. But this tradition changed in the 1970s with the inauguration of recreational research and management programs. USFS social scientists have since acquired a worldwide reputation in outdoor recreation research—as illustrated in a recent wilderness research conference (Lucas 1986). Ironically, the agency now has better theories and

[1]This project funded by Utah Agricultural Experiment Station, MacIntire-Stennis Project 712 (Journal paper 3741), in cooperation with the USDA-Forest Service.

data to understand the attitudes and behavior of recreational groups, such as wilderness users, than their own employees.

The Yankee tradition of macho self-reliance may also have inhibited career development research by the USFS and other agencies. In our society, individuals are generally believed to be accountable for their own success and failure. Yet the high-profile USFS safety program belies this tradition. This program stresses that physical injury is not only the responsibility of the individual, but also their supervisors and work units. A pervasive USFS safety educational program is designed to prevent employee injury and supervisors are held accountable when accidents occur. No such program exists to maintain career health (i.e., rewarding jobs with longterm prospects of a satisfying and productive career). Yet this can be more important to longterm employee "wellness" and agency productivity than the loss of fingers or toes. Career satisfaction and productivity is inseparable from employee (body and spirit) wellness; and an agency's career development program should be as well conceived, studied and monitored as its safety program. This will require some changes in agency traditions.

Compared to other natural resource agencies, the USFS has been well studied. Classics like Gulick (1951) and Kaufman (1960), recently updated by Leman (1981), provide some career development insights; but they follow political science traditions of studying employees to extrapolate to broad, agency-wide descriptions. We suggest reversing this tradition to focus on employees for their own sake. This would be a bottom-up approach to understand employee attitudes, behavior and achievements/failures in the organizational behaviorist tradition (e.g., Schein 1978).

With the exception of recent policy studies (e.g., Leman 1981) special studies of USFS women (Enarson 1984) or of professional-types (such as WL/F-biologists, Kennedy and Mincolla 1985a), most classic USFS policy studies (e.g., Kaufman 1960) are dated. They describe an agency dominated by male foresters. Perhaps career development was simpler then and did not warrant investigation. But that era is history. Today the USFS culture is much more professionally, ethically and sexually diverse. The role of staff positions, USFS "family loyalty" norms, or willingness to transfer have also changed. USFS recruits now encounter a much more fluid and complex organizational culture in which to find productive, satisfying careers.

Insights of Two Recent USFS Studies and Further Career Development Needs

Kennedy and Mincolla (1982) was explicitly designed as a career development study: a 50 percent sample (n = 109, 81 percent rate-return) of all USFS entry-level foresters, range-cons and WL/F-biologists hired by the Intermountain (R4) and Pacific Northwest (R6) Regions between 1978–81. We will refer to this as the R4/R6 study.

Recognizing that about half the USFS professionals hired by Regions 4 and 6 (1978–81) were women, we anticipated many men and women career development differences. There were some (e.g., women had more dual-career conflicts, higher expectations and lower initial job satisfaction than men). However, many more career development differences occurred based on type of professional: WL/F-biologists (regardless of sex) had stronger allegiance to their profession, less acceptance of agency values and lower expectations of future USFS career opportunities than foresters and range-cons (Kennedy and Mincolla 1985b). In recognition of the more difficult career development tasks for WL/F biologists in the USFS culture, a second study focused on their needs (Kennedy and Mincolla 1985a). Hereafter referred to as the WL/F-MGR study, it was a 43 percent sample (n = 99, 86 percent rate-return) of entry-level WL/F managers in all USFS regions hired between 1978–83 (Kennedy 1987). The next section of this paper applies some career development findings of the R4/R6 and WL/F-MGR studies to important USFS human-resource issues.

Issue: Recruitment and Retention of Women and Minorities

A recent report (*Workforce 1995—Strength Through Diversity*, USDA Forest Service 1987) highlights programs to increase the professional, ethnic and sexual diversity of the USFS workforce. This includes *recruiting* diverse employees and facilitating USFS careers that will *retain* them as respected, contributing members of the USFS. There is very little data on how such USFS recruitment and retention processes have operated with traditional male foresters, much less new types of employees. This deficiency must be resolved if the recruitment, retention and career development of women and minorities (and all employees) is to be understood and enhanced in a professional manner.

Our studies offer insights that might improve the management of a diverse USFS workforce. For example, the R4/R6 study found that women and men were attracted to their professions and USFS jobs for different reasons. Men described geographic preference (in an open-ended question) as their major job attraction (e.g., to live and work in eastern Oregon for quality of life, especially outdoor recreation). Women put geographic preference much lower (and then mostly because family or friends were there, not because of good hunting and fishing). Their primary motivation was professional: to care of forest and environmental values. Whereas men used "work with" or "manage" verbs, women described their professional motivations as "love," "concern for," "take care of" forest resource values.

Women also had higher first job expectations than men on the eight items offered (e.g., job challenge, professional prestige or group morale expected). These higher expectations and less USFS summer job experience probably contributed to their significantly lower first-job satisfaction (X^2, p = 0.01). These differences in job satisfaction between men and women disappeared in several months, or by their second assignment.

In both studies, women were more dependent on and vulnerable to people—especially their supervisors and peers. This was both an asset and liability. On the positive side, women in the R4/R6 study received significantly more personal and professional support from their "most significant peer" than their male colleagues (X^2, p = 0.04). Women in the WL/F-MGR study also receive more support from their mentors (examined more in a section below).

Women in the R4/R6 study were also more influenced by first job supervisors, who could have a great positive (the likely case) or negative impact on their job satisfaction and desire to stay in the USFS. Men were more wary of and distant from others, and proudly perceived themselves as less dependent on colleagues and supervisors. This protected them somewhat, but foreclosed many career (and human) development opportunities.

These few results illustrate some ways that retention of women might be improved. More temporary or cooperative job experiences would help women formulate expectations that are more consistent with their first permanent jobs. The effects of isolated assignments should also be fully considered, because good hunting and fishing probably will not substitute for other quality of life deficiencies (as they have for many male employees). Women's more idealistic job motivation should also be considered, and their greater receptivity to the positive and negative influences of a first immediate supervisor might justify systematic efforts to screen supervisors who do (and do not) have a reputation for nurturing and developing their employees.

Issue: Initial Training and Development Needs of New Employees

Table 1 illustrates university preparation of WL/F-MGR study participants (57 percent with masters degrees) for their initial USFS jobs. Although the majority were technically well trained, 28 percent felt poorly prepared. This was usually related to the *species* focus of their education (52 percent said their education was species-oriented, 16 percent habitat-oriented, 32 percent an equal habitat-species focus). Yet 84 percent believed the USFS hired them primarily to manage habitat.

Entry-level WL/F-MGRS were even less prepared in attitudes/values and people management skills. When asked "the biggest attitude/value change (if any) "they had to make to succeed in the USFS, open-ended replies fit the following categories (cited as either first or second change): learn to get along with people and in teams (42 percent), understand WL/F resources are often of lower priority (27 percent), accept that many decisions are political (22 percent), and recognize the multiple resource values of the USFS (20 percent). Having succeeded as students in a biology-based education that usually focused on population management and wildlife/fisheries values, these recruits had much to learn about the integration and trade-offs of multiple resource values in a team decision-making and public involvement forum. For them to succeed at the entry career stage, some good shortcourse and on-the-job training is required in these areas.

Issue: Career Advancement and Long-term Agency Commitment

Respondents in both studies were asked if they wanted to make a career of their *professions*, and 90 percent of men and women checked "yes." Commitment to make that career in the *USFS* was much less and more variable.

Table 1. College preparation to succeed in first permanent USFS job (WL/F-MGR study: Kennedy and Mincolla 1985a:5).

Question: "How well did college training provide ___ that helped you be a successful WL/F manager in your first year or two in the FS? (n = 99)

Replies	Technical knowledge (%)	Attitudes and values (%)	People mgmt. skills (%)
Very well	7	10	1
Well	55	22	14
No impact	10	23	27
Poorly	25	35	42
Very poorly	3	10	16
Totals	100	100	100

Half the R4/R6 sample (after an average of two years in the USFS) believed they would spend their career in the agency, but less WL/F-biologists (40 percent) than foresters (57 percent) or range-cons (56 percent) planned to stay in the USFS. After an average of 3.5 years in the USFS, 35 percent of the WL/F-MGR study said they wanted to stay in the USFS (58 percent undecided and 7 percent checked no). Asked why they might leave, those checking "undecided" or "no" replied: lack of longterm career opportunities (50 percent), WL/F management low priority/status (32 percent) and dual career/family issues (18 percent).

New "ologists" were hired by federal natural resource agencies primarily as a result of 1970s environmental legislation (Kennedy 1988). These laws sought to integrate broader environmental values and skills into agencies that were largely professional monocultures. This legislation immediately prompted the hiring of new specialists, but it has taken longer for agencies to open established career ladders (especially line positions) for these newcomers, or to develop new career paths for competent, technically-oriented professionals who want to remain specialists.

Issue: Women's Difficulty in Finding and Benefitting from Mentors

It's a common belief that women in traditionally male organizations have more difficulty developing good mentor relationships. There's little evidence that this is true (Hunt and Michael 1983, Kanter 1977). Yet this was one of the beliefs in proposing a more formalized USFS mentoring program for women and minorities.

In both studies women were as likely as men to have a mentor, even though about 90 percent of their mentors were men (Kennedy and Mohai 1987). Type of profession, not like gender, seemed to be the major factor in selecting a mentor (e.g., men and women foresters sought out other foresters as mentors). Although WL/F-biologists sought other biologists as mentors, and there were fewer potential WL/F-biologist mentors in the USFS, they still found them and were as likely to have a mentor as other professional colleagues.

It was somewhat surprising that women in the WL/F-MGR study believed they received *better* support from their mentors than did their male colleagues. Of nine possible mentor roles (e.g., impact on my value/ethics, as a role model, etc.), women gave their mentor higher evaluations than men in *every* category. In two important roles women rated this mentor assistance significantly higher: "teaching me how to make it in the USFS" and "sponsoring my USFS advancement" (X^2, $p = 0.04$ and 0.02, respectively).

Women's general openness and reliance on other people (Gilligan 1982) probably made it easier for them to seek help and support from their mentors (whereas male colleagues may have found it more difficult to admit their need for help and to seek mentor assistance). In addition, affirmative action policies have increased accountability for USFS supervisors to develop their women employees, possibly motivating greater mentor involvement.

Empirical information in this example does not call for a new program. Rather, that a proposed "formalized mentoring program" for women currently is not justified by our USFS or other studies (e.g., Hunt and Michael 1983).

Closing Comment

The USFS justifiably views itself as a professional agency that bases important decisions on scientific theory and empirical evidence. But over its history, the beliefs and folklore in some management areas have been less scientifically based and empirically challenged than others. For example, Schiff's (1962) classic policy study illustrates the difficulty of scientific evidence changing USFS fire and watershed management beliefs.

Kennedy (1978) and Tweed (1980) illustrate the traditional folk-art nature of USFS outdoor recreation management that, in the last 20 years, has become very professional. USFS human resource management programs need to undergo a similar transformation. Although most personnel and training positions are now staffed with specialists trained in these areas, the lack of adequate career development data hampers the professional management of diverse USFS human resources. This is true with daily career development decisions about placement or transfers, as well as long-term, nationwide issues of training, women and minority retention, or unique career paths options for new types of employees.

Fortunately this tradition is changing. For example, the USFS Wildlife and Fisheries Staff (Washington, DC) sponsored our WL/F-MGR study and used the results to justify and design a series of two-week shortcourses for WL/F-biologists at various career stages (Cross 1987). An initial course helps them understand and operate in the agency culture by confronting their naivety and resistance to normal bureaucratic behaviors of compromise and political negotiation. Two other shortcourses help WL/F-biologists adapt their university (largely species-oriented) knowledge to the habitat concepts required of USFS management. Hopefully, basting training and human resources development programs on good diagnostic studies will soon become the norm in the USFS and other natural resource agencies.

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Teaching and Learning About Natural Resource Policy

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Over the next decade, most of those who will assume key roles in managing natural resources in the first third of the 21st century will be on university campuses, gaining a foundation of knowledge about public land and water management and the wildlife, fish or other natural resources on those areas. The ability and willingness of future managers to seek out and incorporate research knowledge about human dimensions when they create and implement resource policies in the next century will be advanced substantially if their education includes concepts involving human dimensions of resource management.

One approach toward achieving this goal is student enrollment in natural resource policy courses which illustrate the importance of both biological and human components in management decisions, and emphasize the social and political structure in which management and policy decisions are made. We discuss such a course that involves both undergraduate and graduate students, university faculty, agency and legislative staff, and lobbyists in Washington, D.C.

The Course

This three credit-hour course "Natural Resources Policy, Planning, and Politics" moves beyond the "historical-descriptive" and "legislative products" models of policy education, incorporating descriptive and analytical case study techniques and the involvement of resource policy practitioners in the teaching/learning process. The syllabus emphasizes basic concepts of the policy process, particularly as applied to environmental and natural resource issues. These concepts are then illustrated by a series of case studies in which about 20 prominent policy makers at the federal level share their perceptions and experience with current policy issues. Students (and faculty) increase their abilities to assess potential and actual causes of conflict in resource policy and management decisions, and to identify the influence of biological, social, economic and political forces in ultimately shaping policy.

The course involves three distinct elements: (1) theoretical focus on the policy process, important sources of leverage, and characteristics unique to resource policy; (2) focus by Cornell faculty and policy practitioners on five case examples illustrating the dynamics of resource management within policy formation and evaluation processes and (3) development of oral and written communication skills and analytical capabilities through preparation and presentation of a paper on a resource policy issue initiated through personal interviews in Washington.

Policy Education

Several models of resource policy education, such as "historical-descriptive," "legislative products" and "case study" styles could be used. We use the "case study" mode of teaching and learning, with an emphasis on both descriptive and analytical techniques, viewing it as superior to the other policy education models.

The "historical-descriptive" model of policy education focuses on the heritage, structure and historical norms of the resource profession (Romm 1984). The shortcomings of this model center on the historical nature of the approach, ignoring current and emergent concerns. As Romm (1984) noted, the result of this approach to policy education may be a resistance to change and, worse, a resistance to learning from those outside the historical sphere of influence in resource policy discussions. With such an attitude, future resource professionals would be unlikely to succeed in a world of evolving and diverse values regarding appropriate uses of natural resources.

The "legislative products" model of policy education focuses on key pieces of legislation (historical or current) that have influenced the ways in which natural resources management occurs (Clark 1986). For example, a course in fisheries policy might focus on the Fish and Wildlife Coordination Act of 1934 and the National Environmental Policy Act of 1969, and compare and contrast the types of interagency consultation required by each when fisheries habitat was to be affected by federal development projects. The emphasis is on the laws and statutes passed and promulgated, not on the political processes necessary to ensure their passage, nor on the actual success of implementing those acts. If this led to overemphasis on the written rules of the process, future professionals would be lacking in knowledge concerning the formulation, implementation, evaluation and revision of resource policies.

We believe the case study approach is the policy education model with the greatest potential for establishing effective partnerships and team approaches to teaching and learning about resource policy concepts and processes. The case study approach allows students to isolate and analyze the often apparently intangible aspects of decisionmaking (Knuth 1987), a strength not evident in the other two models of policy education discussed above.

A partnership between educators and practitioners exposes future resource professionals to the mix of understandings they will have to call upon to bridge the gap between theory and application. Academic educators provide clarification about terminology used in a case study and theories concerning how policymaking can or should occur. Practitioners bring their unique professional experiences to the classroom to enable students to understand the context in which they will soon be working. Involvement of resource policy practitioners in university courses has been recommended to make today's educational experiences more relevant to the needs of tomorrow's natural resource professionals (Knuth 1987).

Case study approaches to resource policy education can incorporate a combination of descriptive and analytical techniques. Analytical approaches allow students to consider potential alternatives to solving resource policy problems, assess resulting consequences, and make judgments about the feasibility of each alternative. Romm (1984) outlined three objectives for successful courses in policy education. They should (1) develop a curiosity about and understanding of public policy processes; (2) develop a capacity to assess causes of conflict and (3) develop conceptual and communication skills to reduce those conflicts.

Meeting each of Romm's (1984) objectives for policy courses, we emphasize descriptive case study learning during presentations by policy practitioners, and focus on analytical skills during open discussion sessions following each presentation, and through student research projects. Class sessions and discussions facilitate students' analysis of the basis for beliefs and power held by each group. In their individual projects, students analyze an evolving resource policy issue, describe relevant stakeholders and emerging conflicts, and are required to choose the policy alternative they feel is the "best" solution to the policy problem. Student communications skills are developed through oral and written presentation of their projects.

Issue-oriented, analytical research projects force students to encounter conflicting views and to develop strategies for resolving those conflicts (Clark and Kellert 1988), a skill that will surely be useful to resource professionals in the 21st century who seek to identify and weigh the significance of human dimensions information that can be brought to bear on any resource management problem.

Participants

Enrollments include up to 20 students, mainly seniors and a few juniors and graduate students, from Cornell's Departments of Natural Resources, City and Regional Planning, Agricultural Economic, and others. We impose no prerequisites, but expect that all students have had a substantial background or interest in some policy-related area and experience in public speaking, library research and writing.

Participating Cornell faculty have come from the Departments of Natural Resources, Agricultural Economics, and City and Regional Planning and the Graduate School of Business. Their expertise has included wildlife, fisheries, policy analysis, resource economics, environmental law and environmental politics.

Practitioner participants are chosen for their expertise and involvement with the cases under study, as well as their overall experience with the workings of the public policy process. Before the speakers appear, assigned readings and discussions led by Cornell staff have provided students with a substantial background on the cases to be discussed. Some speakers are scheduled to appear singly; others work together in twos, threes or panels of up to four. When speakers are scheduled together, students can observe better some of the cooperation, disagreements, differences in approach or style, and rationales for multiple perspectives on an issue. When speakers appear separately, they sometimes can be more candid about their work, their interactions with colleagues and opponents and their personal opinions beyond their official positions. For each case discussed, we try to achieve a balance between representation from Congressional staff people, officials from the executive bureaucracy and lobbyists from public interest, environmental or industry organizations.

A high level of preparation by all participants is essential. Although listed as a spring-semester offering, most of the course takes place during Cornell's January intersession. Course planning requires selection by November of cases for study, contacts with Washington personalities to arrange for dates and times for time to speak, choice of reading materials and arrangements for housing and staff participation. The classes are conducted, and the students and faculty live, in Washington at the Cornell Center, a residential and teaching facility owned by the university.

Logistics

Students apply and are selected for the course in October and November. We meet in December to discuss course logistics and be begin preparatory discussion and reading. The students are required to buy a text (Jones 1984) and a package of 300 pages of photocopied background materials for the case studies. By the time they arrive in Washington in early January, students have completed independent reading of these materials. (We begin our Washington sessions a day or two after airfares have fallen from their holiday peaks.) We are working in Washington at an ideal time. Congressional staffs and lobbyists are at work but a new session of Congress has not yet begun.

On the third day of our 11-day intensive program, we conduct a "final exam" covering the content of the text, which deals with the policy process and policy analysis. By calling it (accurately) a final examination we emphasize its importance and by having it very early, we ensure both that students are well prepared to make good use of their interactions with guest speakers, and that the students are relieved of possible anxieties about capturing and using ideas considered in the case studies. The learning environment seems to be enhanced markedly by this reversal of the usual order of classroom activities.

After those three days of concentrating on principles and concepts related to the policy process, we present, mainly through the invited speakers, the case studies which demonstrate the rough-and-tumble realities of the process. Using the case study focus, students identify the influence of biological and human dimensions that ultimately shape policy. We choose cases which are complex, current, many-faceted, and with legitimate and substantially differing perspectives brought from various parties. We address issues which are primarily "environmental" and try to include terrestrial wildlife, fisheries, land use, contaminants and toxics, and international affairs. Recently we have included grizzly bear management in the northern Yellowstone ecosystem, farm programs and wildlife habitat, toxic materials in groundwater, Antarctic issues, extended fisheries jurisdiction, proposed oil and gas development in the Arctic National Wildlife Refuge and others.

The Washington schedule includes about six hours of scheduled activities each day (including Saturday and Sunday), with sessions of two to four hours mornings, afternoons, and some evenings. One-and-one-half days are reserved for students to visit with and interview experts in a subject of the students' choice, as part of their preparation for a required policy analysis paper. The class meets at the university in Ithaca four times during February for oral presentation and discussion of student papers.

Two social events, one just after arrival at the Cornell Center and the other near the end of the course, and the spontaneous informal activities which come from living together, help to foster a collegial, pleasant and very productive environment.

Evaluation of the Course

Students, faculty, visiting experts, and staff at the Cornell Center have been virtually unanimous in judging this course as outstanding. In last year's evaluations, every student made highly positive statements; 5 of 17 students (all having experienced 25 or more courses) indicated that it was the best course they had had at Cornell.

Besides the academic success of the course, faculty have made important contacts with Washington colleagues and added detail to their understanding of important issues; students have freed up spring semester schedules; and several students have made contacts leading to internships or jobs in Washington. Last year, four students arranged for internships and one found a full-time job as a direct result of contacts they made during the January course.

Practitioners value the course, and their participation is a critical element of the case study approach. Practitioner evaluations of the program may be based largely on student responses to the issues raised during discussions. Washington practitioners, both decisionmakers and advocates, often discuss current issues with groups brought to Washington by trade associations, universities, internship programs, and other organizations. They may be requested to discuss their role in shaping a particular policy or policy making generally, or simply to provide a status report on a pending matter. In some cases this is done as a service to a constituency. Usually, however, it is part of a broad effort to generate support for their position.

The Cornell program offers practitioners a small audience interested in resource policy that has an initial understanding of the particular case they will address. This has had a significant influence on their reactions of the course, which have been positive.

Practitioners do not expect to convert each group they address into vigorous supporters. Realistically, they cannot even expect every group to be a friendly audience. This may be a concern to development-oriented practitioners asked to address college students. Rightly or wrongly, many who side generally with resource development interests feel they face an uphill battle with college groups, while those opposed often consider these same groups as natural allies.

Giving advocates an opportunity to provide material supporting their position for review prior to their session addresses this concern while laying groundwork for their presentation. When this is not practical, simply assuring that the students are being exposed to a balance of information does much to dispel possible doubts about appearing before students.

Applicability

Using case studies in government centers, with heavy practitioner input might be replicated by a number of universities—at state capitals for example. Our colleague, Dr. David Allee, who helped organize our first Washington course, initiated a similar course in New York's capital this past January. Covering a different topical area, and using a fraternity house as a residence hall, student evaluations noted the outstanding contribution this course made to their overall education, but also identified as a weakness some lack of access to policymakers as the residence was somewhat distant from the capital city complex.

Pracitioners have been outstandingly cooperative. Advance notice and choosing a time when Congress is "out-of-session" facilitates scheduling. Providing balanced, advanced readings for each session dispels apprehensions some pracitioners, particularly those representing resource development interests, may have about appearing before a group of students.

We are interested in exploring with others ideas on how the academic community might expand education involving human dimensions in resource management. For example, how might we generate inter-university use of this or related opportunities in Washington, D.C.? Such opportunities might include a similar course offered jointly by ourselves and other institutions in late May or early June.

Summary

Natural resource managers of the 21st Century will benefit if they have a detailed understanding of human components of natural resource management. Students have responded enthusiastically to gaining such knowledge through a concentrated course on natural resource policy and politics that uses theoretical and experiential components. Elements of each of three policy education models can be found in the course described.

Students learn the objectives of various interest groups involved in policy debates and are introduced to the political processes involved in resource policy formation and implementation. Practitioners (e.g., legislative staff, agency bureaucrats, interest group lobbyists) provide insights about the dynamics and relationships of their respective organizations. The ten-day session, involving up to 20 practitioners, several faculty members and five case studies, helps students recognize elements involving human dimensions that are increasingly affecting resource management.

Elements of this experience may be adopted by other institutions through implementation of similar courses in state capitals and, perhaps, joint or independently offered courses in Washington, D.C.

Acknowledgments

Establishing this, or any course, requires commitment of time and resources. We wish to particularly thank Dr. David Allee, Professor of Resource Economics at Cornell for organizing and initiating this course. Special funding for this course came from Cornell's "President's Fund for Educational Initiatives" and the New York State College of Agriculture and Life Sciences.

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Developing Wildlife Education Strategies for Women

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Background and Literature Review

Wildlife planners are being confronted with increasing challenges in maintaining broad constituencies and support bases for management. Various "anti" and "rights" groups seem to have become even more militant. Increased urbanization and land access issues provide difficult problems for managers and those who administer wildlife management and education programs (Brown et al. 1987).

Two recent trends have exaggerated these wildlife concerns. First, and most critically, wildlife planners are concerned about declining participation in hunting and the concomitant decline in revenues available for management efforts. A second, more pervasive societal change is also apparent; the structure of the American family, the traditional setting for hunting initiation and participation, has changed drastically. Only 40 percent of children born in 1988 are expected to grow to the age of 18 living continuously with both parents. These children, nearly all of whom will reside with their mothers, might well be considered "youth at risk" in terms of their limited opportunity for hunting initiation and involvement (Brown et al. 1987).

Corollary issues raised by these megatrends are the concerns related to minority participation in outdoor recreation (see Daniel 1987, McDonald 1987), and the future recruitment of females and minorities into the wildlife professional ranks (Kellert and Berry 1987). Traditionally, wildlife personnel have had extensive early outdoor experience including hunting.

At a time when men and women share participation in most areas of work and leisure activity, hunting remains a highly segregated activity. In 1980, female hunters constituted only about 8 percent of the U.S. hunting population, and only 2 percent of U.S. females hunted as compared to 20 percent of U.S. males (U.S. Fish and Wildlife Service 1982). In spite of this low level of participation, females represent a significant and growing market share of U.S. hunters, having increased in number from just 418,000 women hunters in 1955 to over 1.4 million in 1980.

Numbers of women adopting other recreational pursuits are even more encouraging. Since 1955 the number of female anglers has doubled, and women now constitute 31 percent of all U.S. anglers (U.S. Fish and Wildlife Service 1982). Women are also adopting most outdoor recreation activities at faster rates than men, most likely due to women's changing family and leisure roles (Bevins et al. 1979). Leisure marketing efforts in tourism, however, are only slowly turning to female audiences and family-centered programming. Particularly encouraging are increasing numbers of "outdoor adventure" program offerings for women (Miranda and Yerkes 1982), yet little is known about motivating factors for women who participate in canoeing, hiking, climbing and other group or individual outdoor activities.

We note the tendency of human dimension researchers to focus on segments of recreational populations (e.g., specialized trout anglers) which constitute relatively small portions of recreationist audiences. Yet little is known about the wildlife and outdoor interests of the majority of the U.S. population, women and girls. Other authors (Brown et al. 1987) have gone so far as to state that since overall female hunting participation is low, women do not constitute a major pool of potential recruits. Just because females are present in low numbers does not indicate there is no potential audience. In fact, in a recent study of Missouri school youth (Stout et al. 1988) 18 percent of girls who did not hunt indicated they were interested in trying hunting; an additional 13 percent of girls had already participated. Considering that women are increasingly serving in the single parent role, and that women's participation in family recreation decision making is expected to increase for both single- and two-parent families (Owen 1980, Reidel 1980), women comprise a viable, readily identifiable and important audience for wildlife education programs.

Several causal factors may contribute to low participation of females in hunting and other wildlife-related activities. Numerous studies have documented lower wildlife knowledge levels in females vs. males (Kellert and Berry 1987, Pomerantz 1977, Dahlgren et al. 1977). Kellert and Berry also found significant sex differences in attitudes toward wildlife, and even postulate gender is one of the most important demographic factors influencing attitudes toward animals. Perhaps females are less informed than their male peers concerning wildlife in part due to their lower performance in science courses and less attention from science teachers (Burrus-Bammel and Bammel 1986).

Human dimension research has already begun to address these megatrends and the challenges they pose to the future of resource management (Brown et al. 1987, Jackson 1988a, McCarty and Kelley 1985). Before recommending particular strategies, the authors will report in greater detail two research efforts, describing a particular "minority," (women hunters); the findings are the base for the tools to be proposed in this paper for enhancing future wildlife education and management.

Male/Female Differences in Hunter Initiation

Successful completion of a hunter education course is a required "initiation rite" for beginning hunters in many states (e.g., New York). Human dimensions researchers have described sociopsychological characteristics of hunting initiates in order to make recommendations for wildlife and hunter education efforts of resource agencies (Applegate and Otto 1982). Detailed insights into male-female differences in hunter initiation variables were first quantified in a study of 1983 New York State Hunter Education Course (HEC) graduates. The study sample, stratified by sex and systematically selected from a random starting point, consisted of students of the HEC as listed on course rosters. A self-administered, mail questionnaire was sent to 736 graduates, and a 69.9 percent response rate was achieved. For more details of the study methodology, readers may consult McCarty and Kelley (1985).

Many male-female differences in hunting initiation characteristics among HEC students were described (Table 1). As noted in other studies (Decker and Brown 1982, Jackson 1988a), females were significantly older than males (females had a median age of 24 years, while males were 16 years). Significantly fewer females had a pre-HEC shooting or hunting experience. Furthermore, females had drastically different support networks at initiation; females were more likely to have had spousal support for initiation, whereas males were much more likely to have had a male role model (e.g., father) who supported their hunting activity. Likewise Jackson (1988a) reported that 52 percent of females were introduced to hunting by husbands and 68 percent of males by their fathers.

Significantly more females than males reported they took the HEC in order to accompany a relative: however, there was no significant difference in proportions of males and females reporting they took the HEC mainly to obtain a hunting license. Nearly half of the females (45.6 percent) were motivated to take the course to learn about wildlife.

Females' self-ratings of pre-HEC hunting and wildlife knowledge were significantly lower than that of males. This finding is consistent with numerous other studies which have reported actual differences (as measured by various test instruments in wildlife knowledge (Kellert and Berry 1987, Burrus-Bammel and Bammel 1986). Self-ratings, as obtained in the HEC study, may be more accurately considered a reflection of self-confidence; females' ratings of their confidence in all hunting-related activities (with the exception of learning about wildlife) were significantly lower than males' confidence ratings. The greatest sex differences in confidence were in those activities most related to shooting and firearms, a finding consistent with those of Cartner and Tierney (1978).

Significant male-female differences existed in proportions of HEC students experiencing problems with hunting and outdoor equipment. For example, 23 percent of new female hunters vs. 3.5 percent of males reported finding equipment too large. Additional (market) research is desirable to determine to what degree these problems and differential early socialization, contribute to lower female interest in hunting and low self-confidence in hunting ability.

Hunting Motivation and Satisfaction

Probably no other factors associated with hunting and outdoor recreation have been so intensively studied as motivation and satisfaction. Knowledge of these two factors should be critical to successful recruitment and sustained interest and participation of female recreationists. Because of their different childhood experiences and rearing, women might be expected to have more in common with other women than with the spouses or fathers who shaped them as hunters.

To study these developmental stimuli and hunting behaviors and characteristics, the names of women hunters were chosen at random from records of license sales

Table 1. Summary of significant male-female differences in hunting initiation characteristics among New York State Hunter Education graduates, as reported in McCarty and Kelley (1985).

Hunting initiation variable	% of male hunter education students		% of female hunter education students
Pre-hunter education experiences			
Shooting	96.1	**	80.0
Hunting	29.9	**	5.9
High hunting interest pre-hunter education course	55.3	**	31.0
Reasons for taking HEC[a]			
To obtain a license	80.8		85.7
To learn about wildlife	38.9		45.6
To accompany a relative	6.0	**	17.1
Supportive familial contacts			
% w/*mothers* w/positive attitudes toward hunting	42.1	*	32.2
% w/*fathers* w/positive attitude	70.2		62.8
% w/*mothers* who hunt	9.4	*	18.2
% w/*fathers* who hunt	62.1		61.2
% w/*mothers* who support their hunting activity	37.4		31.0
% w/*fathers* who support their hunting activity	65.5	*	53.9
Supportive peer contacts			
% w/spouse w/positive attitude toward hunting	14.5	*	47.7
% w/spouse who hunts	4.3	*	48.4
% w/spouse who supports their hunting activity	13.2	*	45.7
Mean self-rating of pre-course knowledge[b]	26.08	*	20.63
Mean self-rating of self confidence in. . .[c]			
—acquiring more knowledge about wildlife	4.09		3.96
—hunting safely in the field	4.68	**	4.27
—picking proper firearms, ammunition for a particular game species	4.32	**	3.67
—being an accurate shooter	4.39	**	3.70
—being a successful hunter (bagging game)	4.13	**	3.45

*Significant difference between male and female ($p < 0.05$).
**Significant difference between males and females ($p < 0.01$).
[a]Percentages will not sum to 100% for either sex because of multiple reasons.
[b]Overall knowledge = sum of self-ratings (where 1 = low and 5 = high) on each of 8 subject areas. Maximum possible overall knowledge self-rating score = 40.
[c]Where 1 = very low confidence, 5 = very high confidence.

in three Wisconsin counties. (The studies were later replicated by the investigator in both Iowa and Washington states.) Because some women buy hunting licenses to provide extra bag opportunities for husbands or boyfriends, actual hunting activity was verified through a personal phone call to each subject. The data were then collected through a mail questionnaire to which 72 percent of the 345 females selected actually responded. For more details of the study methodology, readers may consult Jackson (1988a).

These female subjects were asked to evaluate the relative importance of 17 factors which could motivate them to participate in outdoor recreational activities. The four top-ranked items, "desire to be outside," "opportunity to share the interests of my husband," "popularity of the activity with my husband" and "need to get away or escape" were ranked highly by the female hunters in all three states. In answering open-ended questions asking "Why do you hunt?", females consistently alluded to the pleasures of shared experience, and many pointed out that the only way to be part of their husband's life at this time of the year was to become a hunter. "Socialization," "competition," "need for adventure and risk," and "meeting the expectations of others" received low ratings as motivating factors in these women's lives.

The nature of hunter satisfaction was adapted by the investigator from the theoretical model offered by Hendee (1974). A broad spectrum of recreational and hunting satisfactions were presented to the respondents in a 21 item scale. In this analysis (Table 2) the women deer hunters (N = 256) were compared to a group of male deer hunters (N = 250) selected through stratified sampling from 10 percent Wisconsin deer management units (Jackson et al. 1981).

In comparing mean ratings, significant differences between female and male hunters can be noted for 13 of the 21 Likkert items. Female hunters reported significantly

Table 2 Rank and mean rating of hunting satisfaction for female and male deer hunters, as reported in Jackson (1988a).[a]

Satisfaction factor	Female hunters	P level	Male hunters
Nature appreciation	4.48 (1)		4.35 (3)
Seeing deer	4.29 (2)	*	4.50 (1)
Exercise and outdoor activity	4.10 (3)	*	4.34 (4)
Companionship: family	3.99 (4)		3.79 (8)
Utilizing hunting skills	3.88 (5)	**	4.38 (2)
Escape from routine	3.82 (6)	*	4.10 (5)
Shooting a bow or gun	3.69 (7)	**	2.83 (16)
Companionship: friends	3.61(8)	**	4.06 (6)
Solitude	3.55 (9)		3.55 (11)
Provision of food	3.47 (10)		3.44 (12)
Using outdoor skills	3.44 (11)	*	3.73 (9)
Getting shooting	3.29 (12)	*	3.60 (10)
Marksmanship	3.24 (13)	**	4.03 (7)
Killing a deer	2.89 (14)	**	3.40 (13)
Telling hunting stories	2.78 (15)	**	3.35 (14)
Show game I bagged	2.77 (16)		2.87 (15)
Having the best equipment	2.76 (17)		2.72 (19)
Watching hunting movies or TV programs	2.61 (18)		2.84 (17)
Trophy (display)	2.28 (19)	**	2.83 (18)
Doing better than friends	1.93 (20)	*	2.28 (20)
Using special equipment you own (off-road vehicle)	1.75 (21)		1.73 (21)

[a]This test was a one-way ANOVA comparing the means of female and male deer hunters.
*Significant difference between males and females ($p < .01$)
**Significant difference between males and females ($p < .001$)

greater satisfaction for "nature appreciation," "family companionship" and "shooting a gun or bow." Male deer hunters gave higher ratings to "seeing deer," "utilizing hunting skills," "exercise and outdoor activity," "escape from routine," "companionship with friends," "marksmanship," "using outdoor skills," "getting shooting," "killing a deer," "telling hunting stories," "displaying a trophy" and "doing better than friends." While both sexes ranked the more macho and competitive factors (displaying trophy, doing better than my friends, etc.) in the bottom half of the rankings, the males had consistently higher mean ratings.

Strategies

What can be done to open the door to greater participation by females in outdoor and wildlife activities, recreational and professional? Our recommendations will focus in particular on hunting. First, because of the research base we have established, and secondly, because, we contend, it is the last recreational opportunity to be equally appealing to women. The models and strategies we suggest should be applicable to other wildlife related activities; the problems just won't be as difficult to solve.

Hunter Education and Nonformal Youth Organizations

Hunter education programs are among the most widely subscribed and most volunteer-intensive wildlife education programs operated by resource agencies. They constitute a critical first-point-of-contact for new and potential hunters. Nonformal youth education programs, such as the 4-H Shooting Sports Program, also provide important opportunities for recruitment and training.

For a young female of 12 or 13, access to the shooting sports is particularly difficult. Adolescent girls, especially, are experiencing a sex role identity crisis, trying to balance personal interests with traditional sex role demands even in recreational participation (Harris 1975). If through appropriate publicity, teenage girls know they are welcome and that there will likely be other girls attending, they will be more likely to attend courses or events themselves. As one female instructor pointed out, "The weight of peer pressure may be clearly anti-hunting; when there are only two girls, if one quits, the second will never come back."

Once in the class it will be critical for the young woman to find female role models as sources of identification. A female teaching in the classroom and on the shooting range could clearly be helpful. (It is surprising how few top female shooters are active in the hunter education program.) Likewise, positive and active female images should also be included in instructional materials and audiovisuals. Findings from McCarty and Kelley (1985) indicate that most women who currently take the course are satisfied with mixed-sex groups of students, but 23 percent would prefer to have both male and female instructors. While classes and outings "for women only" have found support in other recreational activities, the women responding in the Jackson (1988) studies gave their lowest preference ratings to attending classes or hunting solely with other women.

Once in the classroom young women do well. Studies conducted in the New Jersey Hunter Education program (Drowbough and Locandro 1978) found that the attitudes of females improved more than those of males. Females, they report may be more open and willing to accept the behaviors, morals and values of hunting and hunters as described by the instructor. For the same reasons, shooting instructors across North America report that women can and do become excellent shots and are typically more teachable than young males.

Since many females being introduced to hunting are older, education programs should be (1) tailored to meet their educational needs by providing supplemental information on topics of interest to this group (i.e., more wildlife information, etc.) and by providing materials at appropriate reading levels; (2) offered specifically for adult, more mature audiences and (3) marketed to attract more single mothers.

Volunteer training should describe findings regarding male-female differences. Individual instructors may draw conclusions about "female hunters" on the basis of limited experiences. Instructors should be made aware of student differences in age, previous shooting and hunting experience and knowledge, and their meanings for the educational setting. They should know how to facilitate constructive discussions among students in mixed-sex groups. Male-female differences in hunter education audiences may be quite apparent, but this does not mean every female lacks experience in shooting or that every male will outperform female peers in wildlife knowledge. Comparable recommendations would apply to other atypical audiences including urban youth, minority members, etc.

The writers suggest that the most critical strategy of all could be to give hunter education and hunting a new *family-centered paradigm*. Adult women can attend classes with children and spouses whether they expect to hunt or not. Scouting, preparations for the hunt, hunting and shooting, game preparation and cooking, etc., can all be conducted as family-centered activities. Our studies of motivation and satisfaction emphatically point to this strategy.

The Media

The media play an important role in everyone's life. What we see, hear and read is the foundation of what we are—how we think, how we behave. Hunting and fishing publications have a responsibility to both female and male subscribers. They can promote outdoor sports as appealing activities for women *and* raise the level of acceptance of women in the field by men. Most hunting magazines have accepted the responsibility of promoting hunting magazines, excluding an occasional cigarette advertisement or cartoon. All the hunters were men and all the children were boys. In stories and articles, moms were portrayed as somewhat 'anti' hunting or fishing, and persuasion or deceit was required for husbands' or sons' outdoor adventure. Women might be tolerant of this foolishness because "boys must be boys."

Today, almost every issue of any outdoor magazine has something positive about women on its pages. Some have devoted whole issues or sections to women anglers, hunters, backpackers, etc. Ideally, these periodicals would induce their male readership to provide field experiences for wives, daughters and other female relatives and friends as in an article by Thompson (1984) in *American Hunter*. Yet they reach only a small portion of the desired audience. The majority of women who read such magazines are already committed outdoorswomen.

A second effective strategy using medial tools would be the inclusion of outdoor adventure material, emphasizing fishing and hunting, in the so-called 'women's magazines.' These publications would reach the intended audience of nonhunters and parents of pròspective hunting youth. Young women's magazines such as *Red-*

book or *Glamour* reach a very impressionable age group. Role model portrayals in teen publications have a dramatic impact on young women's lifestyles and values.

Newspapers and television are important media since they pervade virtually every household. Some outdoor writers have made conscientious efforts to include women in write-ups on hunting and fishing. Again, these reach the already-committed. Women's pages or state and local news sections would be more effective outlets for features on women who fish or hunt.

The Agencies

To date, agencies have taken a relatively passive role in encouraging women's interest in wildlife programs. Agencies are generally sympathetic to the idea of increased participation of women in outdoor pursuits such as hunting, but have directed little thought and few resources to programs targeting women.

That conservation agencies have neglected women is rather remarkable. Across the nation, wildlife agencies have recognized the decline in hunters, the growth in anti-hunting sympathy, and the great need to better sell wildlife programs to the public. The majority of the non-hunters, the majority of the 'anti-hunters' and the majority of the public are women. Given no change in the status of current trends, the rapid evolution to a non-hunting ethic will prevail.

A trend which might accelerate the progression to an anti-hunting society is the increasing numbers of women entering administrative and political careers. Women are making policy—policy that will impact agencies and agency programs. Will this policy be sympathetic to hunting and trapping? Most women were neglected in the outdoor ritual and values development process, which primarily transpired between father and son. Why should women be sympathetic to a value system from which they were excluded?

Agencies must take a lead responsibility to develop programs that will instill traditional wildlife values in women and children. Fish and wildlife agencies have useful tools at their disposal. Expertise is available to provide a sound base of knowledge for the uninformed or the misinformed. Thousands of acres of public land are available for providing firsthand field experience to those uninitiated in the way of the wild. Agencies often have the capability to enact rules allowing for special or controlled hunts. We again suggest "family" themes as a major marketing strategy.

Sports and Conservation Groups

Sportsman's clubs and conservation leagues have traditionally been male bastions. Until very recently, females were often actively excluded from membership in some clubs. In dismissing a request to fund the Wisconsin study cited earlier, the president of one state hunter organization states, "Sorry, I don't want women in the woods with me." Today most of these groups are doing a 180 degree turnabout in their attitude toward women's involvement and participation in outdoor activities (two other state organizations, Whitetails Unlimited and the Wisconsin Bowhunters, generously funded this research). They not only are inviting membership by women, but also developing and sponsoring programs which provide women and/or children with outdoor experiences. The level of service such organizations give to mothers or children, especially field experiences, must escalate to stem the decline of hunters.

Professional Societies

Professional societies, such as The Wildlife Society, Society of American Foresters and the American Fisheries Society have adopted positive attitudes toward encouraging professional women to actively participate in societies. This attitude has nurtured women resource professionals. However, professionals must recognize that they occupy a profession at the will of society. If the public has little interest in wildlife, we in the wildlife business will no longer be paid for our services. To insure that wildlife work remains a viable profession, the Wildlife Society should undertake responsibility to educate an inclusive public about the value of our profession's goals and pursuits.

Hunters and Trappers

It is, of course, critical that hunters and trappers become advocates and mentors to women and children. Without the encouragement and help of male hunters, few women will bolster the ranks of hunters. The NRA, for example, has taken an active role in supporting women's involvement (as shown by its sponsorship of the New York research through the grants-in-aid program). The first task at hand is to overcome the reluctance of many hunters and trappers to share their traditional male-bonding pursuits with women. These pursuits are still held by some as sacred, male-only rituals. As much as women were considered unworthy of seafaring in days of yore are they considered unworthy of hunting in present days. But, just as the attitude about women aboard ship has changed, so will the attitude about women with firearms change—given time. But time is of the essence. How much time do we have? How long can we afford to wait? Anti-hunting groups are not biding time, waiting. They are working, promoting, gaining support.

Conclusion

The need to develop strategies to encourage and sustain women's appreciation for biotic systems and involvement in wildlife recreation can be soundly based upon any one of three objectives: (1) to enrich the lives of women; (2) to provide for the perpetuation of wildlife appreciation, hunting and trapping, through proper indoctrination of current and future generations and (3) to increase the public support base for wildlife programs and professions. The stakes are high for those of us who hunt. Without widespread societal support including females and minorities, we stand to lose what for many of us is a treasured legacy. There are many indications that the time is ripe to open the doors to greater participation by females. Quoting the editor of *Deer and Deer Hunting* in reference to an article recently published on women who hunt (Jackson 1988b:42), "This story elicited the highest number of letters ever received in response to a single article." The letters dealt with personal satisfactions and experiences and obviously touched an emotional chord. The challenge to professional managers and educators is to move quickly and skillfully in response to that readiness.

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Comprehensive Wildlife Education Planning in Florida: The Value of Human Dimensions Research

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Introduction

The State of Florida is among the most diverse in the nation in terms of wildlife. Yet numerous problems threaten the wildlife resource and its associated habitat, largely due to the state's unprecedented growth.

Recent research (Millsap et al. 1988) suggests that at least half of Florida's nongame species are declining. Florida's unique human demographics, including a skyrocketing population, high immigration and emigration rates and expanding senior-citizen and urban populations increase the challenge of determining how the Florida Game and Fresh Water Fish Commission's Nongame Wildlife Program (NGWP) should allocate its relatively limited educational resources. Comprehensive education planning is vital because the preservation of Florida's wildlife ultimately depends upon the commitment of Floridians to its protection. The key to instilling this commitment is through effectively-designed information and education (I&E) programs.

Just as wildlife management efforts are based on biological research, wildlife I&E efforts must be based on sociological research. Therefore, human dimensions data were the foundation upon which we built our current NGWP I&E programs. We were able to base programs on the public's real wildlife education needs rather than perceived needs. We were forced to recognize that I&E programs could not be all things to all people and, therefore, we had to target specific groups with specific programs. It also allowed us to tailor messages based on how target publics perceive wildlife. Finally, the human dimensions information we gathered will enable us to evaluate I&E programs more easily by providing quantifiable baseline data.

This paper is divided into three sections. The first section summarizes some important elements we considered when planning and developing our I&E programs. The second section describes the sociological research we conducted to develop our I&E programs. The third section describes the programs the NGWP initiated as a result of this extensive research and planning.

Planning and Developing Wildlife I&E Programs: Some Important Considerations

This section briefly describes: the importance of identifying and prioritizing species and habitats; how to identify, define and target publics; a way to understand the public; the importance of demographic trends; how to get the message across; and project evaluation.

Identify and Prioritize Species and Habitats

The first step in comprehensive wildlife education planning is the challenging task of identifying and prioritizing species and habitats and related issues. For example, the NGWP in Florida has management responsibility for almost 700 native vertebrate species and over 20 major upland and wetland natural plant communities. Some type of prioritization is necessary if programs are to proceed in a proactive rather than a reactive manner.

Identify, Define and Target Publics

The next step is to identify, define and target different publics. Research indicates the ways people relate to wildlife are affected by a variety of factors—their gender, age, race, income, level of education, place of residence, knowledge of wildlife, etc. (Kellert 1976, 1980a,b,c, Pomerantz 1977, Snyder and George 1981, Moss and Fraser 1984, deHaven-Smith 1986, Duda 1987a, Montgomery 1988). The days have passed when generic programs can be directed toward a "general public." There is no such thing as a general public (Henderson 1985). Varying groups of citizens perceive wildlife differently. To be effective, wildlife I&E programs must target specific groups with specific messages and programs.

For example, programs that traditionally have succeeded in the rural Florida panhandle will not be well received in Miami. Likewise, programs that will work for 25–44 year olds probably won't work for the elderly. By targeting specific groups with specific messages, wildlife I&E efforts will become more effective, and their outcomes may be measured more effectively.

Subdividing the heterogenous public into smaller homogeneous subsets based on one or more variables is known as "market segmentation," and was an important component of our program planning efforts. Market segmentation offers many benefits: (1) it allows more precise definition of a particular group's needs, (2) it strengthens the agency's ability to meet changing demands, (3) it allows efficient allocation of resources and (4) it makes more precise objective-setting possible (Montgomery 1988). Once different publics are identified and understood, programs can be tailored to specific groups. This is known as "target marketing."

Understand The Public

An enormous amount of information about how people relate to wildlife and the natural environment has been generated within the past decade (Kellert and Berry 1985). This research is an important foundation upon which education programs are built and can determine how an agency approaches target groups. This section will focus on three major aspects of how people relate to wildlife—stages of awareness, public opinion and attitudes.

Stages of Awareness. One widely accepted model of conservation education developed by Henderson (1985) presents the learning process necessary to achieve desired conservation actions in six developmental steps: (1) little or no awareness or concern, (2) awareness of a program/problem, (3) appreciation, (4) understanding, (5) concern and (6) action. Determining where publics fall on this continuum should determine how programs are developed. For example, if a targeted public is not familiar with southeastern kestrels (*Falco sparverius paulus*) and their associated habitat problems, a first task in gaining support for the species would be to make the public aware of the animal and its problems. It would be premature to attempt to foster concern or to ask them to take actions such as requesting their park authority or homeowners association to let dead trees stand or build kestrel boxes. On the other hand, if the targeted public expresses concern over the issue, it would be redundant to continue efforts focusing on raising concern. Instead, it would be more effective to concentrate on teaching publics specific actions they could take to assist in kestrel conservation efforts.

Public Opinion. Understanding public opinion on an issue is vital when developing I&E programs and can serve as a launching point from which all efforts flow. It can be an important indicator of where publics fall on Henderson's model of conservation education. Public opinion surveys on a variety of environmental topics are quite popular these days and information obtained from these sources is often free and valuable to program planning.

Attitudes. Many researchers, including Kellert (1974, 1976) and Purdy et al. (1984), have developed attitude typologies that are extremely useful when designing programs. Incorporating this type of information into programs will help determine the types of programs and messages that can be used to reach different publics. Attitudes determine how individuals perceive wildlife, and ultimately, how they perceive your message. Because attitudes are so difficult to change, it is best to match programs and messages with existing or similar attitudes (Kotler 1980).

Consider Demographic, Social, Economic and Political Trends

Schenborn (1985) noted that most natural resource agency programs are developed in response to yesterday's society. Agencies can incorporate information about demographics, social, economic and political trends into planning and become proactive rather than reactive to external forces. Information on societal makeup and change also can be used in conjunction with market segmentation, target marketing and target group prioritization.

Getting The Message Across: A Marketing and Advertising Approach

The first step in bringing an agency's message or program to target groups is to select the appropriate medium. The decision should be based on target groups—where they live, how often you want to reach them, where you want to reach them and when you want to reach them.

Costs should also be evaluated carefully. Wildlife professionals often assume brochures, pamphlets and slide shows are the only media available, probably because at face value they appear less expensive. But if brochures cost 10–15 cents each to produce and another few cents to distribute (through the mail or a paid employee), real costs may average 20–25 cents per message per individual. Paid magazine, radio and television advertisements may be viable alternatives since they often can reduce costs to as low as a penny per message per person. Whatever media is chosen, careful dissemination of the information is necessary. Media options are practically limitless, but it should always be kept in mind that the medium is only a tool to reach the target audience; it is not an end in and of itself. Any publication that sits on a shelf in an agency office or a radio advertisement that never runs does no one any good.

The next step in getting the message across is to identify and describe the benefits the program offers the target audience. Advertisers always make the important distinction between a product's (yes, wildlifers are selling a product) features and benefits. A benefit is what the audience receives, and a feature is an attribute of the product or service. Advertising professionals suggest focusing on the benefits the program offers the audience—not the features. "Sell the sizzle, not the steak," they stress.

Next, choose an appeal and develop and pretest messages and program outlines. Appeals induce the public to become interested in your program by stimulating their internal needs and desires.

Advertisers have identified several basic appeals over the years. When choosing an appeal it is vital that it be appropriate to the target audience. Programs can be tailored to appeal to vanity and egotism, fun and pleasure, moral duties as citizens of society, exclusivity, guilt, fear, hero worship or the profit motive.

The final step is to pretest and evaluate the message. This can be done through use of a storyboard (a panel or series of panels on which rough drawings depict the outline). This is pretested on the target audience for which it was designed. Feedback must be taken seriously and incorporated into an updated message. The exercise is repeated until the message produces the desired result.

The importance of message testing should not be underestimated. Programs are designed to be effective—to increase knowledge or change attitudes or behaviors. Testing measures the potential effectiveness before programs are initiated and enables restructuring if needed before large amounts of time and money are expended on full-scale programs.

Project Evaluation

Human dimensions data provide a foundation upon which to measure results and evaluate programs. By clearly defining the objectives of I&E efforts, we can measure the success of such efforts by comparing knowledge levels, perceptions, attitudes and public opinions before and after implementation of our programs.

Because educational efforts should be driven with the goal of conserving wildlife, evaluation of projects should not only answer the question of how the program affected people, but how the program affected wildlife.

Sociological and Biological Research Conducted to Develop NGWP I&E Programs

This section describes the research we conducted to develop our I&E programs. This research included identification and prioritization of problems, a species prioritization project, public opinion polls, an analysis of Florida demographic trends and a marketing study.

Identification and Prioritization of Problems Facing Florida's Wildlife

The most important problems facing Florida's wildlife were identified and ranked during several nominal group meetings with NGWP staff and a thorough review of the Commission's Strategic Plan. These broad problem areas were: (1) public attitudes, knowledge, behavior, perceptions and actions are not always conducive to wildlife conservation; (2) the quality and quantity of fish and wildlife habitat is declining; (3) many of Florida's wildlife species are declining; (4) willful or ignorant violations of regulations governing wildlife are compromising conservation efforts; (5) there is an increasing public demand for the use of Florida's wildlife and (6) sufficient information on wildlife is not reaching the public. Strategies to solve each problem and education programs to address each strategy were also identified and ranked.

Species Prioritization Project

During the past two years, the NGWP has created a species ranking system for Florida's nongame wildlife (Millsap et al. 1988). The system has produced a comprehensive ranking of Florida's nongame wildlife that takes into account the species' vulnerability and relative biological significance.

The species for our educational programs were selected from those that scored highest in terms of overall biological vulnerability and were in need of management attention. We know that these species are priority candidates for meaningful, effective educational programs because they are declining, we know what factors are responsible for their decline and we know most of the actions which can help preserve the species, including things that citizens can do.

1985 Public Opinion Survey

In June 1985, the Commission conducted a telephone survey to determine Floridians' opinions, knowledge and attitudes toward wildlife, as well as their participation in wildlife-related recreational activities (Cerulan and Duda 1988). Although work of this nature had been conducted nationally and in other states, a Florida-specific study on these subjects had never been conducted.

Floridians and Wildlife Study

To assist in market segmentation, target marketing and target group prioritization, a complementary project was initiated in 1986 focusing on trends in Florida's growth and how people relate to wildlife. This review and analysis of over 200 papers and studies was completed in 1987 (Duda 1987a).

The Montgomery Marketing Study

In February 1987, the Commission hired the Atlanta-based Montgomery Research Consultants, Inc., a research and marketing firm, to: (1) identify and prioritize Florida publics on their likelihood of becoming more actively involved in an supportive of wildlife conservation, as well as their likelihood of hindering the achievement of the Commission's goals; (2) develop messages addressing wildlife-related issues and actions which should be taken by targeted segments; (3) identify appropriate communication mechanisms to deliver messages to these groups and (4) develop cost-effective evaluation methods for each recommended strategy.

The project was multi-phased and consisted of a public opinion poll, a series of ten focus groups, an assessment of the Commission's I&E materials, development of new messages, and pre- and post-testing of newly developed communication strategies. Subsequently, a second public opinion poll was conducted to further explore how Floridians related to wildlife and fill gaps in our knowledge.

A series of ten focus groups was conducted throughout Florida to develop in-depth, qualitative information concerning the perceptions, motivations and behaviors both of groups identified as having good potential for greater support and positive action for wildlife and groups that might negatively impact wildlife. Based on the *Floridians and Wildlife* study and the two public opinion polls, ten groups were selected for focus group research. Focus groups provided us with new insights, new hypotheses and understanding through the interaction process. The use of focus groups is an accepted research technique for qualitative explorations of attitudes, motivations and behavioral predispositions and practices (Montgomery 1988).

Focus groups, containing 10–12 people recruited to represent the chosen target group, met for a two-hour discussion on their attitudes toward wildlife. Discussions were led by an unbiased moderator; Commission staff observed the groups from behind a one-way mirror. Although focus group data should not be projected to larger population segments, they are a powerful tool when analyzed in conjunction with quantitative data.

Target Group Selection

Based on all research, we identified several target groups with a high potential to become more actively involved in wildlife conservation. Target groups were selected based on their level of awareness, concern and action potential over the short- and long-term. Short- and long-term potential ratings were based on attitude and opinion profiles and Florida demographic trends. The groups selected were: college-educated professionals, members of conservation groups, hunters, landowners, developers, educators/children, and volunteer-oriented women. Not only were target groups selected, but time allocations for each group were also identified. Combining demographic trend information with opinion, attitude and behavioral profiles was an extremely useful target group prioritization exercise. For example, demographic trends indicated senior citizens should be an important target group. However, opinion, attitude and behavior profiles indicated otherwise. In general, senior citizens were far less positively oriented toward wildlife and much less likely than other groups to engage in positive environmental behaviors.

Message Testing

Sample messages were designed from information gained throughout the study. These messages were then tested on the target groups they were designed for through pre- and post-testing. This message testing determined how the messages affected attitudes and behaviors and the believability of the scripts.

Project Time and Target Group Allocation

At this point, the NGWP had identified its highest priority issues as well as its highest priority target groups. The next step was to match projects with appropriate staff and match target groups to projects in such a way that total time allocations matched the target group time allocations. An initial spreadsheet was developed to allocate projects and project time to staff. A second spreadsheet was designed to allocate project time and percent time devoted to target groups. Projects were assigned both an estimated number of days for completion and allocation of time for each target group.

NGWP I&E Programs Initiated as a Result of Research and Planning Efforts

As a result of this extensive research and planning, the NGWP has realigned its I&E efforts. We have moved away from "generic" I&E wildlife programming to programs that target specific subgroups of Floridians with tailored programs. Program approaches are based on opinion and attitude profiles of the target groups.

The Importance of Adult Education

Overall, there will be a greater emphasis on adult education because Florida's skyrocketing population has created wildlife problems in need of immediate attention. Since we view education as a management tool, a realignment of emphasis from children to adults is necessary to meet this challenge. There were also other reasons for an emphasis on adult education. Florida's total population is not only growing quickly, but several segments of the population are experiencing a tremendous turnover within the population. Every day, about 2,400 new people move to Florida and another 1,400 people move out. One implication of this is that there is a large segment of the adult population living in Florida that was not raised or educated in the state. Another implication is that, because of the high citizen turnover rate, education programs that "build" upon one another, a common tactic used for educating youth, may not be as effective in Florida as in other states with more stable populations. Finally, new residents are the least knowledgeable about how much wildlife the state has already lost because they do not have a long-term perspective.

Although NGWP educational emphasis will be on adults, many valuable programs for children were retained and others initiated because our research also indicated that the childhood years are crucial in the development of, knowledge of and perceptions and attitudes toward wildlife (see references in Duda 1987a). Project WILD, a *Handbook to Schoolyard Flora and Fauna*, youth camps and an animated alphabet coloring book are all part of our continuing children's wildlife education arsenal.

The Importance of Citizen Involvement

Perhaps the most significant result of our research was the documentation of overwhelming public support for wildlife conservation and environmental protection efforts. The 1985 public opinion poll found that 96 percent of the respondents agreed that knowing wildlife exists in Florida is important. The same poll found that 60 percent support increased governmental spending for wildlife conservation. According to Florida State University's Annual Policy Survey, the percentage of Floridians supporting increased funding for environmental protection has grown from 49.6 percent in 1983 to 68 percent in 1988 (Parker an Oppenhein 1988). The major growth problem—even bigger than crime—is loss of natural areas, according to 76 percent of the respondents in another survey (Frank and Connerly 1985). This latter survey also found that 81 percent of Floridians felt that development in the state's fragile natural areas such as marshes, beaches, floodplains and scenic areas should be prohibited.

Recently, in two separate elections, residents of Volusia and Marion counties voted on a referendum to tax themselves to purchase environmentally sensitive land. Dozens of other published opinion poll conclusions were reviewed with the same result:

Floridians and Americans are not only expressing concern for wildlife and the natural environment, but they are willing to sacrifice some social and economic benefits in order to protect them (Kellert 1980a,b,c, New York Times 1983, Schneider 1983, Mitchell 1984, deHaven-Smith and Gatlin 1985, Frank and Connerly 1985, Harris 1986, Cerulean and Duda 1988, Duda 1987, Parker and Oppenhein 1987, Parker and Oppenhein 1988).

Strong public support for wildlife conservation and environmental protection issues indicates many Floridians are at the ''concern'' stage of Henderson's (1985) model of the conservation education process. Coupled with the critical loss of habitat and species decline currently being experienced in Florida, the new challenge is to bring citizens from the ''concern'' stage to the ''action'' stage.

Public action is vital to the protection of Florida's natural environment and wildlife. A citizenry which is concerned, but does not act upon its behalf, does not contribute to the protection of these resources.

We first discovered that Floridians are not acting on behalf of Florida's wildlife and do not know the actions one can take to help Florida's wildlife during the 1985 survey. An unusually large number of respondents had no answers or very generic answers to the open-ended question ''What is the most important action a citizen can take to help Florida's wildlife?'' The 1987 poll and the series of ten focus groups looked more closely at this issue. We confirmed that although citizens were concerned about the loss of Florida's wildlife, very few individuals were acting on its behalf, largely because they didn't know what to do.

It became evident that the overriding theme of our I&E programs must be to motivate more citizens to act on behalf of wildlife. Programs would need to focus on teaching citizens the appropriate action they could take to assist in wildlife conservation. There was another important aspect of getting citizens more involved in wildlife conservation. There is a long-term debate in psychology concerning whether attitudes precede actions or actions precede attitudes. That attitudes precede actions seems the more logical, but the more dominant theory among psychologists reverses the order. As Harvard psychologist Jerome Bruner noted ''you more likely act yourself into feeling than feel yourself into action'' (Peters and Waterman 1982:73). The importance and implications of this line of reasoning are evident. As Peters and Waterman (1982:74) note ''only if you get people acting, even in small ways, the way you want them to, will they come to believe in what they're doing.'' Finally, in a meta-analysis on environmental behavior, Hines et al. (1987) found that knowledge of action strategies was one of the most important variables in responsible environmental behavior and action.

Based on these findings, Montgomery (1988) recommended the use of a single theme to tie together all NGWP I&E efforts. The theme developed was: ''What Have You Done For Wildlife Lately?'' This theme combined several important elements: (1) the need for action to protect and preserve Florida's wildlife; (2) the importance of efforts by ''typical'' Floridians in achieving conservation goals; (3) an emphasis on personal involvement; (4) the assumption that individuals have a responsibility to take action for wildlife and (5) a feeling of immediacy. In future I&E programs, this central theme will tie together all communication efforts and attempts to create the desired atmosphere for citizen involvement and action.

We are developing a ''What have you done for wildlife lately?'' mass media campaign for television. Television, as our research indicated, was by far the most powerful educational tool available.

In addition to the mass media campaign, we are producing a booklet outlining specific ways citizens can help wildlife. The booklet, tentatively entitled "What have you done for wildlife lately? A handbook of ways you can help Florida's wildlife," will describe how to landscape using native vegetation, how to build nest boxes, how to watch wildlife without disrupting them, how to report wildlife law violators, why "orphaned" animals should not be picked up, and how to volunteer for wildlife, among other subjects. These action strategies will be stressed throughout all NGWP I&E programs.

Because we know what percentage of Floridians (and target groups) are currently engaged in a variety of wildlife actions, we will be able to measure the campaign's effectiveness by comparing action and knowledge of action strategies after implementation of the campaign.

In addition to the central theme, Montgomery (1988) recommended four basic appeals to interest target groups. The four basic appeals and groups for which they are appropriate are: (1) it is important to save wildlife for the benefit of future generations. It is a valuable legacy for our children and grandchildren (to be used with college-educated, volunteer-oriented women, development professionals and educators). (2) It is important to save wildlife to make our own lives better and more enjoyable in the present. Seeing and being around wildlife brings me pleasure (to be used with landowners, conservation-oriented people and hunters). (3) We have an obligation or moral duty as citizens of society to act as stewards of this earth and to preserve wildlife for the good of all living things. Florida, in particular, has unique natural resources which must be preserved (to be used with landowners, conservation-oriented individuals, hunters, college-educated individuals, teachers, development professionals and volunteer-oriented women). And (4) wildlife conservation is "the thing to do." Everybody who's anybody is involved—besides, it's fun (to be used with children).

Cooperative Urban Wildlife Program

Currently, more than 85 percent of Florida's residents live in an urban environment. Demographic analyses indicate that Florida will continue to urbanize, although on a national level, urbanization has slowed as citizens migrate from urban areas to small towns and rural areas.

The *Floridians and Wildlife* literature review and the two public opinion polls indicated that urban/rural differences were important factors in the formation of attitudes toward, and knowledge and perceptions of wildlife. In general, suburban and urban residents were far less willing than rural residents to sacrifice wildlife and environmental values for economic gain. However, urban residents were less knowledgeable about wildlife than ruralites.

Traditionally, the Commission's main constituent base has come from rural Floridians. However, the high degree of support for wildlife conservation efforts expressed by urban dwellers, coupled with the state's demographic trends, represented a potentially significant new support base. The challenge, of course, is to capture this support and increase knowledge levels through programs tailored to urbanites' perceptions of and attitudes toward wildlife. To meet this challenge, the Commission initiated a Cooperative Urban Wildlife Program with the University of Florida. This program now employs three urban wildlife specialists who devote their time to the needs of urbanites and urban wildlife.

Planting a Refuge for Wildlife Project

Our research indicated that, in general, a majority of Floridians had only a vague understanding of the vital link between wildlife and habitat. However, our polls indicated that homeowners and other landowners, the target group for this project, were ready to take action on behalf of wildlife. Since a majority of Floridians were predisposed to residential nonconsumptive wildlife activities, enjoyed wildlife around their homes and enjoyed gardening, we developed a booklet to teach citizens specific actions they could take to attract wildlife to their yards (Cerulean et al. 1987). This booklet was designed to teach people the relationship between habitat and wildlife and to teach citizens how to act on behalf of wildlife. Baseline data on how many Floridians currently plant native vegetation and Floridians' understanding of wildlife and habitat are available, so evaluation of this project will be relatively straightforward. The project will also be evaluated in terms of the number of acres ''managed'' by Floridians as a result of this program.

Scrub and Tropical Hardwood Hammock Habitat Education Projects

The most crucial problem facing Florida's wildlife is habitat loss. Nominal group meetings with NGWP staff identified scrub and tropical hardwood hammock habitat as the two most endangered in Florida.

Two projects will focus on educating the public about these habitats and the wildlife species inhabiting them. In keeping with the ''action'' oriented theme, ''What have you done for wildlife lately?,'' programs will ultimately be geared toward citizen involvement in preserving these habitats.

Each educator participating in the project was assigned a priority habitat and target groups. For example, the educator responsible for tropical hardwood hammock education was not only assigned the habitat, but also was assigned to target conservation groups, landowners and college-educated individuals. Programs will be built based on these groups' attitudinal profiles and the large body of knowledge accumulated about them over the course of the project.

Southeastern Kestrel and Shorebird Projects

Our species prioritization project identified southeastern kestrels and beach-nesting shorebirds (least terns [*Sterna albifrons*], American oystercatchers [*Haematopus palliatus*] and other affiliated shorebirds) as prime targets for education and management. Data suggested that least tern populations in the eastern U.S. declined as much as 80 percent between the 1940s and the mid-1970s and may still be declining. American oystercatcher and black skimmer (*Rynchops niger*) populations may be impacted equally. The continued existence of these shorebirds in Florida can only be assured if existing breeding areas are protected. Shorebird education efforts will focus on teaching citizens appropriate behavior while at the beach, such as staying clear of beach nesting colonies and the importance of keeping dogs on leashes.

Southeastern kestrels have declined an estimated 82 percent in North-central Florida since the early 1940s. Along the central Florida ridge, kestrels have also declined significantly, and in the Miami rocklands and Southeast Florida the bird has been extirpated. Conversion of native forest to citrus, loss of large pine stands, loss of foraging habitat due to fire exclusion and loss of nest sites (snags and other cavities) are the primary reasons for this decline. Education can help mitigate the loss of nest sites in particular. The construction of nest boxes will be encouraged as an essential short-term tool while we pursue more long-term management strategies. The importance of letting snags stand when possible will also be encouraged.

Developer Program

Perhaps no other group of Floridians is having a greater impact on wildlife habitat as development professionals. This group was one of our highest priority target groups. Developer focus groups, as well as nominal group meetings with staff biologists, indicated that an informational booklet was needed to advise developers of regulations, and provide basic information on the relationship between wildlife and habitat, endangered species, range maps and suggested mitigation techniques. Such a booklet is now being developed. Seminars, media advertisements on radio and in magazines and lectures will promote the booklet and Commission efforts toward influencing developers.

Development of Wildlife Viewing Areas

Participation in nonconsumptive wildlife-related recreational activities is very popular among Floridians. Our research indicated that Floridians who participated in nonconsumptive activities had more positive attitudes toward wildlife than those who did not participate in such activities. Other studies (Kellert 1980a) found that committed birdwatchers had the highest wildlife knowledge levels among all groups examined.

The literature review revealed that children who participate in wildlife activities know more about wildlife, appreciate wildlife more, are less fearful of wild animals and exhibit less anthropomorphic tendencies toward wildlife than children who do not participate (see references in Duda 1987a). Collectively, research indicates that positive attitudes toward wildlife and knowledge of wildlife can be enhanced by promoting wildlife-related recreational activities.

The Commission is currently developing three wildlife viewing areas on existing wildlife management areas. The viewing areas will be designed based on the research and polls we have conducted. For example, the 1985 survey revealed that restroom availability was the most important amenity to Floridians when considering taking wildlife and nature-oriented trips. The facilities that promoted nonconsumptive wildlife recreation such as nature trails and wildlife exhibits were of secondary importance. Survey information such as this enabled us to design facilities with our constituents' actual needs in mind, not what we thought they needed. This is not to say we should let our constituents dictate facility development, but it does underscore the importance of a greater sensitivity to their needs.

Proactive Literature Dissemination

Instead of waiting for citizens to write in for NGWP I&E materials, important information is sent to targeted groups. For example, a recent paper "Floridians' Wildlife Education Needs" (Duda 1988a, 1988b) was not only published in a journal, but also was sent to over 500 educators. The animated alphabet coloring book (Gillan 1986) has been mailed to 100,000 kindergarten and first grade teachers.

Conclusion

Human dimensions information is invaluable when developing and designing wildlife I&E programs. It is clear that a body of knowledge has been built to the point where almost all wildlife management programs can benefit from human dimensions work, not just I&E programs. Agencies have realized that just as wildlife management efforts must be based on biological research, programs dealing with the public must be based on sociological research.

As with most disciplines, there is a lag time between the birth of the discipline and its movement into the mainstream. This transition is taking place in the human dimensions discipline as it moves out of the universities and classroom and into a multitude of everyday wildlife agency functions. The title of this session is quite appropriate as we approach the 1990s. Human dimensions is taking its rightful place and will become a critical component in future natural resource management.

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Animal Welfare and Wildlife Management

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Introduction

The ''human dimension'' in natural resource management is evolving rapidly. In particular, animal welfare issues as they relate to activities, techniques and programs of wildlife biologists are receiving more attention than they have in the past. Examples include leghold traps, vertebrate pest control, lead versus steel shot, mountain lion (*Felis concolor*) hunting and wild horse (*Equus caballus*) management. Attention is being focused on university and agency animal use and care committees, and the appropriateness of all types of research which may cause pain and distress to animals. Currently, wildlife biologists, like many professionals in the agricultural and biomedical communities, are very sensitive to criticism regarding animal welfare issues. This paper explores the philosophical and ethical consequences of what wildlife biologists do for a living. Are we the saviors of wildlife or ruthless sadists? How can wildlife biologists survive the next decade with their sanity, respect and professionalism intact?

Animal Rights and Animal Welfare

The terms *animal rights* and *animal welfare* often are used interchangeably, even though they represent two very different philosophies. This distinction is important because their clientele, actions and effectiveness vary significantly, as do their attitudes toward wildlife management concerns (Schmidt 1989).

Animal rights refers to a philosophy that animals have rights equal or similar to those of humans. Biomedical, agricultural or other uses of animals have no place in society unless humans could receive the same treatment. If it would be morally and ethically repugnant to conduct a research project on humans, the same principles would apply to the use of animals. A concept rejected within the animal rights movement is *speciesism*. A *speciesist* allows the interests of his or her own species to override the greater interests of members of other species (Singer 1975:9).

Animal welfare, on the other hand, is primarily concerned with reducing pain and suffering in animals. Although a member of a humane organization interested in eliminating the leghold trap to end the suffering of captured animals obviously is concerned with animal suffering, the agriculturist, biomedical researcher or hunter can also be concerned with animal welfare. In other words, if a person is interested in finding ways to reduce animal suffering, he or she is interested in animal welfare. You are concerned about animal welfare issues if you are repelled by the thought of somebody intentionally burning a dog or intentionally starving a horse. I submit that the majority of persons in the United States has animal welfare concerns to some degree. Note that this concern has nothing to do with giving animals rights. Animal rights is not the evolutionary endpoint to the animal welfare philosophy.

This "animal welfare majority" is bombarded with information from both sides of the fence (animal rightists and animal consumers). Animal rightists are especially vocal, and receive a great deal of media attention with their activities. To a sympathetic or neutral public, their statements bring out powerful emotions:

> *As I sat in that solitary cell, I envisioned the tormented animals in laboratory cages around the country. Pleading eyes reminded me of their plight, their terrible pain and suffering. I thought of my responsibilities towards these gentle beings. As I felt their grief, I renewed my commitment and determination to end their pain* (Katz 1987).

> *Those of us committed to the struggle for animal rights share the same goals. In the case of animals used in laboratories, it is not larger cages, it is* empty *cages for which we struggle. Not until the last animal is released from the last cage will our struggle be over* (Regan 1988).

Shaw (1977), Anderson (1979), Schmidt and Bruner (1981), Decker and Brown (1987) and others have argued that wildlife biologists should take these concerns seriously. Many biologists agree, yet a common reaction is a call to "educate the public." Jones (1988) has argued that "education" does not work. Examples from the agrichemical and nuclear industries indicate that even well-funded public relations programs fail to convince the majority of Americans that pest-free food is a good trade-off for some chemical residues on food or that nuclear power is clean and safe.

How should the wildlife management profession view the animal welfare movement? Is it a disease to be cauterized? Is it a mutation that will eventually go extinct? I argue that concerns about animal welfare are a predictable ethical development of the moral fabric of a sophisticated culture which embraces a variety of religious, medical and political freedoms. Another predictable development is the keen interest in the environment. Hence, animal welfare concerns cannot be cauterized, and, as long as society is not repressive, they will not go extinct. Therefore, this leaves one with the option of evolving with them.

Wildlife Management Interacting with Animal Welfare

Schmidt (1989) has identified ways that the wildlife damage prevention and control profession can both improve its "black hat" image and evolve in step with animal welfare concerns. The entire wildlife management profession has similar options. Wildlife management activities can be compatible with animal welfare concerns (*not* animal rights concerns) *if* the reduction of pain, suffering and unnecessary death are incorporated in the decision-making process. The following examples may help clarify this concept.

Fishing Tournaments

Animal rights advocates are beginning to direct some attention to recreational and professional fishing (Singer 1975:186, Fox 1987, Brown 1988). John Muir wondered why people could find ". . .pleasure in the pain of fishes struggling for their lives" (Mighetto 1985). This point of view is certain to receive more attention in the future. Animal welfare considerations can be brought into good use without banning fishing. For example, Schmidt and Bruner (1981) encouraged anglers to kill their catch by pithing before scaling or filleting them.

In many bass (*Micropterus* spp.) fishing tournaments, at least some attempt is made to bring fish in, register and weigh them, and release them alive. This is commendable, but not always successful. Schramm and Heidinger (1988) developed research-based guidelines for reducing bass mortality during these tournaments, including information on how to handle fish properly, how to maintain and improve livewell water quality, and guidelines for conducting weigh-in tournaments (Table 1). To their credit, they also provided guidelines for the development of alternatives to weigh-in tournaments. Again, this is a positive step that encourages the sane development of a positive animal welfare policy.

Trapping Practices And Policies

Trapping, especially with the leghold trap (also known as the steel-jawed trap, the foothold trap and the steel-jaw leghold trap), has received organized criticism in the United States for over 60 years (Figure 1). Anti-trapping regulations have been proposed and/or initiated at the local, state and federal levels throughout the United States, and in countries throughout the world (Barrett et al. 1988). Clearly, with current lobbying to both ban trapping and to have furs caught with these traps so labeled, pressures are building to either ban trapping altogether or to modify the current institution in some manner. Scheffer (1974:71, 1976) predicted the demise of the wild-caught fur industry because of the rising tide of protest against the leghold trap. These prohibitions against traps will probably affect trapping practices not related to the fur industry, such as wildlife damage control and animals caught for research.

To incorporate animal welfare concerns into the trapping issue, it is neither necessary nor required to push for a complete ban on traps. The initial requirement is to determine whether any current practices have options which can cause less suffering. For example, padded leghold traps have the capability of reducing foot injuries (and thus suffering) for a variety of furbearing species (Olsen et al. 1986, 1988). Research, evaluation and (hopefully) acceptance of these techniques should be applauded by both the fur industry and the wildlife management profession. Research should continue on finding better, safer and less stressful techniques for catching furbearers (Barrett et al. 1988). In a similar manner, the mandatory trapper education programs required by some states can improve upon the lessons dealing specifically

Table 1. Example of research-based information developing into fish welfare recommendations. Time in minutes for a bass (*Micropterus salmoides*) in a 15 gallon (57 liters) livewell to reduce the oxygen concentration from 75 percent of saturation to a stressful level (3 ppm). Modified from Schramm and Heidinger (1988).

Weight of bass		Minutes to reduce O_2 level		
lbs	(kg)	68°F	77°F	86°F
5	(2.3)	82	70	27
10	(4.5)	41	35	14
15	(6.8)	27	23	9
20	(9.0)	21	18	7
25	(11.3)	16	14	6
30	(13.6)	14	12	5

Figure 1. A sample from a collection of anti-trapping advertisements circulated throughout the United States by Project Floodlight. Information like this is reaching the general public at an ever-increasing rate.

with how to remove or painlessly kill animals in traps and how to eliminate nontarget catches (Stocek and Cartwright (1985). Although these small yet significant advances certainly will not appease animal rights organizations, they will accelerate the processes of steering the industry toward more animal welfare concerns. Even if the same total number of animals trapped and killed each year does not change, total suffering is reduced.

Hunting Practices and Policies

Ninety-three million Americans aged 16 or older participate in some form of nonconsumptive use of wildlife while 17 million hunt, according to a 1980 survey (Shaw and Mangun 1984). Hunting survives as a minority use of wildlife in this environment for a number of reasons. Chief among these is the fact that a majority of the public believes hunting is part of a wise management program for keeping wildlife populations healthy. For example, a sample of California residents were asked whether "Hunting is a useful tool for maintaining a balance between wildlife populations and their available habitat'' (Fletcher and King 1987:54), and a majority (55.5 percent of 1,179 respondents) agreed.

Hunting is a broad-faceted form of recreation which covers many species of birds and mammals, a variety of guns and other lethal weapons, a maze of regulatory statutes and treaties, and many different culturally-dependent hunting behaviors and techniques. This variability results in a broad range of available strategies for reducing animal suffering. For example, the caliber or gauge of a rifle or shotgun for shooting a particular species can be specified in accordance with research-based information on crippling or wounding rates. Techniques which are known to cause more crippling or wounding than other available techniques should be revised or phased out. This is being done, albeit reluctantly, with lead shot for waterfowl hunting (Sanderson and Bellrose 1986, Williams 1988). However, bowhunting for deer (*Odocoileus* spp.), which has a higher wounding rate than hunting with modern guns (Causey et al. 1978, Stormer et al. 1979, Langenau 1986), is not being addressed.

Consideration of animal welfare-related decision rules as seasons and regulations are being formulated is the first step toward incorporating animal welfare concerns in recreational hunting (''Is there an option that will allow the same management goal to be reached yet involve less suffering for individual animals?'').

Are Animal Welfare Concerns Affecting the Wildlife Management Profession?

Both hunting and trapping as wildlife management institutions have been under attack by animal rights and animal welfare organizations for a number of years. However, much more attention has been focused on biomedical uses of animals. Seventeen to 20 million animals are utilized by laboratories each year (Office of Technology Assessment 1986). Organized protests of university and government research have halted long-term studies (Norman 1988), delayed the funding and construction of new laboratories (Anonymous 1988) and resulted in research organizations spending considerable resources in evaluating and justifying their programs (University of California 1988). Proposed regulations under the 1985 Animal Welfare Act may cost the private sector over $885 million in initial outlays (Holden 1988), and may also impact wildlife research laboratories, including field study areas (Anonymous 1987a). Institutional animal use and care committees are requiring wildlife researchers to justify their use of animals, with concerns over the number of animals used, treatment, disposition at the termination of the study, control of pain, and validity and applicability of the results. One reviewer objected to a study on ground squirrel (*Spermophilus* sp.) control methods on the basis that ''. . . so called 'pest' animals have just as much right to live as do we and their control should be as humane as possible'' (Buyukmihci 1986). Although this is an extreme viewpoint, it indicates that changing societal attitudes will have impacts on wildlife research at this level. Animal agriculture production, consumption and research is also being criticized by animal rights and animal welfare organizations.

There are many specific cases where animal welfare or animal rights considerations have affected specific wildlife management programs. These examples include harp seal (*Phoca groenlandica*) management in the northwest Atlantic (Ronald and Dougan 1982), management of excess deer on Angel island in the San Francisco Bay (Levenson 1984), and coyote (*Canis latrans*) control throughout the western United States. I see no indications that these influences will stop anytime soon; in fact, I forsee these external pressures continuing and increasing their influence until they actually become pressures internal to the wildlife management agencies themselves.

Discussion and Conclusions

Animal welfare considerations need to become first-order decision rules in future activities in wildlife management. Society is evolving in that direction, and the wildlife profession must evolve with it. Agriculture, long on the defensive regarding the issue of pesticides and food safety, appears to be changing its attitudes. An officer of the California Farm Bureau has stated that ". . . the tendency is to view this as another attack on our way of life. Instead, why not seize the opportunity to get out ahead of our critics and put our best foot forward? We care about consumers" (Richardson 1989). Another leader in California agriculture has recently stated that "Each industry group must be willing to police its own people and go after those who refuse to accept moral, ethical, and lawful practices" (Richardson 1989). These same considerations are important for the wildlife profession. Wildlife professionals may wince whenever animal welfare considerations are brought up, but it is time to put our best foot forward and police our own activities.

Humans will always have impacts on the environment. It does not matter if you are a vegetarian or a meat-eater, a hunter or a birdwatcher, everything affects wild creatures whether it is direct or not. Acid rain damage to aquatic communities (Schindler 1988), impacts from oil field development along the Arctic Coastal Plain of Alaska on wetlands (Walker et al. 1987), bird mortality because of power lines in North Dakota (Faanes 1987) and damage to mature trees and changes in the species composition of understory growth at wilderness campsites in Oregon (Cole 1982) all attest to the impact of humans on both the local and global environment.

The time is right for positive and constructive change. The American Society of Mammalogists, the American Ornithologists' Union, the American Society of Ichtyologists and Herpetologists, The Herpetologists' League, the Society for the Study of Amphibians and Reptiles, the American Institute of Fisheries Research Biologists and the American Fisheries Society have produced field research guidelines (Orlans 1988). The various wildlife societies should do this. There are committees and publications directed to finding alternatives to animal use in research, testing and education (Office of Technology Assessment 1986), or nondestructive methods of using animals for research (Walsberg 1988). The wildlife management profession should do this. Researchers are trying to quantify pain and suffering in lab animals (Wright et al. 1985). We should do this. An animal rights magazine is starting a program to encourage people to reduce the number of wild animals killed on this nation's highways (Anonymous 1989). We should help them. The Department of Fish and Game for the State of Oregon is promoting a new philosophy, focusing on a newly defined and changing constituency which views non-hunted species management as a co-equal use of fish and wildlife resources alongside consumptive uses (Anonymous 1987b). We should not discourage them.

Animal welfare considerations have an important place in wildlife management today. If we work with this philosophy, the profession will grow with a changing society. The seeds planted today can grow into a lasting oak.

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Wildlife Rehabilitation: Its Role in Future Resource Management

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Introduction

Human population growth and urbanization increase the potential for both interaction and conflict between people and wildlife. The conflict frequently results from inadvertent competition for resources and living space; wildlife often suffer directly or indirectly from removal or alteration of habitats, highway mortality, harassment by humans and their pets and a wide variety of similar maladies. A typical human response when wild animals are found with injuries has been to take these animals into custody and to nurse them back to health. Wildlife rehabilitation is an attempt to preserve the life of injured, sick or orphaned wildlife and as such, it is focused on a case-by-case, individual-animal basis. Traditionally, many trained wildlife biologists and managers have either ignored or labeled wildlife rehabilitation as simply "humanitarian" activities, as the overall positive impacts on wild, living vertebrates have very likely been minimal. But the sphere of wildlife rehabilitation is more complex and multi-faceted, and the underlying motivations and relative effectiveness of these efforts are worthy of careful examination.

Interaction with wildlife frequently is viewed by the public as positive, particularly when the animals are relatively small and "cute." Surveys conducted throughout the United States have consistently shown that Americans support wildlife issues, enjoy having wildlife around their homes and, most importantly, feel a need to *do something* to help wildlife. Rehabilitation of wildlife has become a popular effort with high public visibility. In an attempt to respond to the perceived need for assistance, hundreds of wildlife rehabilitation facilities have developed in the U.S. and the numbers of people involved in these efforts are increasing. It has been estimated (Horton 1987:129–130) that the total number of wildlife cases handled each year by the nearly 600 member National Wildlife Rehabilitators Association (NWRA) is approximately 442,000 in addition to annual responses to about 980,000 telephone inquiries. With this level of public exposure and interest in the welfare of wildlife, it seems beneficial for wildlife biologists and environmental educators to consider the long-term implications for both fields of endeavor.

Survey of Wildlife Rehabilitators

In an effort to better understand the current status of wildlife rehabilitation in the United States, a brief 10-question survey was developed and distributed for response during 1988 to 596 members of the NWRA. Questions addressed wildlife species rehabilitated, policy on acceptance or selection of animals, primary objectives for rehabilitation centers, staff size, budget, funding sources and level of involvement in environmental education programs. The NWRA organization was established in the early 1980s in response to a recognized need for improved professionalism in wildlife rehabilitation nationwide. Since only members of this young organization were surveyed, it is likely that responses received may represent a better qualified and organized subset of all wildlife rehabilitators in the U.S. Thus, the data likely reflect better-than-average quality of respondents and this may bias the results accordingly. For example, the response rate for this survey (62 percent) was well above the 10–20 percent return rate for similar surveys (Horton 1987, J. Scheck, pers. comm.) directed at wildlife rehabilitators.

Results

As expected, the variety of answers to questions was broad; I intend to emphasize major findings and trends. Of the 372 questionnaires completed and returned, about 87 percent of respondents were actively involved in wildlife rehabilitation. Rehabilitation centers were diverse, including schools of veterinary medicine, wildlife rescue centers, environmental education programs, humane and conservation foundations, zoos, an elementary school and many private individuals.

In response to a question about the types of wildlife typically rehabilitated, more than one-third indicated "all animals." Other wildlife categories frequently mentioned were small birds, small mammals, and raptors. Few respondents indicated any interest in rehabilitating large mammals. In general, animals admitted for rehabilitation were not prioritized based on characteristics such as relative rarity or status in the wild. This generalization was valid regardless of the magnitude of the rehabilitation program. Respondents seemed reluctant to put any "relative value" on animals brought to them and therefore, most rehabilitation efforts were directed at common wildlife species.

Another survey question addressed the issue of whether rehabilitators used a selection procedure based upon the condition of animals being brought to their facility. About two- thirds of the respondents indicated that they did and that truly hopeless animals were euthanized. Other factors that influenced admission were releasability (20 percent), status as an exotic (9 percent) and veterinarian opinion (8 percent). Few facilities made decisions based on the rarity of the species, competence of the rehabilitator, potential for disease transmission or availability of space and personnel time. In general, large rehabilitation centers with paid staffs were more likely to avoid indiscriminate acceptance of all animals.

A question regarding the primary objective for the animals being treated at the rehabilitation facility yielded two frequent responses: (1) to rehabilitate for eventual release to the wild (63 percent) and (2) to save the animal's life (27 percent). Other infrequent primary objectives were: (3) to use for display/educational purposes, (4) to use for captive breeding, (5) to learn about the animals, and (6) to prevent suffering. Several respondents were dismayed that rehabilitation would be done for display and/or educational purposes.

A common problem with rehabilitated animals is their acclimation to people due to repeated exposure to human caretakers during the process (Olsen and Olsen 1980). Therefore, wildlife rehabilitators were asked if they attempted to avoid direct contact with animals intended for release. Although the question was answered by only about half (N = 163) of the active rehabilitators, the majority (74 percent) of these respondents stated that such contact was avoided.

Several questions were directed at the size, staffing, support levels and relative permanency of the surveyed rehabilitation operations. Only 30 percent of the operations contacted had a paid staff, the remainder were either run by a single unpaid individual (43 percent) or were dependent upon volunteers. Most wildlife rehabilitation efforts appear to be small operations as evidenced by the fact that 62 percent (160/258) of the programs were operated on less than $5,000 per year. Of the larger rehabilitation efforts, only 12 percent (31/258) had annual budgets of over $50,000. Sources of these funds were primarily from public donations (36 percent of respondents) and personal funds of the rehabilitator (21 percent of respondents). Other less important sources mentioned included fund-raiser events, memberships, private foundations, grants and private businesses. As to the adequacy of this support, 39 percent of respondents (104/265) indicated that the budget was inadequate and an additional 34 percent (90/265) called the budget ''barely adequate.'' Also, 25 percent (65/265) considered their budget to be adequate and a mere 2 percent (6/265) were dealing with a budget that was ''more than adequate.'' Thus, for the most part, wildlife rehabilitators are operating with minimal budgets, small facilities, and volunteer support.

The majority (74 percent) of respondents also indicated that there was an educational program associated with their rehabilitation efforts. This result was only slightly smaller than the proportion (81 percent) reported by Horton (1987:127). Descriptions of educational programs in this survey varied greatly, but included public school interaction, interaction with natural resource organizations, facility tours, outreach programs and workshops.

Discussion

That attitudes of people toward animals is a major consideration in putting wildlife rehabilitation into perspective. As stated by Stephen Kellert, a well-known socioecologist at Yale University, ''with more and more citizens becoming involved in various wildlife issues, the success or failure of many programs depend on understanding the public's attitudes toward, knowledge of, and concerns and values regarding wildlife.'' When placing current wildlife rehabilitation efforts in perspective with wildlife conservation, it is important to understand both the broad variety of viewpoints toward wildlife held by the different publics and our track record in educating these publics about wildlife and wildlife habitats.

Kellert (1980:116–117) described 10 general attitudes toward animals as: (1) naturalistic, (2) ecologistic, (3) humanistic, (4) moralistic, (5) scientistic, (6) aesthetic, (7) utilitarian, (8) dominionistic, (9) negativistic, and (10) neutralistic. Although several of these attitudes may be self-explanatory, the ones of specific interest here are:

- *Naturalistic:* primary interest and affection for wildlife and the outdoors.
- *Ecologistic:* primary concern for the environment as a system, for interrelationships between wildlife species and natural habitats.
- *Humanistic:* primary interest and strong affection for individual animals, principally pets.
- *Moralistic:* primary concern for the right and wrong treatment of animals, with opposition to exploitation or cruelty toward animals.

- *Utilitarian:* primary concern for the practical and material value of animals or the animal's habitat.
- *Dominionistic:* primary interest is the mastery and control over animals, typically in sporting situations.
- *Negativistic:* primary orientation is an active avoidance of animals due to dislike or fear.

These categories of attitudes reflect fundamental and substantial differences in the ways people relate to animals and provide some insight into potential sources of controversy in wildlife conservation programs. For example, wildlife biologists could be classified as generally ecologistic, scientistic and maybe naturalistic; wildlife rehabilitators probably are humanistic and may be moralistic; hunters and fishermen may be utilitarian tending at times toward dominionistic (Kellert 1980:118–119). The even more confusing aspect is that not all people within these general attitude categories are consistent in their views and there is considerable overlap among categories. Labeling groups of people, therefore, may serve no useful purpose other than to enable us to refer to major attitudinal similarities and differences. In general, it seems fair and accurate to note that utilitarian and dominionistic attitudes are becoming less common and naturalistic and humanistic attitudes are more common.

Attitude surveys have shown that "the public" tends to view wildlife not in terms of populations, but seeks to help individual animals, without a clear understanding of population ecology *per se*. If the individual animal is thought of as part of a much larger population and ecosystem (ecologistic attitude), then the removal or loss of one or a few individuals may not have a long-term adverse impact upon either the population or the ecosystem. If, however, the animal is viewed individually as being extremely important (humanistic attitude), then the welfare of this particular individual becomes ultimately important and much effort may be expended on efforts to save or maintain this animal. This probably represents a succinct appraisal of the differing perspectives of traditional wildlife management and wildlife rehabilitation, respectively, with environmental education very likely being somewhere between the two perspectives. Also, in my opinion, human emotions become involved and make it difficult to be consistently rational and objective, particularly when dealing directly with the animal. Additionally, emotional appeals represent a major portion of the underlying motivation and sociological framework in which wildlife rehabilitation programs operate and expand.

Studies of Floridians (Duda 1987) have shown that the largest and fastest growing segment of the public, urban residents, tend to view wildlife from a humanistic and moralistic attitude. Specifically, their primary interest comes from a strong affection for individual animals (e.g., treating wildlife as pets) or from a strong concern for the moral treatment of animals (e.g., avoiding exploitation or cruelty). Duda's study also demonstrated that urban residents have very little specific knowledge of wildlife and their requirements.

Although the goal of many environmental education programs is to move the audience to a naturalistic or ecologistic attitude regarding wildlife, educators must be aware that some of their audience shares a markedly different viewpoint and may not be fully receptive to education programs that do not also address their current attitudes. Conservation education programs sometimes avoid working closely with humanistic and/or moralistic groups because of differences in attitudes concerning wildlife. Effective wildlife education programs, however, should respect these differing viewpoints and attitudes while maintaining the critical need to accurately increase the public's awareness and understanding of wildlife and their habitats.

Wildlife rehabilitation centers provide a potentially effective, but poorly used mechanism to teach major segments of the public about wildlife. Rehabilitation work, almost by definition, often is a greatly emotional activity. Injured, orphaned and helpless animals provide strong humanistic and moralistic appeals. Rehabilitation also is viewed by the public as a noble and moral endeavor, staffed by noble people. As such, rehabilitation centers draw respect and attention from a large segment of the public—those with humanistic and moralistic attitudes toward wildlife who want to do something to help them. And these centers, through educational programs, have the potential to reach many people that traditional conservation education does not.

Rehabilitation centers provide many excellent "teachable moments" useful for public education. Animals are available for demonstration and their condition often elicits from the public both sympathy and desire to understand. Although the survey indicates that rehabilitators do not consider rehabilitation-for- demonstration to be a high priority, using such animals could be an effective education tool by showing that humans can both help and harm wildlife. Using this then as a background, environmental educators could delve into broader conservation issues.

Results of this survey showed that most rehabilitation centers provide some public education. However, these results also suggest that education is not a high priority, and it appears that the educational potential is vastly underutilized. Rehabilitators tend to focus their educational programs on goals and objectives in a different manner than mainstream conservation educators. Horton (1987) found that the most prevalent educational objectives of rehabilitators were "to promote a greater appreciation and respect for wildlife" (85.3 percent) and "to share knowledge gained by wildlife experiences" (63.2 percent). Barely half responded that their objective was to increase "a better understanding of the environment" and far fewer indicated a desire "to implement research and management programs for the survival of wildlife" (30.9 percent). Due to the attitudes of many rehabilitators, it is not surprising that educational efforts tend to focus more on humanistic and moralistic than on naturalistic or ecologistic themes. In deciding whether or not to become closely aligned with wildlife rehabilitation, it may be useful to consider the following advantages and disadvantages of rehabilitative efforts.

Advantages of Wildlife Rehabilitation Programs

1. Provide the public with a place to take sick, injured and orphaned wildlife.
2. Provide a source of non-domestic animal patients for the training of veterinary students.
3. Provide a humanistic/moralistic outlet for people to care for wildlife.
4. May provide public relations benefits for those doing the rehabilitation.
5. Saves the lives of some animals and may result in the release of some animals back into the wild.
6. May provide a source of unreleasable animals to be used for educational display or research efforts.
7. May promote preventive rehabilitation to discourage unnecessary harm/injury to wildlife.

8. Rehabilitation of common species as time and resources permit may further facilitate efforts with rare species as they come in.
9. Wildlife rehabilitation is becoming more organized and this may lead to improvement in standards and involvements in additional educational programs.

Disadvantages of Wildlife Rehabilitation Programs

1. It is extremely expensive to initiate and maintain a program; it is not cost effective as a means of wildlife management.
2. The majority of the species handled are common and the numbers rehabilitated and released have no major impact on wild populations.
3. Rehabilitation and the handling of animals, in my opinion, often becomes an emotional experience and may inhibit the ability of those involved to remain objective.
4. The potential risk of disease (rabies, *Salmonella*, ringworms, mange, etc.) transmission to other animals and people is frequently high and may not receive adequate consideration.
5. Facilities frequently are not adequate due to a poor funding base and inadequate staff support.
6. Future competition may occur for state/federal funds currently allocated to other forms of wildlife management (e.g., habitat acquisition/management).
7. Imprinting on or acclimation to people during rehabilitation may hinder success in the subsequent attempt to release the animal.

These two lists are an attempt to provide an objective look at both sides of the issue of wildlife rehabilitation. If you plan to cooperate with or become directly involved in wildlife rehabilitation, it is recommended that you: (1) seriously consider the advantages and disadvantages outlined above, (2) develop a priority system for acceptance or rejection of animals brought to your facility, (3) have adequate support in terms of space, staff and budget to operate the facility, and (4) have trained and/or experienced people available to properly rehabilitate the animals and provide educational programs.

Summary

The motivations and characteristics of wildlife rehabilitation efforts in the U.S. were examined to place these into perspective with regard to future wildlife resource conservation and education. Rehabilitation programs were highly variable—from individuals housing orphaned and injured animals on their back porches to universities keeping these animals to facilitate the training of veterinary students. To attempt to understand rehabilitation efforts, it is useful to recognize that many people have a "humanistic need" to *help* wildlife. In most cases, all animals brought to facilities were accepted, with no special effort to prioritize the allocation of resources (care and money) for particularly rare or unique species. Generally, individual rehabilitation efforts were small operations heavily dependent upon a few individuals and/or volunteers and with budgets (mostly from personal funds) that were inadequate or barely adequate to meet their needs. Some educational activities were associated with rehabilitation efforts, but further expansion in his area is both possible and expected.

Wildlife ecologists, managers and environmental educators are encouraged to become more involved with rehabilitation centers from an educational standpoint. This survey indicated that rehabilitators make a sincere effort to benefit the wildlife resource and teach the public on small and often insufficient budgets. Rehabilitation work is commitment-based not education-based, and rehabilitators rarely are trained as wildlife ecologists. Therefore, their educational efforts often may reflect attitudes that are more emotional than ecological, and ecological information that is disseminated may not always be factual. Rehabilitators' educational efforts also are not confined only to their direct public programs because the media frequently seeks information from them regarding wildlife issues. Environmental educators would do well to seek more interaction with rehabilitation centers that provide public education programs as both could potentially benefit from that involvement and a large segment of the public could be more effectively educated on wildlife issues.

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Broadening the Paradigm of Natural Resource Management

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Introduction

The demographic characteristics of United States residents are undergoing fundamental changes that will directly affect the course of natural resource management in the 1990s and into the twenty-first century. For example, the population increased by 7.4 percent from 1980–87 and 28.4 of this growth was the result of immigration predominantly from Mexico and Southeast Asian countries. The projected median age of the population in 1990 will be 33 years and 43 years in 2080. Nearly 74 percent of U.S. residents lived in urban areas in 1980 (Weber 1988)). The 1985 public, 16 years old or older, participated more in nonconsumptive activities (74 percent) compared to fishing (19 percent) and hunting (2 percent). Participation in angling and primary nonresidential nonconsumptive activities increased 9.81 percent and 1.82 percent, respectively, between 1980 and 1985. Participation in hunting decreased 4.3 percent during the same time period. Participants in all activities were the minority urban, white, males that earn over $30,000/year and have college educations (U.S. Department of the Interior 1982 and preliminary results of 1985 National Survey of Fishing, Hinting, and Wildlife Associated Recreation). It seems important to consider whether the paradigm of natural resource management in 1988 has sufficient internal diversity to evolve with changes in the public demographic structure and their involvement with the natural resource heritage.

Human dimensions and education are the two components in the paradigm of natural resource management that provide the tools to assess and address changing public responses to wildlife and fisheries resources. This paper examines how the wildlife and fisheries professions may be able to respond to these changes as evidenced in a synthesis of the education and dimensions publications in their journals. A descriptive assessment of literature related to education and human dimensions in wildlife and fisheries management is given in terms of content and frequency. This assessment led to several recommendations that may help the wildlife and fisheries professions prepare to develop a natural resource management paradigm that meets changing public characteristics and their attitudes, activities and expectations concerning natural resources.

Journal Selections

Journal selections for this study were identical to those used by Adams and Thomas (1986) with the addition of three fisheries journals. Information was sought using articles published from 1978 through 1988 in *The American Biology Teacher* (ABT), *The Journal of Environment Education* (JEE), *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* (Proceedings), *The*

Wildlife Society Bulletin (WSB), *The Journal of Wildlife Management* (JWM), *Transactions of the North American Wildlife and Natural Resources Conference* (Transactions), *Fisheries Bulletin* (Fisheries), *North American Journal of Fisheries Management* (JFM), and *Transactions of the American Fisheries Society* (AFS). For search purposes, education articles had to consist of those that integrated specific wildlife or fisheries resources, their habitats, conservation, and management strategies into educational programs. Dimensions articles had to relate to human attitudes, activities, knowledge or expectations concerning wildlife or fisheries resources or their habitats. Articles were classified by title or by reading the abstract or introduction when the overall theme of the article was not clear by the title. This procedure eliminated redundancy in article classification, made it possible to classify article content by title and to develop the patterns of emphases in the education and dimensions articles by journal.

Assessment of Education and Dimensions Articles

A 10-year summary of the total number of articles published in nine selected journals and those on education and dimensions is given in Table 1. The frequency of education and dimensions publications from 1978–88 in these nine journals is given in Figure 1. An analysis of the patterns of emphases in education and dimensions articles in each of the nine journals is given below.

ABT: Most ($N = 41$) ABT education articles addressed the use of specific animals or their habitats as the focal point in biology education. The full range of "wildlife" from invertebrates to vertebrates were included. The ABT literature also included articles relating wildlife to the teaching of basic concepts ($N = 25$) such as predator/prey relationships, behavior, classification, adaptation and territoriality, among others; conservation ($N = 7$); careers planning ($N = 4$); field studies ($N = 8$) that included birding, whale watching, insects, gray squirrels, owls, road kills and nesting birds; and the ethics ($N = 7$) that need to be considered in the use of live animals

Table 1. A 10-year (1978–88) summary of published articles on wildlife and fisheries education and human dimensions in wildlife and fisheries management in nine selected journals.

	Total articles	Education	Dimensions
Am. Biol. Teacher	906	75	5
J. Environ. Ed.	333	13	15
Proc. Annu. Conf. SEAFWA[a]	768	21	11
Wildl. Soc. Bull.	795	23	32
J. Wildl. Manage.	1,748	0	6
Trans. N.A. Wildl. Conf.	707	52	39
Fisheries	391	17	26
N. Amer. J. Fish. Manage.[b]	500	0	15
Trans. Am. Fish. Society[c]	1,030	0	16
Totals	7,176	201	165

[a]1978 to 1986.
[b]1981 to 1988.
[c]1978 to June 1988.

in the classroom. Other articles examined the utility of selected facilities ($N = 6$) for wildlife education including zoos, museums, school campus, urban areas and national parks; and techniques ($N = 18$) for including wildlife in the biology classroom such as study skins, skeleton preparation, taxidermy, marine aquaria and culture methods. The dimensions literature in ABT basically addressed students' attitudes toward animals in general and the use of live animals in the classroom.

JEE: The JEE approach to education focused on interpretations of the environment, natural resources or specific habitats (e.g., wilderness areas). Other articles evaluated environmental education systems or specific programs that used wildlife and fisheries resources, their habitats, related facilities (e.g., zoological parks or aquariums) or specific technologies (e.g., mass media). JEE articles on dimensions focused on peoples' attitudes toward animals in general, resource use and management and public sources of information on the environment.

Proceedings: The Proceedings articles on education emphasized audiences served (e.g., hunters, youth, boaters or school groups); descriptions of programs developed by extension, state or federal agencies; and methods of conducting or evaluating education programs. Proceedings articles on dimensions contained a blend of studies on hunters, anglers, landowners, students, teachers and the general public. Most dealt with the "characteristics" or "attitudes" of these groups.

WSB: The majority ($N = 17$) of WSB articles on education addressed issues related to training needs of resource professionals, enrollment and hiring patterns within the profession, and university curricula in wildlife and fisheries management. Most ($N = 24$) of the WSB articles on dimensions dealt with attitudes of the general public toward hunting, management practices, nongame tax check-off programs or wildlife-related activities. A few reported the results of hunter attitudes based on demographic characteristics or toward management practices.

JWM: The JWM did not publish articles on education and rarely published articles on dimensions unless they dealt with hunters.

Transactions: Articles on education in the Transactions were national or historical reviews of programs ($N = 15$), program descriptions ($N = 16$), or descriptions of educational methods or techniques ($N = 12$). Six articles addressed the training needs of natural resource professionals or required credentials for employment by natural resource agencies or industry. Four articles reported the results of program evaluations. Most ($N = 18$) of the dimensions articles in the Transactions examined the general public's attitudes on wildlife in general or on selected animal groups (e.g., endangered, nongame, urban, predators), natural resource issues, recreational priorities, and hunting or hunters. Another group ($N = 12$) of articles focused on mandatory hunter education, hunter ethics, and participation in wildlife management.

Fisheries: Like WSB, the majority ($N = 16$) of Fisheries articles on education addressed issues related to training needs of resource professionals and university curricula in fisheries management. Dimensions articles concentrated on anglers ($N = 11$) attitudes towards the process or product and the characteristics or attitudes of fisheries professionals ($N = 13$) concerning the policies, structure, or function of the fisheries profession.

JFM: Like the JWM, the JFM did not publish articles on education but pays over twice as much attention to dimensions research when compared to the JWM. However, the sole focus group in JFM dimensions research was anglers and concerned their participation rates and compliance with legal limits.

AFS: Like the JWM and JFM, the AFS did not publish articles on education but had the same level of published articles on dimensions as did the JFM. In contrast to the JFM, the AFS dimensions articles dealt with the importance of socioeconomic analysis of the general population in fisheries management.

Summary: Wildlife and fisheries education did not command a high priority in the professional (2 percent) when compared to the education (7 percent) literature. There is a higher probability of finding education articles in journals outside the mainstream (ABT, 8 percent) of the wildlife and fisheries profession or in the literature that does not have peer-review status (e.g., Transactions, 7 percent) compared to the ''management'' (0 percent) literature (Table 1). Education articles in ABT and JEE highlight the integration of wildlife or fisheries resources or their habitats into biology or environmental education. In contrast, the education emphasis in the professional journals is on the training of more professionals, descriptions of ongoing programs and enrollment or hiring patterns. The number of education articles published from 1978–88 was consistently low even with the addition of those in the education literature (Figure 1).

The frequency of dimensions articles in the professional and educational literature was the same (2 percent). However, dimensions articles appeared at a higher frequency in the education (2 percent) when compared to the ''management'' (1 percent) literature. The probabilities of dimensions articles appearing in the professional literature were Fisheries (7 percent), Transactions (6 percent), WSB (4 percent), JFM (3 percent), AFS (2 percent), Proceedings (1 percent) and < 1 percent in JWM

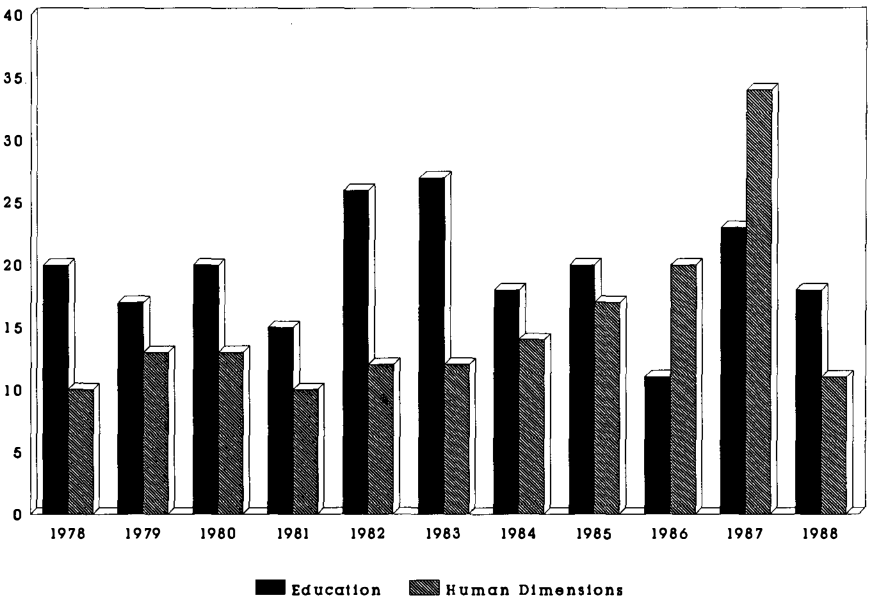

Figure 1. A 10-year (1978–88) trend in the number of published articles on wildlife and fisheries education and human dimensions in wildlife and fisheries management.

(Table 1). Dimensions articles in ABT and JEE focused on students' or the general public's natural resource knowledge or attitudes toward wildlife or their habitats. The dimensions literature in the professional journals covered a broad range of issues and respondent groups. There were 145 articles on the characteristics of specific user groups (e.g., hunters, anglers, birders), youth, wildlife or fisheries professionals, and general public; their attitudes on hunting or fishing, endangered species, management techniques, laws and wildlife or fisheries-related education; or their wildlife-related activities. Publication of dimensions articles increased from 1981–87 until a sharp drop in 1988 (Figure 1).

This study revealed extreme biological and tradition bias in the natural resource management paradigm. For example, if the type of publications most often accepted in the professional journals reflect management priorities, then only token attention was given to education and human dimensions issues. Furthermore, the attention given to these two components of the natural resource paradigm by the wildlife and fisheries professions focused heavily on professional rather than public concerns.

Recommendations

This synthesis of the literature led to several recommendations to broaden the natural resource paradigm and prepare for the natural resource needs of a growing but aging, nonhunting, minority enriched, urban public.

First, the wildlife and fisheries professionals must demonstrate the importance of education and dimensions issues in natural resource management by placing related research on a parity level with that conducted on the resource. This would require that articles on education and dimensions have a significantly higher visibility in the "management" journals. Furthermore, sessions on education and dimensions issues should be on the agenda of every national, regional and sectional wildlife and fisheries meeting.

Second, university wildlife and fisheries programs must be expanded to include urban wildlife (Adams et al. 1987), teacher training (Adams and Thomas 1986) and human dimensions programs (Adams 1988). This will require the addition of faculty trained to conduct program development and research in education and dimensions issues. Recognition of the importance of the education and dimensions component of natural resource management by state and federal agencies should lead to employment opportunities of more graduates in these areas (Adams 1988).

Finally, the role of information and education (I&E) divisions within state departments of natural resources should change form an administrative perspective (Knuth and Nielsen 1986) to one of being an active participant in public education and human dimensions research. However, significant increases in I&E personnel and budget allocations and changes in program priorities will be required (Adams et al. 1987).

This study identified the deficiencies in the natural resource management paradigm for meeting future public needs. Management is an activity prompted by change and driven by people's orientations toward natural resources. This study demonstrated that the wildlife and fisheries professions need to give a higher priority to education and human dimensions in order to have the most effective tools for conducting the natural resource management process in the future.

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Summary and Look to the Future

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My assigned topic, "Summary And Look To The Future," allegedly included a summary of today's session as well as a look to the future. Let me dispense quickly with the summary and concentrate on the future. That's where we're going, ready or not!

Today's session was especially gratifying because of my long-standing interest in people problems of resource management. As I listened to the presentations, I reflected on my first human dimensions of wildlife paper at a North American Conference 20 years ago and the several sessions at Conferences since then. Today's much expanded network of interested colleagues, now formalized in the Human Dimensions of Wildlife Study Group and Newsletter, is a good foothold for the future but it's not enough.

I want to congratulate the session organizers and all the authors of today's presentations. But it would be unfair to single out any one of them for comment. Instead, I want to spend my time on three trends I've observed in human dimensions activity the past 20 years and challenge us toward some goals for the next 20 years.

Some Trends

First, there is today a much expanded and diversified scope of topics addressed under the human dimensions heading. Today's session included papers on such diverse topics as career development, teaching and learning, wildlife education strategies for women, wildlife education planning, animal welfare, and wildlife rehabilitation. Many of these topics wouldn't have made the program 20 years ago when we were more narrowly focused.

Second, this North American Wildlife and Natural Resource Conference program has several sessions—not just this one—that address human dimensions. For example, two technical sessions respectively address wildlife economics and law enforcement, and three other sessions address related subjects of public access, conservation partnerships and planning. Clearly, interest in wildlife-people issues has expanded beyond the leadership of any one sponsoring group and is now diffused, with many generic people and natural resource concerns attracting a critical mass for technical sessions.

Third, over the past 20 years, we've experienced some remarkable transformations in wildlife management. For example, social-political aspects now outweigh the biology of wildlife resource planning and decision making—yet our biotechnical knowledge is way ahead of our social-political skills. Biological and technical knowledge is still necessary but no longer sufficient for management success. Consider how important the social-political aspects have become in wildlife management.

Public involvement has become a reality—not just a promise—and we are having problems integrating it with our expanded technical capability to manage wildlife habitat and populations. Good wildlife science has increased our understanding of the nutritional links between wildlife, food and habitat; capture techniques and implants for physical monitoring have increased our knowledge of wildlife movements and responses to stress and translocation; geographic information systems and satellite imagery have increased our ability to evaluate habitat. But a lot of this underlying science and today's management is driven by the need to mitigate the impacts of civilization on fish and wildlife—such as the impacts of water impoundments and reduced water quality on fisheries, and urbanization, roads and agriculture on wildlife. With urbanization, appreciative uses and wildlife entertainment have emerged to challenge consumptive uses, which in turn are evolving from their "subsistence way of life" origins to fish and wildlife sport as an important leisure economic activity. Of course, these appreciative and sport uses of wildlife often clash, and the resulting social-political problems are not as easily resolved as biological issues. Sometimes, the sociology and biology of wildlife issues are intertwined—as in threatened or endangered species such as the spotted owl, red cockaded woodpecker, gray wolf, mountain caribou and grizzly, or harvest regulations for elk, bison and waterfowl. As this quick review of wildlife management progress documents—as I see it, at least—an even greater need today for human dimensions understanding and skill is the key to the future.

Future Directions and Goals

So what leadership directions for human dimensions are needed today? What are feasible goals to shoot for 20 years hence? What would adoption of those goals suggest for action today and tomorrow? At the risk of seeming trite, I'd like to suggest three things. We need to (1) strengthen human dimensions research—to develop the knowledge base, (2) strengthen human dimensions teaching to impart that knowledge to tomorrow's management professionals, and (3) broaden the social and demographic representation and cultural relevance of wildlife programs.

Strengthen Research

There is a need to strengthen the rigor as well as the extent of human dimensions research. We need a science base for advancing human dimensions of wildlife—just as the biologists need research to support their progress. How to strengthen research? I've come to believe we need a "Journal of Wildlife and People" as a peer-reviewed repository of human dimensions research. Nothing less will ensure the documentation, validation through peer review, replication and accumulation of empirical knowledge about people-wildlife relationships and situations—all supporting theoretical speculation toward greater inference from that knowledge and subsequently more creative studies. A journal won't solve all our problems or meet all the needs, but it will be a key to strengthening our knowledge base.

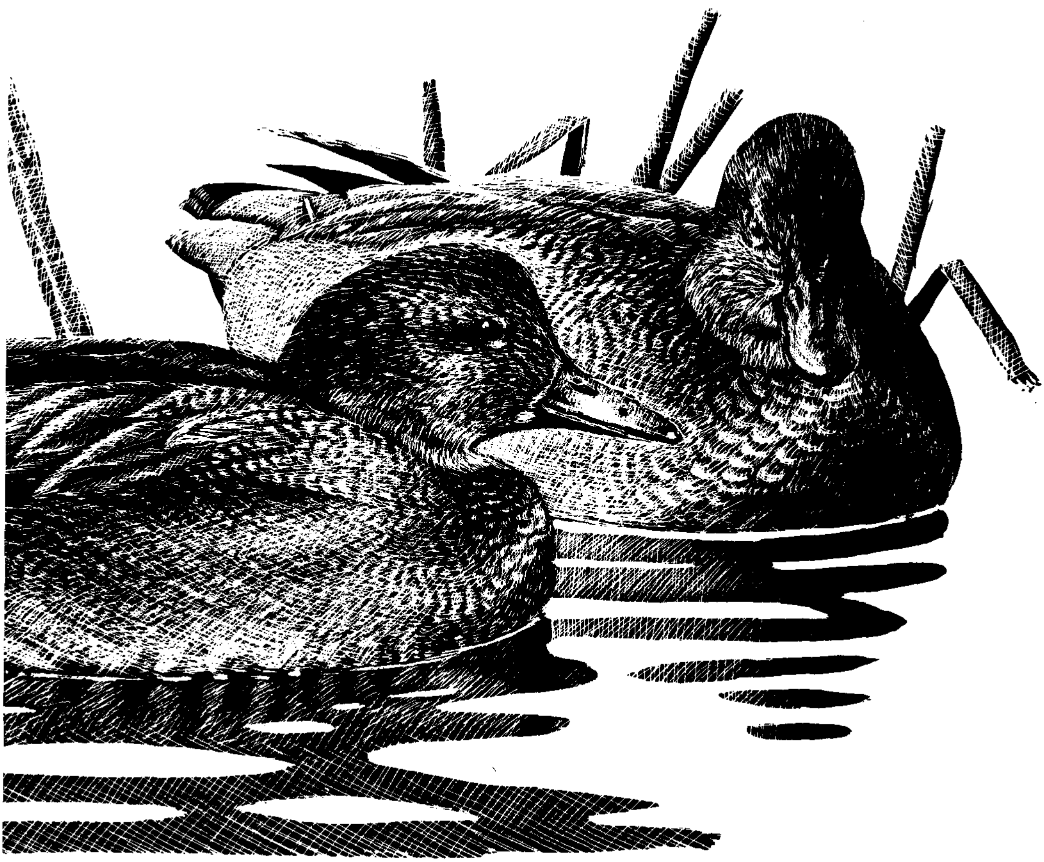
How much further progress will we make in 20 years under today's situation—with human dimensions research spread among a plethora of outlets and special issues, special conference sessions and periodic conferences?

Strengthen Teaching

We need to work toward the availability of human dimensions education for *all* wildlife students. It would be naive to think that a separate course would become required for accreditation—and, even so, it would be self-defeating by compartmentalizing the topic. Human dimensions has gained a foothold in academic programs at a few universities, but I fear its compartmentalization as a specialty, rather than being integrated in the curriculum. Twenty years hence it will be a hollow victory if human dimensions has only expanded its foothold at the extensive margin of special research units, special issues, special conferences and special elective courses. And if that's where we're headed—and the signals are mixed at best—then we need to change our strategy. We need to work toward the inclusion of human dimensions as an integrated part, not a specialized part, of the academic education of all future fish and wildlife managers. What do we need to do today and tomorrow to achieve integration of the human dimension in wildlife education in the future?

Strengthen Social and Demographic Representation and Cultural Relevance

United States society is changing in its social and demographic composition and diversity of perspectives—and resource management needs to work toward representation of those changes. Some of the projected changes are shocking. For example, 20 years hence only 15–20 percent of the entering work force in the U.S. will be white male—the rest will be female and minorities. The diversity of U.S. society is increasing with urbanization and more representation of international cultures. Today, all natural resource agencies are, of necessity, pursuing affirmative action with unprecedented rigor. This topic must fit within the broader natural resource paradigm pursued by the Human Dimensions in Wildlife Study Group. We need to expand our dialogue to address this issue and other topics concerned with the interface of wildlife and society in the broadest sense. Of the three challenges I've posed, this will be the hardest.



Special Session 9. *Duck Harvest Management: Questions and Needs*

Chair
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A Turning Point for Duck Harvest Management

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Why Are We Here?

Ducks and their habitat base in North America are in trouble, and harvest management has become more controversial than ever. During the 1980s we have broken records for low numbers for most of the things that are important to duck populations. Pond numbers in breeding habitat, number of breeding ducks, breeding numbers of many important species such as mallards and pintails, and fall flights have broken records for low levels. Of great concern is that some of these records have been broken repeatedly. An example is the successive lows in pintail breeding population numbers. The occasional signs of improvement in habitat or populations have quickly turned around, and in 1988 we experienced the worst overall outlook for ducks and their habitat on record.

We have faced this problem before, such as in the 1960s when drought contributed to driving duck populations to previous lows. We have known for several decades that breeding habitat, and also migration and wintering habitat, were the key to both the short- and long-term welfare of ducks. Comprehensive evaluation of data on ducks and their habitats has been done in developing the North American Waterfowl Management Plan signed by the U.S. and Canada in 1986, as part of the analysis of the Stabilized Regulations studies reported on at the 52nd North American Wildlife and Natural Resources Conference in 1987, and through development of the 1988 Supplemental Environment Impact Statement on the Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds. These evaluations reveal that the problem faced in the 1980s is considerably more serious than that which occurred in the 1960s. The low duck breeding populations now are associated with widespread severe drought, low recruitment linked to long-term habitat change, predation impact, and other influences. There have been major distributional changes and alarming species declines.

A major difference in the information base now is that data from field work in the 1980s has shown in simple measures how pervasive habitat modification has become on vast areas of Canadian breeding grounds. The conclusion has been that major habitat restoration and management programs, and harvest restraint, will be required to rebuild duck populations to numbers that produced high hunter participation in the early 1970s. No one believes that turning this situation around will be easy, or that major gains will be quick in coming. Because we have to deal with utilization of the resource in the interim, duck hunting regulations in the 1980s have become steadily more controversial. Some feel the regulations of the stabilized regulations period of 1980–84 were too liberal and contributed to the depressed status of ducks. Others feel restrictions of the 1985–1988 period have gone further than necessary. We are here today to explore some different viewpoints on future directions.

To Whom Are We Talking in this Session?

The hunting public has been largely responsible for maintaining the land base that has sustained the duck resource in North America, and certainly the management programs directed at ducks. The target of this session is to some extent the duck hunting public, but more strongly those that represent them and administer programs that affect duck hunters. We recognize that many interests other than duck hunters are needed to help restore ducks and their habitats, and that much of the work that must be done under the North American Waterfowl Management Plan, will be done for purposes such as wetland preservation and enhancement of a variety of wildlife. Therefore, it is important for those who serve the hunting public to better understand the basis of harvest management and its strengths and weaknesses. Many of those people are faced with the difficult task of maintaining hunter interest and management programs while the duck resource is depressed and sacrifices are necessary in hunting activity. It is over this dilemma that much of the controversy arises.

What Is the Basic Approach to Managing Duck Harvest?

Because ducks are an international resource and migrate across international and state boundaries, duck harvest management is by necessity a cooperative endeavor. State, private, and federal knowledge is pooled, constituting perhaps the largest database on a wildlife resource used anywhere for management. Cooperation through these programs means that some give up a bit so the whole can maintain a broad capability to enjoy the resource. Regulations for harvest are debated publicly, so all can see the basis for decisions. This is important, since many interests other than hunters focus on this far-ranging resource. The social climate in which we live is changing dramatically, and hunters are a minority in a swiftly urbanizing population. Public attitudes toward hunting are constantly in a state of change.

During the 1960s drought and low duck numbers led to serious harvest restrictions, and considerable strife in the wildlife management community. Wildlife managers responded by trying to build a more cooperative approach to decision making on regulations, and expanded their scientific information base considerably. The Fish and Wildlife Service and Flyway Councils consciously embraced a program to try to find ways to maintain hunting opportunity by a focus on portions of the resource that hopefully could sustain it. This led to expanded species management, special regulations, and extensive efforts designed to target harvest at lightly hunted species, sometimes, but not always, in ways that increased harvest. The overall goal was to maintain hunting opportunity, and thereby enhance the likelihood of maintaining management programs and habitats upon which ducks depend. The relatively high number of ducks and high interest among hunters in the early 1970s led to wide flexibility in regulations and development of a complex array of harvest programs. Extensive scientific work on difficult topics such as the impact of harvest on duck populations had a strong influence on attitudes toward harvest management. A series of legal challenges, on the black duck, hunting on national wildlife refuges, and administrative procedures for setting duck hunting regulations also influenced attitudes toward harvest management programs.

As the resource has declined, it has become harder to cooperate. At least it has become more difficult to reach conclusions leading to regulatory actions that are agreeable to a majority. Wide public knowledge of drought and progressively lower duck numbers during the decade of the 1980s have focused attention on harvest and what is known about managing it. For the most part, public treatment of these issues through magazines, newspapers, and other media have correctly assessed the drought and the existence of a crisis with low duck numbers, but have incorrectly treated cause and effect relationships between hunting and population numbers and appropriate solutions to the problem. Blame for this misunderstanding can be shared by the wildlife management community, because the topic of harvest and the science that surrounds it is unclear at best in answering some of the very basic questions about what can or should be done in harvest management.

The period of 1985-88 has seen significant reductions in seasons and bag limits, and suspension of some of the harvest opportunities and special regulations developed during the 1970s when ducks were more abundant. The 1988 SEIS by the Fish and Wildlife Service reviewed options for duck harvest management, and questioned some past approaches to harvest based partly on the status of ducks, and also on a reappraisal of what we think we know and don't know about many of our harvest tools. All of this has focused attention on harvest, possibly out of proportion to its role in influencing duck numbers. Nevertheless, because of the depressed status of ducks on the continent, a basic stance has been taken by the Fish and Wildlife Service and many others that ducks are at such a low point that we cannot afford to maintain the same pressures of harvest that we have in the past.

How Should Duck Harvest Be Maintained for the Future?

Questions to be addressed in this special session are: (1) What do people want from programs regionally? (2) What is the information base for harvest management? (3) What are our capabilities to utilize and evaluate harvest management? (4) How do we balance our desires for hunting programs, the status of the resource, and our scientific capabilities to manage programs for the future?

Atlantic Flyway Perspectives and Expectations

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The United States portion of the Atlantic Flyway includes 17 states extending from Maine to Florida (Figure 1). The Atlantic Flyway is 1,800 miles (2,896 km) in length, has over 7,000 miles (11,265 km) of coastline, and covers 446,000 square miles (1,155,141 km^2) (Addy 1964). The human population is 85.5 million, approximately 38 percent of the total population of the contiguous United States (Keane 1989). Waterfowl habitat within the Atlantic Flyway can be broadly divided into inland and coastal regions. River swamps, farm ponds, bogs, beaver ponds, hydroelectric reservoirs, sluggish rivers, and large lakes typify inland habitats. Important coastal habitats include bays, sounds, and tidal marsh (fresh, brackish, and salt). Unimpounded unmanaged marsh in the southern part of the flyway is of little value to dabbling ducks due to extreme tidal variations which limit the growth of desirable food and cover plants (Gordon et al. 1987).

The Atlantic Flyway is the geographic birthplace of waterfowl hunting in the United States. The list of famous historic hunting areas is long and well-known, including Merrymeeting Bay, Lake Champlain, Narragansett Bay, Long Island Sound, Barnegat Bay, Delaware Bay, Chesapeake Bay, the Canaan Valley, the Susquehanna Flats, Buzzards Bay, Back Bay, Pamlico, Albemarle and Currituck sounds in North Carolina, the coastal rice-growing areas of South Carolina and Georgia, and the Everglades drainage basin in Florida. Prior to the Migratory Bird Treaty Act of 1916, market hunting was a respected profession and a necessary way of life for people living off the land (Walsh 1971). Large numbers of wildfowl, from the Chesapeake Bay to the Carolinas, were available for the taking.

On April 5, 1946, Ducks Unlimited (DU) established the Black Duck (*Anas rubripes*) committee to recommend and coordinate a DU black duck program. Later that year, the committee was expanded to include personnel from the U.S. Fish and Wildlife Service, state game departments, and other private organizations and renamed the Joint Black Duck Committee. From this committee grew the Northeast Region Waterfowl Committee and the South Atlantic Flyway Waterfowl Committee (Addy and Kennedy 1969). Management of waterfowl by flyways began in 1948, and it soon became evident that there was a need for cooperation among all concerns

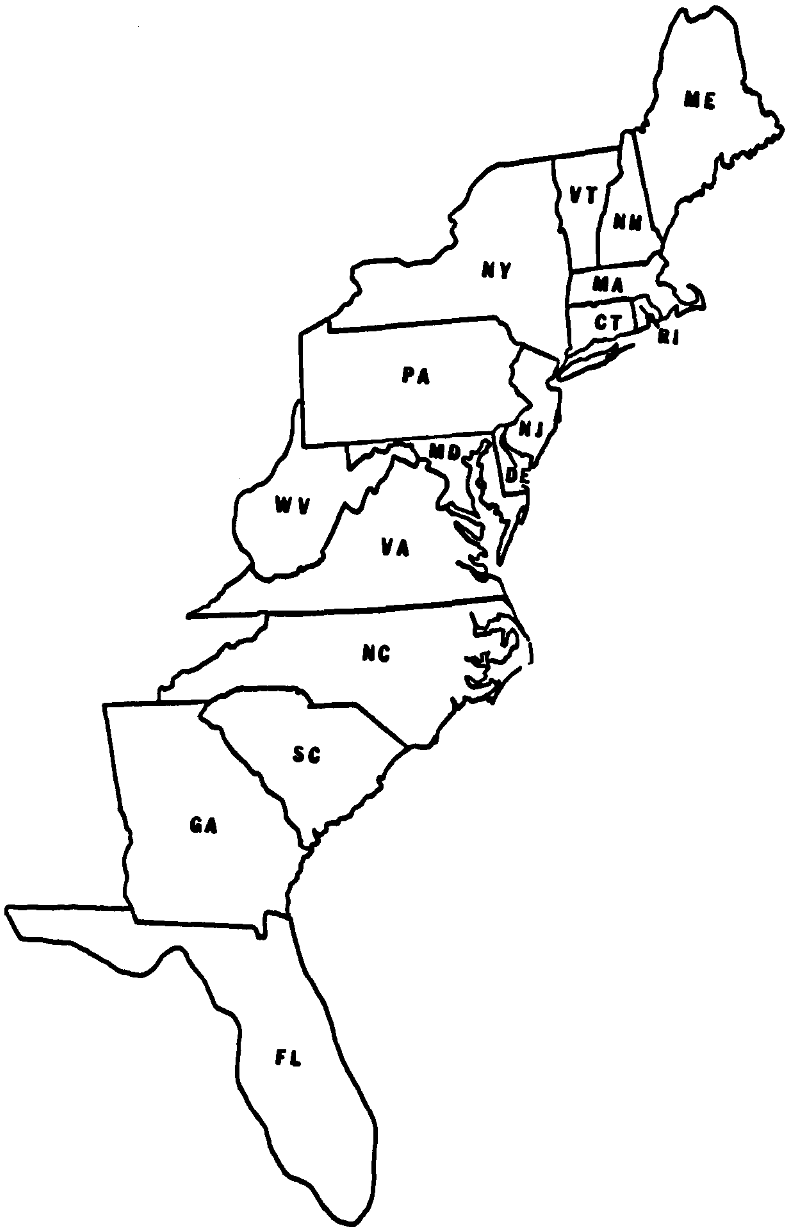

Figure 1. States that are within the United States portion of the Atlantic Flyway.

in the flyway (Addy and Blandin 1984). Thus, under sponsorship of the Wildlife Management Institute, the two groups met in January 1952 and consolidated to form the Atlantic Waterfowl Council. The Atlantic Flyway Council Technical Section was formed in May 1960 and has since served as an advisor to the Atlantic Waterfowl Council (Addy and Kennedy 1969). Through the Atlantic Waterfowl Council, states, private individuals, and private conservation organizations have made their interests concerning management of migratory birds known to the U.S. Fish and Wildlife Service.

Duck Populations

The Atlantic Flyway is unique in its geographic orientation to duck breeding areas. It lies to the east of primary production areas in the mid-continent prairies and parklands, yet has a large wintering component of ducks (Figure 2). Breeding duck populations in both the mid-continent region and eastern Canada contribute significantly to Atlantic Flyway populations. However, the relative contribution that each of these large breeding reference areas makes to the flyway varies by species and region and remains largely unquantified.

Mid-winter waterfowl surveys provide the only comprehensive measure of the relative distribution and abundance of ducks [excluding wood ducks (*Aix sponsa*)] within the flyway (Table 1). Long-term mid-winter population trends for some species more strongly associated with prairie breeding areas [e.g., lesser scaup (*Aythya affinis*), mallards (*Anas platyrhynchos*), northern pintails (*Anas acuta*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and northern shovelers (*Anas clypeata*)] have been declining in the flyway, especially during the recent 1980-88 drought period. Populations of species associated with eastern Canadian breeding areas [green-winged teal (*Anas crecca*), eiders (*Somateria* spp.), scoters (*Melanitta* spp.) and oldsquaw (*Clangula hyemalis*)] have tended to fluctuate around the long-term mean and have had small increases in recent years. Trends in Altantic Flyway wood duck populations are difficult to assess, as effective survey methods do not exist. Black ducks have declined steadily since 1955, yet this decline has not occurred throughout the entire wintering range. Black duck numbers in the New England states have increased, whereas in other regions the population has declined. The greatest decline (88 percent) occurred in four southern states: North Carolina, South Carolina, Georgia and Florida.

The Atlantic Flyway is critically important to the continential populations of certain duck species (Table 2). For black ducks, wood ducks, ring-necked ducks (*Aythya collaris*), and eiders, the Atlantic Flyway is important to breeding, migrating, and wintering population components. The Atlantic Flyway is of primary importance to migrating and wintering population components of canvasback (*Aythya valisineria*), scaup, eiders, scoters, and oldsquaw. A relatively small proportion of the continental populations of mallards, pintails, green-winged teal, gadwall, American wigeon, and northern shovelers winters in the Atlantic Flyway, but from a Flyway perspective, these are important species.

Duck Harvest

Important species in the Atlantic Flyway harvest include the mallard, black duck, green-winged teal, wood duck, ring-necked duck, scaup, eiders and scoters (Table 3). Five species contribute more than 70 percent of the annual Atlantic Flyway duck

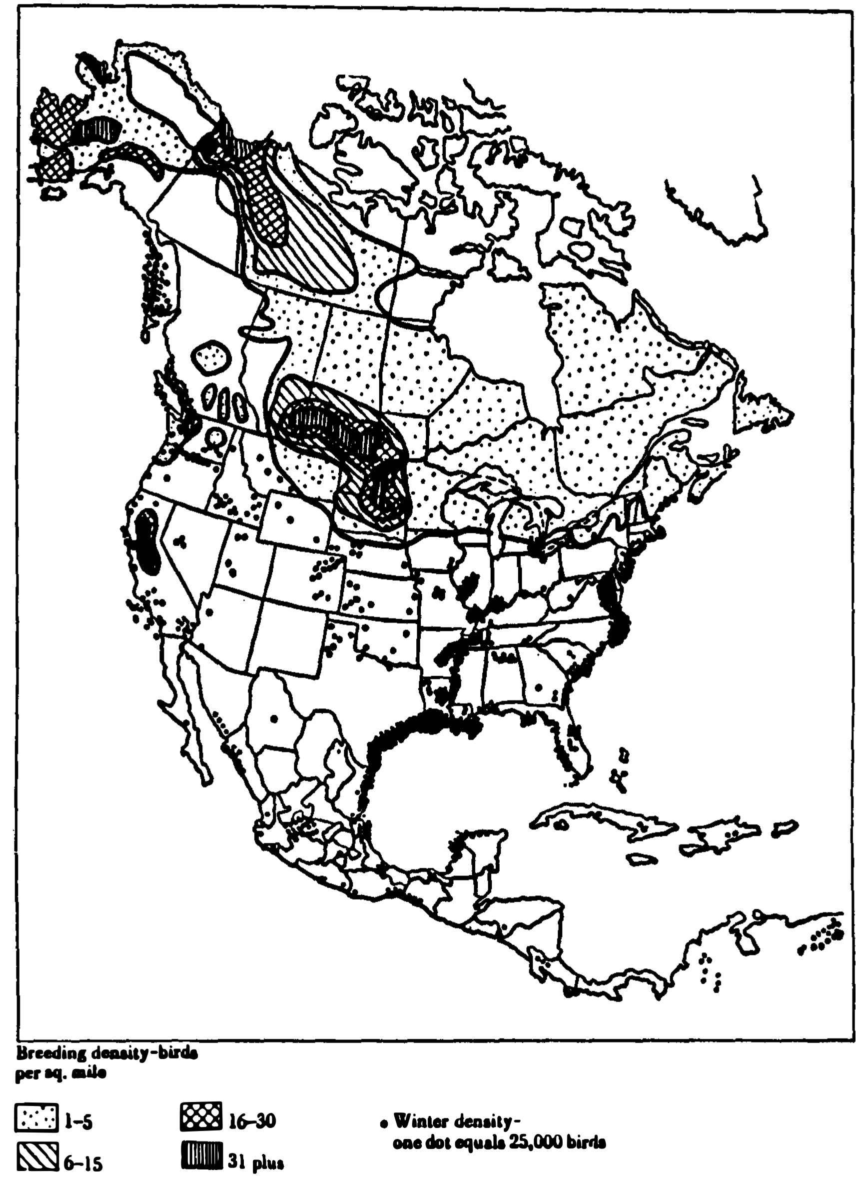

Figure 2. Generalized distribution and density of North American breeding and wintering duck populations (from Kiel et al. 1972).

harvest. In recent years, 48 percent of the total duck harvest has been mallards (25 percent) and wood ducks (23 percent). Black ducks (10 percent), ring-necked ducks (8 percent), and green-winged teal (8 percent) represent smaller but significant proportions. All other species contribute relatively small proportions (≤4 percent) to

Table 1. Average annual Atlantic Flyway midwinter population indices (in thousands) by species and 5-year period: 1961–88 (USFWS 1969–88, Steiner 1984).

	1961–65		1966–70		1971–75		1976–80		1981–85		1986–88	
Species	Midwinter	%	Midwinter	%	Midwinter	%	Midwinter	%	Midwinter	%	Midwinter	%
Mallard	212.8	9	196.3	9	181.55	10	246.2	13	200.2	12	156.9	10
Black duck	335.9	14	308.8	13	258.1	14	250.6	134	225.7	13	215.5	14
Mottled duck	2.1	<1	1.7	<1	0.5	<1	0.4	<1	1.8	<1	0.7	<1
Gadwall	34.3	1	23.9	1	14.7	1	30.7	2	21.8	1	10.2	1
American wigeon	109.5	5	103.8	4	64.7	3	76.4	4	40.8	2	45.4	3
Green-winged teal	79.4	3	69.4	3	68.4	4	43.9	2	38.0	2	65.1	4
Blue-winged teal	24.7	1	12.2	1	7.8	<1	15.6	1	14.1	1	15.3	1
Northern shoveler	17.5	1	22.6	1	12.7	1	9.7	1	8.2	1	8.3	1
Northern pintail	175.4	7	148.2	6	92.1	5	82.7	4	53.1	3	40.3	3
Redhead	113.2	5	181.7	8	115.6	6	127.1	7	96.6	6	59.8	4
Canvasback	161.4	7	140.0	6	107.1	6	140.2	8	127.3	7	114.0	8
Scaup	711.9	30	632.5	27	522.3	28	391.2	21	366.4	21	337.0	22
Ring-necked duck	121.2	5	88.1	4	60.8	3	38.7	2	56.3	3	59.0	4
Common goldeneye	84.8	4	73.9	3	47.0	2	42.2	2	48.5	3	34.1	2
Bufflehead	46.9	2	49.3	2	45.2	2	62.3	3	53.3	3	53.0	4
Ruddy duck	64.8	3	50.6	2	53.3	3	75.9	4	50.3	3	60.2	4
Mergansers	57.2	2	5102	2	38.0	2	59.7	3	72.5	4	93.1	6
Oldsquaw			8.9	<1	13.3	1	16.2	1	17.5	1	18.4	1
Scoters/Eiders	66.1	3	186.1	8	162.6	9	157.7	8	200.9	12	100.9	7
Unidentified ducks					28.5	2	23.4	1	7.5	<1	10.8	1
Total ducks	2416.1	103	2313.0	102	1891.6	100	1878.6	100	1709.5	102	1506.7	100

Table 2. Atlantic Flyway (AF) and United States (US) midwinter population indices (in thousands) for selected duck species and 5-year period: 1961–87, and the percent of the US total midwinter population in the AF (H. Bourne pers. comm. 1989, USFWS 1969–88, Steiner 1984).

	1961–65			1966–70			1971–75			1976–80			1961–85			1986–87		
Species	AF	US	%	AF	US	%	AF	US	%	AF	US	%	AF	US	%	AF	US	%
Mallard	212.8	7089.8	3	196.3	7247.3	3	181.5	7267.6	2	246.2	6625.3	4	200.2	5355.8	4	156.9	4803.3	3
Black duck	335.9	503.4	67	308.8	465.2	66	258.1	393.3	65	250.6	356.1	70	225.7	300.1	75	215.5	308.9	70
Green-winged teal	79.4	1243.3	6	69.4	1394.5	5	68.4	1527.0	4	43.9	4622.6	3	38.0	1043.9	4	65.1	1250.0	5
Northern pintail	175.4	3357.6	5	148.2	3525.0	4	92.1	5076.1	2	87.7	5343.7	2	53.1	3060.2	2	40.3	1318.0	3
Canvasback	161.4	277.3	58	140.0	258.6	54	107.0	220.6	49	140.2	318.8	44	127.3	312.8	41	114.0	257.5	44
Scaup	711.9	2204.8	32	632.5	1557.6	41	522.3	1447.1	36	391.2	1134.4	35	366.4	986.6	37	337.0	1002.1	34
Ring-necked duck	121.2	249.3	49	88.1	230.1	38	60.8	157.5	39	38.7	109.2	35	56.3	208.2	27	59.0	316.9	19
Oldsquaw				8.9	12.5	71	13.3	16.4	81	16.2	19.9	81	17.5	19.8	88	18.4	19.9	92
Eider/Scoter	66.1	204.6	32	186.1	281.7	66	162.6	250.1	65	157.7	260.1	61	200.9	281.0	72	100.9	210.2	48
Other ducks	531.5	5177.2	10	551.1	4799.6	11	681.0	4370.7	16	526.0	2133.4	25	445.5	3747.6	12	376.7	4177.3	9
Total ducks	2416.1	20307.2	12	2313.0	19772.1	12	1891.6	21086.4	9	1878.6	20923.5	9	1709.5	15316.0	11	1506.7	13663.8	11

Table 3. Average annual Atlantic Flyway duck harvests (in thousands) by species and 5-year period: 1961–87 (USDI 1988a).

	1961–65		1966–70		1971–75		1976–80		1981–85		1986–87	
Species	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%
Mallard	138.7	16	283.7	18	373.0	22	443.8	23	397.2	24	352.5	25
Black duck	217.3	25	290.6	18	272.3	16	265.0	14	170.2	10	137.7	10
Mallard x black duck	7.4	1	8.4	1	9.6	1	11.4	1	10.8	1	8.8	1
Mottled duck	13.9	2	21.7	1	16.4	1	15	1	16	1	14.7	1
Gadwall	11.6	1	24.9	2	24.9	2	37.3	2	31.9	2	21.7	2
American wigeon	40.0	5	65.6	4	60.4	4	83.5	4	42.5	3	47.8	3
Green-winged teal	61.0	7	129.2	8	128.3	8	135.5	7	103.6	6	107.7	8
Blue-winged/cinnamon teal	15.7	2	45.6	3	65.9	4	76.8	4	72.1	4	50.8	4
Northern shoveler	5.5	1	13.2	1	14.0	1	13.8	1	10.2	1	10.7	1
Northern pintail	20.5	2	34.2	2	30.6	2	43.2	2	28.2	2	17.4	1
Wood duck	129.8	15	244.1	15	294.5	17	377.1	19	387.1	23	310.2	22
Redhead	5.3	1	12.6	1	5.9	<1	8.8	1	6.5	<1	3.8	<1
Canvasback	11.0	1	28.9	2	6.8	<1	10.6	1	8.6	1	0.2	<1
Greater scaup	25.6	3	52.2	3	51.3	3	41.5	2	38.5	2	20.3	1
Lesser scaup	24.6	3	62.9	4	43.6	3	67.7	4	65.5	4	21.5	2
Ring-necked duck	57.9	7	100.8	6	98.1	6	126.6	7	103.9	6	106.8	8
Common goldeneye	16.6	2	21.7	1	21.5	1	21.6	1	19.9	1	16.6	1
Bufflehead	21.0	2	39.9	3	48.3	3	54.9	3	47.8	3	38.2	3
Ruddy duck	4.4	1	8.1	1	13.2	1	7.7	<1	7.8	1	4.3	<1
Hooded merganser	12.8	2	20.6	1	17.9	1	21.0	1	20.9	1	21.2	2
Other mergansers	7.0	1	11.8	1	12.0	1	11.3	1	15.5	1	13.3	1
Oldsquaw	2.7	<1	9.0	1	13.9	1	11.1	1	16.0	1	13.5	1
Common eider	2.9	<1	7.9	1	17.1	1	16.7	1	24.3	1	28.1	2
Scoters	25.9	3	46.8	3	59.9	4	38.4	2	38.8	2	41.8	1
Other ducks	0.7	<1	1.2	<1	2.9	<1	1.2	<1	1.5	<1	1.5	<1
Total ducks	880.0	103	1585.6	101	1702.5	103	1941.4	103	1685.3	102	1411.1	100

the annual Atlantic Flyway duck harvest, but are significant within certain regions. Sea ducks are relatively important in the duck harvest, with most being taken during special sea duck seasons in Maine, Massachusetts, New York, and Maryland.

The Atlantic Flyway proportion of the United States duck harvest (15 percent) ranks last in comparison to the Pacific Flyway (22 percent), Mississippi Flyway (45 percent), and the Central Flyway (18 percent) (Table 4). Between the early 1950s and the 1980s, the total duck harvest in the Atlantic Flyway has increased. The proportion of the United States duck harvest increased from 10 percent in 1952 to 15 percent in 1988. Almost 80 percent of the total United States black duck harvest and 30 percent of the wood duck harvest occurs in the Atlantic Flyway. Over 90 percent of the United States total sea duck harvest occurs in the northern part of the flyway. Also, 25 percent of the ring-necked duck harvest occurs in the Atlantic Flyway.

Hunter Activity

Atlantic Flyway annual duck stamp sales reached a peak in the early 1970s (500,000) and have since steadily declined, with 367,000 sold in 1987. Atlantic Flyway duck stamp sales averaged 19 percent of the total United States estimate during the 1961–65 period and 23 percent during 1983–87, second to the Mississippi Flyway (40 percent). During 1983–87, an average of 84 percent of Atlantic Flyway duck stamp buyers were active adult hunters.

Atlantic Flyway waterfowl hunters numbered approximately 320,000 in 1987, 23 percent of the United States estimate. Only the Mississippi Flyway has a greater proportion of waterfowl hunters (41 percent). Of 10.3 million days afield by United States waterfowl hunters in 1987, approximately 2 million (19 percent) occurred in the Atlantic Flyway, which is slightly higher than the Pacific (17 percent) and Central (18 percent) flyways, but lower than the Mississippi Flyway (45 percent). Among the four flyways, the Atlantic Flyway has the lowest proportion of successful hunters (63 percent), the lowest seasonal duck harvest per adult hunter (4.37 ducks), and the fewest days hunted per adult hunter (6.2 days) (1983–87 averages).

History of Harvest Approaches

A principle of waterfowl management in the Atlantic Flyway is to provide the greatest amount of hunting recreation to as many people as possible while maintaining waterfowl populations at levels compatible with their seasonal habitats. This is a unique challenge to waterfowl managers, since waterfowl do not recognize local, state, national or international boundaries. The length and breadth of the Atlantic Flyway covers a range of climate, habitat, and unit size of such complexity that uniform regulations historically have been unsatisfactory.

In the 1960s, when some waterfowl populations were low, interest shifted to a species management approach in order to utilize species with abundant numbers while lending protection to less numerous species (Addy 1962). This interest led to the formulation of special harvest strategies, including zoning, bonus bag limits, special seasons, split seasons, and the point system.

The concept of zoning waterfowl seasons dates back to the early 1900s. New York and Massachusetts had zones prior to the 1948 initiation of flyway management (Serie 1988). Harvest management by administrative flyways created a situation

Table 4. Atlantic Flyway (AF) and United States (US) duck harvest (in thousands) for selected species and 5-year period: 1961–87, and the percent of the US total harvested in the AF (USFWS 1969–88, Steiner 1984, Gamble 1987, USDI 1988a).

	1961–65			1966–70			1971–75			1976–80			1981–85			1986–87		
Species	AF	US	%	AF	US	%	AF	US	%	AF	US	%	AF	US	%	AF	US	%
Mallard	138.7	2272.0	6	283.7	3950.6	7	373.0	4774.7	8	443.8	4845.2	9	397.2	4003.5	10	352.5	3390.1	10
Black duck	217.3	293.3	74	290.6	392.8	74	272.3	373.1	73	265.0	367.4	76	170.2	222.5	76	137.7	174.8	79
Green-winged teal	61.0	681.7	9	129.2	1389.6	9	128.3	2522.8	9	135.5	1795.3	8	103.6	1222.0	8	107.7	1124.3	10
Northern pintail	20.5	678.0	3	34.2	1380.6	2	30.6	1296.9	2	43.2	1230.9	4	28.2	725.3	4	17.4	505.9	3
Wood duck	129.8	437.0	30	244.1	791.2	31	194.5	964.7	31	377.1	1206.5	31	387.1	1229.9	31	310.2	971.5	32
Canvasback	11.0	41.9	26	18.9	131.3	22	4.8	70.8	10	10.6	85.3	12	8.6	66.8	13	.2	21.8	1
Greater scaup	25.6	51.9	49	52.2	100.6	52	51.3	98.0	52	41.5	78.3	53	38.5	75.8	51	20.3	41.9	48
Lesser scaup	24.6	485.0	9	62.9	388.4	16	43.6	487.8	9	67.7	406.5	17	65.5	464.0	14	21.5	217.1	10
Ring-necked duck	57.9	274.0	21	100.8	393.7	26	98.1	422.0	23	126.6	496.2	26	103.9	412.8	25	106.8	698.4	27
Oldsquaw	2.7	3.6	75	9.0	11.4	79	13.9	16.4	84	11.1	12.6	88	16.0	17.2	93	13.5	14.7	92
Common elder	2.9	2.9	100	7.9	8.0	99	17.1	17.2	99	16.7	16.8	99	24.3	24.4	99	28.1	28.4	99
Scoter	25.9	30.4	85	46.8	59.1	79	59.9	69.0	87	38.4	49.4	78	38.8	49.3	79	41.8	48.2	87
Other ducks	291.7	1483.3	20	539.4	3019.8	18	607.4	2151.7	28	741.4	3445.8	22	684.0	2904.5	24	561.6	2088.7	27
Total ducks	880.0	4708.8	13	1585.6	12017.1	16	1702.5	13265.1	13	1491.4	14036.2	11	1685.3	11418.0	15	1411.1	9325.8	15

where there was concern within flyways, states and regions within states that hunting opportunities were not distributed equitably by basic standardized regulations. Thus, shortly after the formation of the Atlantic Waterfowl Council Technical Section, the Atlantic Waterfowl Council appointed a Zoning Committee to evaluate the desires of Atlantic Flyway states and to recommend an appropriate zoning pattern if it were deemed desirable. The final report of the committee indicated that 10 of 17 states favored some form of zoning. The committee recommended that zoning be approved in principle and could be a useful tool for regulating harvest (Foley 1967). A parallel study was carried out at the same time by a DU Flyway Committee, and the results were provided to the Atlantic Waterfowl Council as a means of modernizing policies concerning waterfowl regulations (Allen 1966). The basic difference in the recommendations of the committees was that the DU report recommended multi-state regions or zones within the Atlantic Flyway while the Atlantic Flyway Zoning Committee recommended zones within states. Finally, in 1970, the Atlantic Waterfowl Council recommended to the U.S. Fish and Wildlife Service that zoning be allowed experimentally. In 1971, Massachusetts began the first season implementing experimental zones and was assessed a 5-day penalty. Since that early beginning, 11 states in the Atlantic Flyway have initiated seasons involving 25 zones. Two states subsequently dropped zoning as a harvest management tool (Serie 1988).

Beginning in 1979, the U.S. Fish and Wildlife Service offered a three-way split season as an alternative to zoning (USDI 1988*a*). This option eliminated the costly proposals, surveys, records and reports involved with zoning, and several states found it desirable as it allowed harvest of early migrants while still retaining traditional later seasons. Southern states selected a three-way split because it allowed an increased wood duck bag limit prior to October 15. The U.S. Fish and Wildlife Service first offered a split season to eastern states in 1947. Selection of this split involved a 20 percent penalty in season length, but the penalty was reduced to 10 percent in 1953 and eliminated in 1970 (USDI 1988*a*). Special seasons in addition to and occurring outside the regular waterfowl season were first available in the mid-1960s. A special scaup season was available to Atlantic Flyway states from 1966 to 1987, and from Georgia northward, a special sea duck season is still available in offshore waters. Other special seasons are utilized to harvest "resident" Canada geese (*Branta canadensis*).

Sex-specific regulations began in the Atlantic Flyway in 1983 with the hen restriction during the special canvasback season. This type of regulation is continued today with the restriction on hen mallards. The value of this regulation is recognized, and its continued use encouraged where necessary.

Bonus bag limits allow additional birds beyond the regular bag limit. Beginning in 1979, bonus blue-winged and green-winged teal were allowed in the Atlantic Flyway. This bonus began with blue-winged teal in 1970. Although seldom selected for harvest by hunters, mergansers (*Mergus* spp.) are actually bonus birds in that they are not considered a portion of the duck bag limit. All bonus birds, with the exception of mergansers, and all special seasons, except sea duck and the September season in Florida, were eliminated in 1988. This resulted from the U.S. Fish and Wildlife Service determination that total harvest should be reduced by 25 percent from the harvest of 1987–88.

A further refinement of species management was the point system bag limit. This harvest management tool was first offered to the Atlantic, Mississippi, and Central flyways in 1973 (USDI 1988A). The impact of the point system has been difficult to assess due to the combination of other special regulations in effect with it.

Other regulations previously available to states included an option of 10 additional days in the season with the reduction of one bird in the bag limit. In short, harvest managers have utilized almost every conceivable method of regulating harvest on the presumption of equality of hunting opportunity. Additionally, the regulations varied with the annual projections of production. This annual variation in regulations has greatly reduced the ability to understand the effects of any particular harvest strategy.

Issues of Concern

One of the greatest frustrations the Atlantic Flyway continues to have relates to the lack of independent consideration it is given in the process of setting annual harvest regulations. Regulation changes recommended each year by the U.S. Fish and Wildlife Service to all four flyways are based largely on breeding population and production indices developed from spring and summer surveys conducted annually in mid-continent breeding areas. However, only a small proportion of the breeding reference area from which the Atlantic Flyway duck harvest is derived is covered by these surveys (Figure 3). Clearly, the Atlantic Flyway should be given more parity in the regulatory process, and its harvest and population management evaluated more independently of other flyways. The lack of breeding ground surveys and banding programs in the eastern continent underscores the need for a better data base from which harvest and population management strategies, more relevant to Atlantic Flyway duck populations, can be developed. Specifically, information is urgently needed for black duck, mallard, ring-necked duck, green-winged teal, wood duck, and pintail.

The North American Waterfowl Management Plan recommends that recreational duck harvests should be managed through the use of stabilized regulations, and changes should not be made unless dramatic population changes occur (USDI and CWS 1986). The Atlantic Waterfowl Council did not propose a formal recommendation on stabilized regulations. Informal discussions indicated that there was not an overwhelming opposition to this type of regulatory system. However, the Atlantic Waterfowl Council assumes that in the establishment of annual harvest regulations consideration will be given to dramatic upward population changes as well as downward changes when appropriate. For example, the breeding population of green-winged teal in 1988 was 3,143,000 (USDI 1988*b*), 46 percent above the 1955–87 average and 27 percent above the goal established in the North American Waterfowl Management Plan. This population level occurred during a period of higher (25–40 percent) basic bag limits and teal bonuses. It is evident that green-winged teal is a species that is capable of sustaining harvest levels beyond that occurring with a three-bird bag limit, yet the U.S. Fish and Wildlife Service reduced harvest opportunity by removing it from a bonus category and by reducing the total bag.

The change in shooting hours for the 1988–89 season from one-half hour before sunrise to sunrise has many ramifications that must be considered. This regulation may contribute to the following: (1) an increase in the number of shooting hour regulation violations; (2) a reduction in hunter satisfaction; (3) a change in the composition of the harvest when harvest pressure moves from species with satisfactory

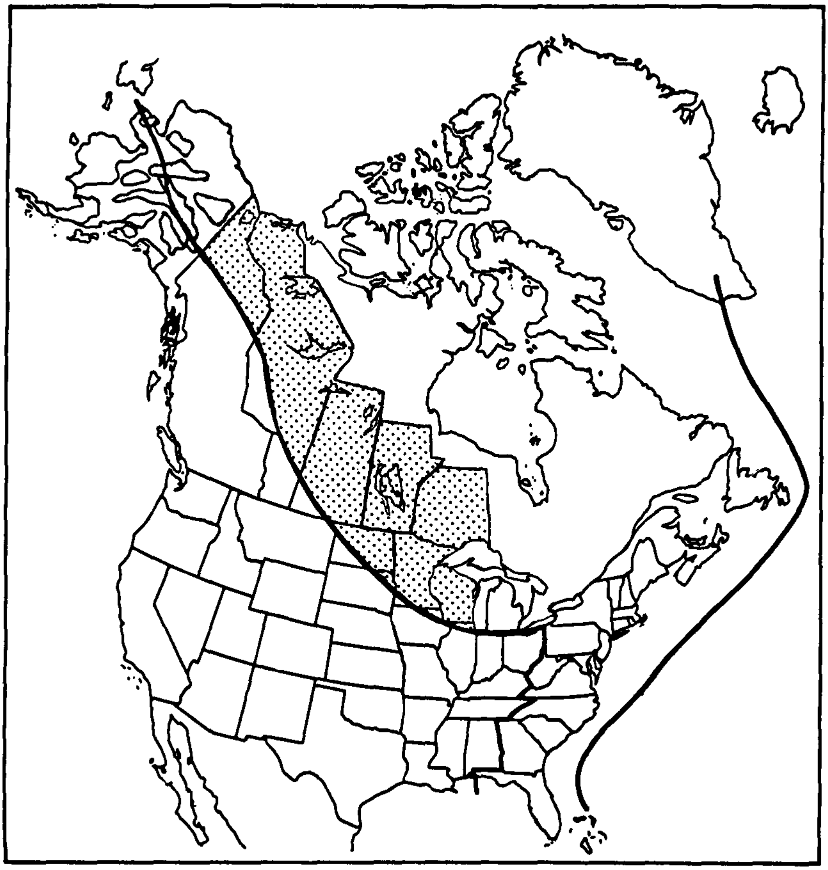

Figure 3. Area covered by U.S. Fish and Wildlife Service/Canadian Wildlife Service May waterfowl breeding population and July production surveys (shaded) in relation to breeding reference area recognized for the Atlantic Flyway (from U.S. Department of the Interior 1988b).

population levels, like the wood duck, to species that actually need more protection; (4) a reduction in the overall harvest. To quote from the *Environmental Assessment* (USDI 1977), "it was concluded that one-half hour before sunrise to sunset shooting hours had an inconsequential impact on protected species." A later federal study (Reynolds 1984) concluded that "early morning is a particularly important hunting period based on the participation and portion of the harvest which occurs then and that more restrictive shooting hours would unnecessarily deprive hunters of the opportunity to harvest waterfowl, while providing little or no additional protection for non-game species and protected waterfowl." This regulation particularly affects the Atlantic Flyway waterfowl hunter in that, as noted earlier, 30 percent of the United States wood duck harvest occurs here, and the wood duck is most active during the pre-sunrise period.

After a period of harvest restrictions on black ducks, it has been determined that the continental population has not increased, and significant harvest is still occurring in eastern Canada. Close coordination between the U.S. Fish and Wildlife Service and the Canadian Wildlife Service (CWS) concerning black duck harvest regulations is strongly encouraged.

Intensive wetland management in the Atlantic Flyway in certain regions is necessary to provide quality waterfowl habitat. Current thinking of wetland ecologists is divided between those who are strict preservationists, and those who feel certain wetland types can be manipulated and intensively managed without significant effects to a broad spectrum of species. Unfortunately, definitive answers are not currently available. In the absence of supportive data, the trend has been to not allow most wetland alterations, regardless of project purposes and potential benefits to waterfowl, other target species, and endangered species. Additional research is needed to provide a more comprehensive understanding of the structure and function of tidal fresh and brackish ecosystems. Likewise, research is needed to evaluate the effects of existing wetland management practices on these systems. We can no longer afford to underutilize existing habitat for breeding and wintering waterfowl.

In the Santee River Estuary in South Carolina, most wintering dabbling ducks use managed impoundments, and this state overwinters an average of 27 percent of all Atlantic Flyway dabbling ducks (Gordon et al. 1987). There are approximately 70,000 acres of coastal wetland impoundments under some form of management in South Carolina. An equal acreage of similar unmanaged wetland types exists largely as a remanent of the early (pre-1900) rice culture era (Tiner 1977). We must immediately intensify our management of these existing habitats and identify and prioritize the additional habitat needed to meet our goals. The resource managers, policy makers, and regulators *must* work together in order to insure that these habitat needs are met. The key word here is ''management.'' Resource managers of state, federal, and private waterfowl management areas should know the best management techniques available. These techniques should be implemented in order to maximize carrying capacity. Habitat management must be a priority over people management, particularly on lands purchased or acquired and designated as waterfowl management areas.

Future Opportunities

The future for waterfowl and waterfowl management in the Atlantic Flyway is bright. However, it depends on the correct determination of goals and objectives and sound, continuing commitment of federal, state, provincial and private interests to the implementation of programs to meet established goals. A commitment toward the future began in earnest in May 1986 with the signing of the North American Waterfowl Management Plan by the United States and Canada (USDI and CWS 1986). The overall goal of this ambitious plan is to help ensure habitat for 62 million breeding ducks and a fall flight of 100 million ducks. Wintering habitat for more than 6 million geese will also be necessary. The time period for meeting these broad goals was 15 years. Many specific goals and objectives of the North American Waterfowl Management Plan will be addressed in species and habitat joint ventures, several being important to the Atlantic Flyway.

The Atlantic Coast Joint Venture is a habitat joint venture unique to the Atlantic Flyway. Waterfowl harvest and population management is predicated on sustaining an adequate habitat base. While the quantity of habitat is important, habitat quality must also be considered. The technicians, policy makers, and regulators involved in planning and implementing the Atlantic Coast Joint Venture and other habitat joint ventures must realize that modern wetland management techniques must be learned, used and continually refined in order to meet the demands placed on wetland habitat by an increasing human population.

The Black Duck Joint Venture will involve the Atlantic and Mississippi Flyways, and will address the population status of the black duck across its entire breeding and wintering range. There is little known about the distribution and density of black duck breeding populations; surveys of breeding areas need to be developed and made operational. Preseason banding of black ducks in northern Quebec, northern Ontario, and the northeastern United states is necessary to help delineate population segments and determine harvest and survival rates. Harvest management strategies must be reviewed, and Canada and the United States must continue discussions and decide on a course of action for the future. Management of sympatric black ducks and mallards is given special emphasis.

The Atlantic Waterfowl Council independently has initiated several important programs to improve waterfowl and population management in the Atlantic Flyway. In 1986, the Atlantic Waterfowl Council charged the Technical Committee to develop a management plan for Atlantic Flyway mallards. The issue of continental declines in mallard numbers and the lack of information regarding the derivation, survival, and productivity of mallards in the Atlantic Flyway harvest prompted this action. Increased preseason banding of mallards in southern Quebec, southern Ontario and the northeastern United States is needed to determine survival and harvest rates and derivation of wintering populations. Breeding population surveys in eastern Canada are also needed. Implementation of the Black Duck Joint Venture will facilitate breeding ground surveys and banding efforts for eastern mallards as similar programs are needed for the black duck. Completion of the plan will allow formulation of habitat and harvest management strategies necessary to deal with complex population derivations. The U.S. Fish and Wildlife Service is urged to cooperate and assist in funding this important plan.

The Canada Goose Subcommittee of the Atlantic Flyway Council Technical Section has submitted a rough draft of a management plan for Canada geese in the Atlantic Flyway. The results of the studies involved in formulating this plan indicate that the U.S. Fish and Wildlife Service and certain northern Atlantic and Mississippi flyway states must cooperate in order to accomplish the objectives of this plan, particularly those objectives involving that portion of the Tennessee Valley Population that uses both flyways.

All regulatory mechanisms should be studied and evaluated carefully. The U.S. Fish and Wildlife Service is urged to consider high population levels of particular species and liberalize bag limits when possible. Liberalization is certainly in keeping with the earlier stated objective of providing the greatest amount of hunting to the largest number of people while maintaining satisfactory population levels. It is suggested that, if the goals for breeding population estimates established in the North American Waterfowl Management Plan are considered reasonable, these levels should serve as a point of derivation from the current harvest level for establishing annual bag limits. This strategy could be implemented utilizing a conventional bag, while maintaining internal restrictions on species needing protection.

The U.S. Fish and Wildlife Service, CWS, and the Atlantic Waterfowl Council, as well as the three other flyways, face major challenges in the future. It is now time to resolve any differences and move forward to face these challenges. The Atlantic Waterfowl Council supports the U.S. Fish and Wildlife Service and hereby expresses a willingness to continue to work cooperatively for the sound management of Atlantic Flyway waterfowl.

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Mississippi Flyway Perspectives and Expectations

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Introduction

The Mississippi Flyway is comprised of 14 states (Alabama, Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Ohio, Tennessee and Wisconsin) and 3 Canadian provinces (Ontario, Manitoba and Saskatchewan). A quick review of waterfowl harvest data shows that each year six to eight of the top ten waterfowl harvest states in this country are in the Mississippi Flyway and that this flyway accounts for nearly one-half of the total annual United States waterfowl harvest (Gamble 1987). Little wonder then, that the history of approaches to harvest in the Mississippi Flyway has been anything but calm.

History of Harvest Approaches

Soon after formation of the Mississippi Flyway Council in 1952 it became apparent that on matters related to regulations the members didn't always agree. Canadian members of the council began abstaining from voting when United States regulations were discussed. The 14 voting U.S. members frequently had tie votes usually due to a north-south split, with the southern states favoring more liberal regulations and the northern states taking a more conservative approach (Gamble and Hawkins 1984). Disagreement within the council reached a serious level in 1968 when the council voted for a 25-day duck season and a two-bird bag limit, and did not support continuation of the teal season. The State of Louisiana did not support the regulations and withdrew from the council in protest. Louisiana operated independently of the council from 1968 until 1975, when they were joined by the states of Alabama and Mississippi. National concern arose at this point and complaints were made that the Mississippi Flyway Council was pulling the other three councils below the professional levels they wanted to maintain. Major complaints were: (1) lack of interest by state directors, (2) no, or very little, leadership, (3) too much fighting between northern and southern states within the council, (4) no compromises for workable solutions between northern and southern states, (5) that waterfowl biologists were running the entire show and that directors could care less, (6) individual states should not pull out of the council—because that only enhances the anti-hunting and anti-guns position and (7) that three states had already withdrawn from the council and two others were contemplating withdrawal (Mississippi Flyway Council files, 1975). There indeed, existed a sad situation in the flyway in late 1975.

This controversy culminated in a meeting in St. Louis in February, 1976, to try and pull the Mississippi Flyway Council back together. Council records indicate that opinions were diverse, but that a frank and open discussion did occur and resulted in another meeting at Rockefeller Refuge in Louisiana, hosted by Louisiana, Mississippi and Alabama. The primary purpose of this meeting was to invite the three states to rejoin the council and to try and determine some method to handle regulations in order to prevent the recurrence of past problems. The meeting was a success as changes in the Mississippi Flyway Council code of Procedures were made to establish upper and lower region regulations committees, with each one sending a representative to the U.S. Fish and Wildlife Service (FWS) Regulations Committee meeting as a flyway consultant. The regulatory recommendations of these groups were to be developed separately and without discussion between groups in both the technical section and the council. All states agreed to re-enter the council, and the basic changes in operating procedures made at Rockefeller have guided council actions relative to regulations to the present time (Mississippi Flyway Council Files, 1976). The Code of Procedures was modified slightly in 1986 to provide for discussion of regulations between the two regulatory groups in both the council and the technical section.

What then were the differences in approach to harvest regulations that caused so much turmoil in the council? The more liberal southern philosophy is based primarily on the view that hunting mortality among ducks is mostly compensated through natural causes. They believe that it is very important from a habitat protection and maintenance standpoint that recreational hunting opportunities be retained at a reasonable level because it encourages a larger segment of society to keep an interest in and provide support for waterfowl conservation programs directed at wetland acquisition, enhancement and restoration. This concept has a tremendous impact on the private landowner in the South who has the capacity to manage his wetlands for ducks or for other pursuits. The southern philosophy also embraces the belief that duck harvest is regulated more by season length and framework than by daily bag limit. They consider environmental conditions, which are beyond our control, as having a much greater role than bag limits, shooting hours, zoning or splits in controlling the annual harvest of ducks. This is especially important when the effect of small changes (e.g., a change of one bird in daily bag limits) are considered on a flyway-wide basis. Finally, the southern philosophy favors seasons set toward the end of the framework to provide reasonable hunting opportunities for sportsmen at a time when huntable numbers of ducks can be expected to be present in the South (Hugh Bateman, pers. comm., 1989).

Flyway records indicate that the northern states in the flyway were criticized by both the southern states and the FWS for being too conservative on the subject of harvest regulations. Yet, according to several sources it is apparent that bag limits were the major bone of contention, especially as it related to the harvest of mallards and in the case of Alabama and Mississippi, wood ducks (Karl Bednarik, pers. comm., 1989 and Mississippi Flyway Council files, 1975). The more conservative northern approach is consistent with the southern as it relates to season length and frameworks being the primary regulators of duck harvest. Northern states, of course, favor seasons that open near the front of the framework dates. The northern states traditionally have favored slightly fewer days in the season and more restrictive bag limits for total ducks, mallards and wood ducks. There is evidence, however, that these long-standing traditions have mellowed somewhat at both ends of the flyway over the past decade.

Most Mississippi Flyway states have used zones and/or split seasons as part of their harvest regulations. Zoning is very popular with waterfowl hunters and has not been shown to increase harvest in most cases. The September teal season has also been popular in our flyway, with ten states taking advantage of this special harvest opportunity and one state having an experimental split season of five days early, aimed at increasing harvest on blue-winged teal. Twelve of the states in the flyway used the point system in lieu of the conventional bag limit until 1988.

The plight of ducks in 1985 caused a great deal of concern in the Mississippi Flyway. Strong efforts were made in both the northern and southern groups to adopt regulatory recommendations for ducks that were consistent throughout the flyway. Finally, at the council meeting in Indianapolis, Indiana, the two regulatory groups met together in executive session and agreed to support a single set of duck hunting regulation recommendations at the FWS Regulations Committee meeting. Efforts in years subsequent to 1985 have paralleled that historic action. When further harvest restrictions were called for in 1988, the council again agreed upon one basic harvest recommendation. I believe this clearly demonstrates in the area of duck harvest regulations our flyway's commitment to the long-term protection of waterfowl populations over and above regional preference.

Relationship Involving Continental Populations and Adjacent Flyways

When duck populations showed significant declines in 1985 and harvest restrictions were called for by the FWS, the Mississippi Flyway Council took the position that when these adjustments in harvest opportunity are necessary all flyways should participate to the same proportional extent as possible. We took this position because duck populations were at an all time low and because the four administrative flyways do not precisely match the migratory patterns of ducks. The flyway boundaries are in fact bio-political boundaries, and many areas in adjacent flyways share the same breeding ground source of ducks. The Mid-Continent mallard population, which we share with the Central Flyway, had continued its long-term decline and was hit especially hard by the drought in parts of the prairie pothole region. Our council opposed the additional mallard that had been allowed in the bag limit of the Low Plains portion of the Central Flyway and called for parity with the Mississippi Flyway bag limit. The western tier of states in our flyway had long recognized that regulatory disparity and could argue that they are more akin to the Central Flyway than the Mississippi. Others argued that the Mississippi Flyway already took a disproportionate part of the harvest of Mid-Continent mallards, yet did not wish to recognize that we winter three times as many mallards from this population than does the Central Flyway because of more and better wintering habitat. While differential regulations may be acceptable when duck populations are high, we felt that across-the-board cuts were necessary at that time of depressed duck populations. Our flyway consultants again opposed the extra mallard in the Low Plains portion of the Central Flyway in 1987 when the FWS Regulations Committee proposed to restore the extra bird. I doubt that our position will change as long as mallard populations continue to be below population objectives. Concurrence by the FWS with this approach has not been popular in some circles and some bruised feelings on either side of our flyway have resulted. We believe the FWS should maintain a leadership role in directing the continuity of restrictions or liberalizations of harvest opportunity in all four flyways.

Relationships with other flyways regarding other populations of waterfowl have occurred when necessary and involved primarily black ducks, canvasbacks, ring-necked ducks, snow geese and trumpeter and tundra swans. With the exception of snow geese and trumpeter and tundra swans, all interactions have been with the Atlantic Flyway. Our flyway has maintained a liaison with the Atlantic Flyway relative to the plight of black ducks for some time. Generally, we have responded to the more restrictive regulations required on black ducks in much the same manner as the Atlantic Flyway, although relatively low numbers of this species are harvested in the Mississippi Flyway.

There has been disagreement between the Atlantic and Mississippi flyways in past years relative to the point values for ring-necked ducks. The Atlantic has favored a more liberal 25-point value, while the Mississippi maintained that the 35-point value was appropriate given (1) our general lack of knowledge of the annual population status of ring-necked ducks and (2) that some long-term data indicates a decline in numbers.

The Mississippi Flyway watched the experimental season on canvasbacks in Chesapeake Bay with interest. Our hope was that this season would prove successful and that some similar type of season could be held in our flyway in areas of canvasback concentration such as Lake St. Clair and Pools 7 and 19 of the Mississippi River. Unfortunately, the population of canvasbacks dropped sharply and hunting of this species was necessarily curtailed.

Technicians from our flyway worked with their counterparts in the Central Flyway on a joint snow goose committee in the 1970s. The efforts of the committee, in cooperation with the Canadian Wildlife Service, were aimed at obtaining more and better breeding ground information to improve fall flight predictions.

Recently, the flyway has been involved in a cooperative project involving both Central and Pacific flyway states in an effort to restore a breeding population of trumpeter swans to our flyway and in the preparation of harvest management plans for tundra swan which involves all flyways.

Special Harvest Opportunities

Similar views on the issue of special harvest regulations exist up and down the flyway, but often involve different species. Wood ducks in the south and Canada geese and diving ducks in the north are excellent examples. The initiation and continuation of experimental wood duck seasons in some southern states has greatly relieved tension in the council on the issue of bag limits for this species. During the 1988 regulatory process there was solid southern support maintained for a September teal season, but a lack of support thereof in the north. The two regions might take a diametrically opposing view if the species involved was Canada geese.

While the current preference within the FWS is for simplified regulations for ducks, there is general agreement in the flyway that some special regulations are desirable and justifiable. When waterfowl populations begin to recover, special regulations will again be sought by the states for teal, scaup and other species, just as they have continued to be sought and allowed for southern wood ducks. The thrust of these requests for special duck regulations will be to harvest a greater proportion of traditionally under-harvested species in order to foster hunter and landowner interest and participation throughout the flyway. Concerns have been expressed by many states over dwindling numbers of waterfowl hunters, which has resulted in reduced dollars for operating some conservation agencies and loss of duck stamp revenues for habitat restoration work. Special regulations will be looked upon in the future, as in the past, as a way to offer additional hunting opportunity, thereby stimulating interest and participation by more people in waterfowl hunting and wetland habitat enhancement and preservation.

Special harvest opportunities will also become increasingly in demand for populations of Canada geese, primarily giants, that are associated with urban situations and with localized problems in rural areas. Conflicts between these birds and urban inhabitants will continue to increase, as will crop depredations in rural areas, causing a furor for population control that can be addressed in part by special early and late goose hunting seasons.

Management Issues of Major Concern

There is no doubt that the Mississippi Flyway is united in its belief that the major management concern facing ducks is the continuing loss and degredation of habitat. The impact of duck harvest regulations and illegal hunting on duck populations seems pale indeed when compared to the effects of drought, wetland conversion to farmland and other uses, and siltation and saltwater intrusion on coastal marshes, all of which result in lost breeding, nesting, migration or wintering habitat. Purely and simply, if we are to rebuild duck populations and maintain previous duck numbers as called for in the North American Waterfowl Management Plan (NAWMP) we must reverse the trend of dwindling wetland habitat. We currently have three major tools at hand to accomplish this. These are implementation of the NAWMP, the 1985 (soon to be 1990) farm bill and legislation in individual states that will help prevent the loss of existing wetland habitat.

The initiatives that have already occurred and are just beginning as a result of the NAWMP are exciting indeed. Step one has provided state, federal and private money to Canada where Canadian funds have been added to the pot for a total of $8 million for improving breeding and nesting habitat. Step two is underway and will again provide funds for use in Canada while also returning funds to contributing states for wetland acquisition and development in the United States. Several northern states and Region III of the FWS, under the impetus of the NAWMP, the 1985 Food Security Act and their own state programs are making unprecedented gains in the restoration of wetlands. The states in the South, some mid-latitude states and Region IV of the FWS are involved in a number of habitat initiatives as part of the Lower Mississippi Valley and Gulf Coast Joint Ventures. There is more interest, cooperation and communication related to wetland habitat now than at any time in the previous decade.

The 1985 Food Security Act offered great potential for restoring and preserving wetlands and ground cover important to nesting ducks on lands enrolled in this program. Unfortunately, Congress allowed haying and mowing on these lands due to the 1988 drought, which resulted in losses of much of the upland cover established with taxpayers' dollars. We must keep this type of legislation alive and its values to wildlife before the public if we are to maintain what we have already gained and strengthen these gains when revisions are made for the 1990 Farm Bill.

Individual states must intensify efforts to protect their remaining wetlands by enacting legislation if necessary and feasible. Model legislation is in effect in Massachusetts. We must closely scrutinize this legislation and look for application in our own states.

Another management issue of major concern is the evaluation of various regulations upon harvest. We applaud the FWS intent to review special seasons, including the September teal season, the point system, one-half hour before sunrise shooting, zones and splits and bonus bags. This action is necessary and appropriate if we are to understand more fully the effects of these regulations on harvest. Another area needing review and investigation is that of frameworks. We have restricted frameworks during this time of depressed duck populations with the full realization that his penalizes northern and southern states while not impacting mid-latitude states. Is this fair? Are frameworks that important in restricting harvest or would other measures be more effective? Answers to these questions would be useful and appreciated in all flyways.

We must be concerned about dwindling numbers of waterfowl hunters across the nation. As these numbers decrease, financial and political support for state agencies and wetland conservation also will decrease. Ways must be found to stimulate interest and participation by more people in waterfowl hunting and wetland conservation. Perhaps the continued use of special harvest regulations is a part of that stimulation process.

Other management issues of concern include more and better contact with Mexico, better control and management of waterfowl diseases and effective law enforcement. Education remains an important part of any management issue impacting waterfowl populations. Many interested citizens and some waterfowl hunters may have erroneous ideas about the cause for declining waterfowl populations. Certainly in some circles regulations and the people responsible for the regulatory process are getting more of the blame than is deserved. Credibility, integrity, honesty and character are words heard in comments and seen in articles about current waterfowl problems and those who must deal with them. This is unfortunate and counterproductive when everyone's cooperation and effort is needed to conserve wetlands and insure success of the NAWMP.

I would like to add in closing that the Mississippi Flyway Council is alive and well. Cooperation and communication are at an all time high due to the depressed status of duck populations and efforts under the NAWMP to reverse the declining trend of wetland habitats. Although we have withstood much internal turmoil, we have emerged stronger than at any other time in our existence. We must build upon that strength in both northern and southern states. Our Flyway Council has been a major force in recent years in the waterfowl regulatory process and recently in habitat initiatives under the NAWMP. This can continue only if we remain united behind the common goals of reversing the declining trend in duck populations and implementing the NAWMP. I am optimistic that the Mississippi Flyway Council will stand united and believe this bodes well for the efforts we must make in 1989 and the 1990s to restore duck populations and wetland habitat.

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Central Flyway Perspectives and Expectations

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Introduction

The Central Flyway has historically played a leadership role and been a strong partner in the management of waterfowl populations. Tremendous progress has been made over the years in understanding and protecting this shared resource and in the development of harvest strategies that strive to provide maximum recreational opportunities consistent with the welfare of the resource. The High Plains Mallard Management Unit, the Point System and the September Teal Season are three important harvest strategies based on cooperative research and well-developed rationale, such as in the ''Justification of the Central Flyway High Plains Mallard Management Unit'' (Funk et al. 1971). Management of this continent's waterfowl resources, including harvest strategies, are at a critical crossroads. The resource and the future of waterfowl hunting lie in the balance. The future will require total cooperation between all management authorities. Meaningful cooperation and significant resolution of resource issues will require an understanding and appreciation of differing viewpoints. The Central Flyway, like the other flyways, and the United States Fish and Wildlife Service (Service) has its own philosophies, concerns and expectations regarding waterfowl management and harvest. Following is a candid presentation of the Central Flyway's philosophies, concerns and expectations. It is hoped this open discussion will provide a positive foundation for future resource management decisions. Because of the drastic decline in duck populations and resulting duck harvest restrictions, geese and migratory birds other than ducks will be mentioned only briefly. The importance of this paper lies in the philosophies, concerns and expectations presented and therefore data, tables, figures and statistics will be minimal. To plan for the future, it is important not to get bogged down in a contest of whose data is better to the nth degree. Rather, let us look at the philosophies, concerns, and expectations that drive each flyway and the Service, and build a common ground of understanding. Ultimate management decisions must be guided by the best biological data base available, and no data forsaken for emotional responses or to what may appear at the time to be politically expedient.

The management and harvest philosophies of the Central Flyway have been consistent since it creation. The flyway supports sound management objectives and maximum utilization consistent with the welfare of the resource. The Central Flyway's origin was in 1947 when the Western Association of Game, Fish and Conservation Commissioners recommended management by flyways because, in the opinion of the members, it was not sound management to have the same seasons and bag limits across the United States. Parallel thinking led the Service (Bureau of Sport Fisheries and Wildlife) to divide the nation into four flyways in 1947 for the purpose of setting different hunting regulations, recognizing the great differences in hunting conditions across the country (Hawkins et al. 1984).

It is important to remember that from the start the flyways were recognized to develop regulations that could be different between regions because of the different hunting conditions. Since the end of stabilized regulations, recognition of differences in biological factors and hunting conditions between the flyways has been downgraded by the Service in its approach to current duck harvest regulations, and all flyways are receiving similar harvest regulations. The Central Flyway will continue to support harvest regulations that take into account the differences in biological parameters and hunting conditions between the flyways, thus providing maximum recreational opportunities without adversely affecting duck populations and ensuring continued support from the sportsmen for vital management programs.

Current harvest strategies must take into account recent major duck declines and the condition of the breeding grounds. The Central Flyway derives nearly all of its ducks, mallards (*Anas platyrhynchos*) in particular, from the prairie pothole region of the Dakotas, Montana, Alberta and Saskatchewan. This area has been hard hit by the drought of the 1980s and is one of the most intensively farmed areas in North America. The critical breeding habitat has deteriorated at an accelerating rate and some duck populations have reached all time low levels. The Central Flyway believes the long-term answer to this decline is preservation and restoration of habitats that provide secure nest sites to ensure adequate recruitment.

The Central Flyway recognized low duck recruitment as a major problem in the 1970s. In 1980, the Council adopted the nation's first prescriptive harvest regulations that identified response levels of differing population sizes. This was followed by development of the Central Flyway Mallard Management Plan, which was adopted in 1985. The Central Flyway strongly supports the North American Waterfowl Management Plan and has proposed development of a mid-continent mallard management plan. From such a species plan, meaningful management decisions can be developed that go to the heart of the problem: recruitment.

The Central Flyway recognizes that mid-continent populations of ducks are largely a shared resource between Canada and the Central and Mississippi flyways. However, the Central Flyway has continually emphasized in its harvest strategies and in frank discussion with the Service that due regard must be given to the *differences* in characteristics of both duck and hunter populations in these flyways.

Charles Schroeder, 1985, Central Flyway Chairman, pointed out to Assistant Secretary William Horn, the harvest between the flyways is disproportionate and any meaningful plan will have to address the areas of high harvest and where harvest has increased (Table 1).

The Central Flyway, in the 1970s acknowledged the importance of recruitment problems in declines of mid-continent ducks, and particularly mallards. The severity of the problem has since been will documented (Cowardin et al. 1985, Sargeant et al. 1984, Johnson et al. 1987). A commitment to an appropriate response to effect

Table 1. Mallard harvest/continental mallard fall flight.

	Mississippi Flyway	Central Flyway	Prairie Canada
1970–74 average	13.1	6.7	8.2
1975–83 average	17.3	6.4	7.5
Percentage change	+32	−5	−9

a long term solution to the serious decline of major duck populations through habitat preservation and restoration, and by aggressively addressing the critical recruitment problems of prairie pothole region ducks led to the development of the Central Flyway Mallard Management Plan. As stated in the introduction, "The purpose of this plan it to expedite cooperative efforts to assure that fall flights of mallards are sufficient to continue to provide satisfactory levels of recreational hunting." The plan's population objective is for a breeding population of 2.2 million mallards from those breeding areas in the Central Flyway states and a fall flight of 5 million mallards. The plan also addresses distribution objectives and harvest levels. Also realizing the limitations of the scope of the plan from the outset, it was stated, "The Council expects that Canadian provinces and other states will find these guidelines useful in planning their management programs and trusts that this plan will eventually lead to the development of a cooperative management plan designed to maintain the mid-continent mallard population." The desire to develop a mid-continent mallard plan was again reiterated in a Central Flyway Council Recommendation to the Service in July 1988.

The harvest philosophy in the Central Flyway has traditionally been based on the premise that harvest levels in the flyway are more dependent on the availability of ducks rather than on changes in harvest regulations. Analysis of Central Flyway information from the 1963–83 period indicated no meaningful association between harvests of all ducks or of mallards and season lengths or bag limits. During this period, season length varied from 30 to 90 days and bag limits from four to ten ducks, including one to five mallards. Central Flyway harvests and the supplies of ducks, as measured by the continental breeding population index, and hunter activity did however show meaningful associations (Miller et al. 1985).

The Central Flyway has from its inception believed that detailed understanding of the dynamics of waterfowl life histories is primary to regulating harvest. Similar to the Central Flyway Mallard Management Plan, the flyway has developed or assisted with the development of more than a dozen species management plans. To answer questions, understand unknowns, and validate management options, the Central Flyway has participated in numerous banding and research efforts.

Based on a sound understanding of the biology of the resource, the Central Flyway has supported increased hunting opportunities that have provided additional hunting recreation for sandhill cranes, tundra swans and snow geese. in addition, the Central Flyway continues to support those harvest strategies that have provided additional hunting opportunities for ducks, such as the High Plains Mallard Management Unit, the Point-System, September Teal Season, and zones and splits.

Central Flyway Harvest Philosophies

High Plains Mallard Management Unit

"During the duck droughts of the 1950s and 1960s, hunter numbers dwindled as low bag limits and short seasons removed some of the satisfaction associated with the sport" (Grieb et al. 1971). As a result, the Service and the flyway councils began efforts to identify populations which were underutilized and to develop management programs that would increase hunting opportunities. This approach of management was included in the Central Flyway Waterfowl Management Plan which was adopted in principle by the Service in 1958 (Buller 1972). The management unit concept was first applied to ducks in 1961 in the Columbia Basin area of the Pacific Flyway (Buller 1972).

Based on this concept and encouraged by the Service, an intensive banding program for wintering mallards was initiated in 1963 and expanded to all Central Flyway states in 1965 to identify distinct populations within the flyway that would permit utilization of surpluses when they existed. Preliminary evaluations in 1966 (Grieb et al. 1966) and during 1967 (Funk et al. 1967) indicated the existence of a distinct subpopulation of mallards in the Central Flyway, generally west of the 100th Meridian, identifiably different from those east of the 100th Meridian, thus the High Plains Mallard Management Unit was proposed to provide additional hunting opportunity on this lightly harvested mallard (drake) population. The Service first recognized the validity of the High Plains Unit in 1968 when portions of the unit were granted the opportunity to test special mallard drake-only regulations.

Results of the analysis of 8,414 band recoveries from 125,317 mallards banded during the winters of 1963 through 1969 allowed Funk et al. (1971) to arrive at the following conclusions: There was a high affinity for the High Plains by mallards winter-banded in the area; first-year recovery rates for winter-banded males and females were considered extremely low; the average survival rates for males and females winter-banded within the High Plains Unit were 75 percent and 73 percent respectively compared to 67 percent and 62 percent for males and females winter-banded in the eastern Central Flyway; and there was a much higher proportion of males than females in most states.

The Service implemented the concept of the High Plains Mallard Management Unit during the 1968–69 season by granting Montana, Wyoming, and Colorado a special late 23-day experimental mallard drake-only season. The intent was to provide additional harvest opportunity directed toward mallard drakes at a time when mallards within a state were comprised almost entirely of birds that would winter in that state and after most other mallards had departed that would winter in areas outside of the state or unit. Thus, a requirement was established that the additional hunting days had to be taken no earlier than the Saturday closest to December 10. Although the initial experimental season was 23 days, the regular season was to be reduced by 7 days in states taking the high plains season. A fixed daily bag and possession limit of four and eight mallard drakes was established. In 1969, New Mexico and parts of Nebraska and South Dakota were also offered the season, and an experimental point system of bag limits was added. Additional days have been permitted in the High Plains Mallard Management Unit through the 1988 season (20 years).

Ladd (1988a) reported the percent of the Central Flyway's harvest of mallards that occurred in the High Plains Mallard Management Unit compared to the flyway total for three time periods, 1963–69, 1970–75 and 1979–84, (28 percent, 27.6 percent and 28 percent respectively), and that the percentage had not changed significantly. The percent of the flyway's harvest of total ducks less mallards in the High Plains was also unchanged (11.7 percent, 12.7 percent and 11.9 percent, respectively). From this comparison, it can be stated that the High Plains Unit provided additional hunting opportunities without redistributing the harvest. The drought of the 1980s is similar to that of the 1950s and 1960s when the High Plains Mallard Management Unit was developed. The unit is just as *valid, needed* and *beneficial now* as it was then. Ending the High Plains Unit would serve no biological purpose, would only penalize hunters and erode support for the real issues of habitat and low recruitment.

Low Plains Mallard Management Unit

During 1979 and 1980, the Central Flyway proposed an Experimental Low Plains Mallard Management Unit. This proposal was based on an analysis of mallard band recoveries and the anticipated minimal effects of proposed harvest regulation changes.

Hyland and Gabig (1980) found through analysis of mallard band recoveries that the low plains portion of the Central Flyway should be recognized as a mallard management unit separate from the High Plains Mallard Management Unit. A specific experimental low plains hunting proposal was presented by the Central Flyway at the Service Director's Regulations Committee meeting, Washington, D.C., August, 1979 and 1980. The Service denied the Low Plains proposal in both 1979 and 1980. Then, during the standardized regulations period, the Service denied it on the grounds that it constituted a major change in regulations. The Central Flyway still feels the Low Plains Mallard Management Unit is valid and appropriate.

Point System

The Point System was developed as a result of the 1968 experimental High Plains Mallard Management Unit season. Specifically, the Point System was developed to provide a sex-specific and species-specific harvest management tool. It was hoped that such regulation would direct hunting pressure and harvest toward target species and/or sexes while protecting others. The Point System also was established to protect the hunter by allowing in-hand duck identification to prevent him from violating conventional bag restrictions and increase recreational opportunity.

The concept was first tried in the San Luis Valley, Colorado, in 1968 (Geis et al 1969). This initial test demonstrated hunting pressure could be directed toward or away from species or sexes of ducks. With a need for a broader test identified, the Central Flyway proposed an experimental Point System season for a larger part of the new High Plains Mallard Management Unit for the 1969 season. This occurred and studies indicated a strong degree of target selection for low point species (Funk et al. 1970, Hopper et al. 1975).

Later, expansion of the point system to the three eastern flyways in 1970 and 1971 suggested 90-point allocations caused shooting pressure to be reduced on hen mallards and wood ducks (Geis and Crissey 1973). For all states combined during the 12-state point system test of 1970, the rate for ducks downed per opportunity was considerably higher for 10-point and 20-point ducks (.68) than 90-point ducks (.45). The rate for mallard drakes (.60) was nearly twice that for mallard hens (.34) (Kimball et al. 1971). The sex ratio of the adult mallard harvest in 10 test states in the Central and Mississippi flyways, showed a more consistent trend in favor of drakes than in states without the Point System. for immature mallards in Central and Mississippi test states, sex ratios were higher in favor of males in 1970 than in prior years in 28 of 40 possible comparisons ($P < 0.002$) (Geis and Crissey 1973).

Comments from hunters regarding the high plains point system season based on questionnaire survey results indicated a high degree of acceptance of the Point System regulations. Less than 1 percent expressed dissatisfaction with the regulation (Funk et al. 1970). Hunting violations during the 1970 experimental hunts were minimal. During the High Plains Mallard Management Unit, the 1969–70 season had 5.17 percent of the parties violate the regulations, and reordering occurred in 1.77 percent of the parties (Funk et al. 1970). Mikula et al. (1972) reported on violations associated with the Point System. He concluded that reordering did not appear to be a serious problem, that few parties had been detected reordering and these did not override the benefits of the Point System.

There is ample evidence that the Point System can direct hunting pressure and harvest toward specific species and sexes while protecting other species and sexes. The system provides additional recreational opportunity and aids in protecting the hunter from inadvertent violations of restrictive conventional bag limits. The Point system is a win-win system for the resource, the hunter and management agencies. The System's most cited negative component, reordering, is largely a perceived one on the part of some enforcement personnel administrators. And although the magnitude of reordering is largely unknown, it can be stated that not all hunters reorder or perhaps more importantly, premeditate to reorder, thereby affecting some level of redirection of harvest. Many of the problems associated with the Point System and its enforcement are also inherent with current restrictive conventional bag limits. To deny the use of a proven species and sex-specific management practice and the additional hunting opportunity it provides based on an undocumented enforcement problem is unjustified.

Recent attention has been placed on the work of Rexstad and Anderson (1988) as one basis for questioning the value of the Point System. Rexstad and Anderson (1987), in response to a request to clarify their statements concerning effectiveness of the Point System with respect to redistribution of mallard harvest, on September 4, 1987, wrote Galen Buterbaugh, Member of the Service Regulations Committee, ''The comments made at the Service Regulations Committee meeting were based on the revised manuscript, which omits our cautionary advice. Our results state that drake and hen direct recovery rates did not change significantly after the initiation of the Point System, while the difference between drake and hen direct recovery rates did increase significantly. The analysis of the point system effectiveness is a fuzzy issue; *our analysis is not the definitive resolution to these questions* [emphasis added].'' To use this study as the definitive answer is questionable. There are many concerns that must also be addressed before we abandon the Point System. It is most interesting to note that the Service's own SEIS 88 on hunting described the point system as an ''alternative to the conventional daily bag limit for ducks . . . a refinement of species-oriented management,'' that it ''offers benefits through increased hunter opportunity and satisfaction . . . it may be the optimum system for providing hunter opportunity.''

September Teal Season

Initiated in 1965 in 20 states in the Central and Mississippi flyways, a nine-day September Teal Season was conducted on an experimental basis through 1967. This unique harvest strategy was originally developed to provide additional harvest opportunity on early migrating blue-winged teal (*Anas discors*), a lightly utilized species. The September Teal Season proved to be highly popular with hunters and successful in providing additional recreational opportunity and harvest during a period when the mallard population was depressed and mallard bag limits severely restricted.

Because of concerns over the illegal harvest of nontarget species, the season was not offered in 1968. By restricting participation to nonproduction states, which generally do not have large numbers of other duck species present during September, the concerns about illegal harvest were addressed. The season was again offered in 1969 and was operational for 19 years.

In 1988, the September Teal Season was suspended by the Service. Severe drought conditions on the prairie breeding grounds, a declining breeding population and anticipated poor production were reasons cited to suspend the season. Additionally, the Service reiterated that the September Teal Season was considered a special season and was originally instituted to provide additional hunting opportunity. Because of the currently depressed and declining status of blue-winged teal, the Service did not believe that a special harvest opportunity was warranted. Unfortunately, there is no definitive data available that indicates the relationship of September teal harvests to the declining status of the blue-winged teal population.

Employing less stringent restrictions short of a closed season, such as reduced season length and/or bag limits or restrictions on the timing of the season in order to target adult males are options that could be used to modify harvest and provide additional protection, while still affording some level of September hunting opportunity.

Blue-winged teal migrate early in the fall and for the most part are not subject to the level of hunting pressure that other later migrants incur, as evidenced by their extremely low band recovery rates (Geis et al. 1963, Martinson 1965, Sorensen 1966, Lobdell et al. 1968). Another index to harvest can be computed by dividing the estimated annual U.S. harvest of blue-winged teal by the estimated continental blue-winged teal breeding population. Comparison of these values with those of a heavily harvested species, such as the mallard also indicate that blue-winged teal are only lightly utilized. From this premise, it can be assumed there is no evidence that blue-winged teal harvest is negatively affecting the population. The complete loss of the September Teal Season, especially in mid-latitude states where the September harvest constitutes the great majority of the opportunity and harvest of blue-winged teal, constitutes an important loss of hunting opportunity and is largely unjustified. The Central Flyway supports reinstatement of the September Teal Season to a cooperatively agreed upon harvest level deemed appropriate to current population status.

Framework Dates

Framework dates are established each year by the Service within which the states may select their seasons. States have traditionally attempted to match their seasons to the periods of expected high duck availability. Adjustment of framework dates has an impact on harvest. It is most pronounced in the northern states where early freeze up reduces duck numbers and in southern states where birds are present in significant numbers at the end of the season. Adjustment of framework dates, hence adjustment of hunting dates, can shift harvest from one species to another and from locally reared birds to migrants. However, framework dates should be used to set a time period during which it is biologically sound to allow harvest.

Floating framework dates, opening the Saturday closet to October 1 and closing the Sunday closet to January 20 provide the maximum framework period possible while opening on a Saturday and closing on Sunday, thus accommodating weekend hunting and providing maximum hunting opportunity.

Frameworks should be left as they were prior to 1985. Adjustment to harvest can be better made by using other harvest strategies more equitable to all states.

Zones And Splits

The Central Flyway proposed zoning in 1980 as a state option. The objective was to provide additional hunting opportunities within regional areas without significantly changing the statewide harvest or redistribution of harvest between states. Data collected during the experimental implementation phase beginning in 1981 paralleled the period of decline in waterfowl populations. The average mallard breeding population, 1981–85, declined 22 percent from the 1976–80 average, and mallard harvest in the Central Flyway declined 23 percent, thus complicating evaluation. Analysis of states utilizing zones (Nebraska, Wyoming, Montana, South Dakota, New Mexico and Oklahoma) showed no significant changes in the proportion of total duck harvest and total mallards by a specific state (Ladd 1988*b*). The State of Colorado elected use of the three-way split in lieu of zoning, Kansas switched to a three-way split after one year of zoning, Texas retained the traditional split season and North Dakota has employed neither zones or splits. While there may be questions about the total overall effect on harvest of states zoning or splitting the duck season, there is no doubt that zones and splits allow the distribution of hunting opportunity to as many hunters as possible. This is extremely important to maintaining hunter support. The zoning and season splitting options should not be terminated. Rather than abolishing zones and splits because of the unknown impacts on harvest, studies, if even needed, should be initiated to determine those impacts. At that time, harvest reductions or increases could be facilitated.

The current situation in which some states are allowed to zone, while others are barred from either option is unfair and intolerable. This should be corrected immediately. Fair, logical and uniform criteria should be established and enforced, and any state which meets these criteria should be allowed to zone or double split its duck season.

Central Flyway Concerns

The Central Flyway and its member states are greatly concerned over the broad-brush approach that the Service has taken in setting waterfowl regulations since the end of the stabilized period. This approach seems not to take into account harvest rates, hunting pressure and distributional differences of specific populations. Hunters are beginning to question the value of participating and support for management is eroding. Exception must also be taken to the message being sent to the public that hunters are responsible for the decline in ducks. Further, there is an implication that in order for ducks to come back, duck hunting needs to be strongly curtailed and that is wrong. The future of duck populations is dependent on maintaining hunting opportunity and hunter support for our management programs. The emphasis has been misplaced and needs to be redirected to habitat loss and its restoration.

Harvest restrictions instituted by the Service in 1985 were designed to reduce harvest 25 percent across the board from 1979–84 levels in order to reduce pressure on declining duck populations, particularly mallards. In the process, the recognition of the differences between the two interior flyways in the potential to harvest mid-continent ducks was ignored. More specifically, the differential in the mallard drake bag limit that reflected the Central Flyway's characteristics of lower mallard harvest rates, lower absolute harvest, lower hunter numbers, smaller proportion of hen mallards in the harvest and high drake to hen ratios in wintering populations were disregarded when the mallard drake bag limits were made equal for the two flyways.

Elimination of floating frameworks and framework compression has created hardships on northern prairie states. Harvest for North Dakota and South Dakota were down 42 percent and 47 percent respectively for all species between 1984 and 1985. The elimination of half hour before sunrise shooting is unjustified, based on the Service's own SEIS 88 on hunting. The increased harvest restrictions on important species, such as green-winged teal (*Anas creca*), wigeon (*Anas americana*) and gadwall (*Anas strepera*) in 1988 unduly penalized the sportsmen's opportunity to harvest these species that are above the long term breeding population average.

It is the feeling of the Central Flyway that the flyway had to operate in the shadow of the Mississippi Flyway through 1965 until implementation of the High Plains Mallard Management Unit and implementation of differences in mallard bag limits, etc. The Central Flyway feels we are again being wrongfully cast into the shadow of the Mississippi Flyway by reconsideration of the High Plains Mallard Management Unit and establishment of identical mallard drake bag limits.

It appears that a completely different approach to the drought of the 1980s has been taken than with the drought of the 1950s and 1960s, when the Service and the flyways actively looked for ways to enhance hunting opportunities of those species and/or sexes available. In the earlier period, innovative answers were developed, such as the High Plains Mallard Management Unit and the Point System. Now, time tested and proven ideas are being abandoned and there has been serious erosion of the partnership between the flyways and the Service.

Central Flyway Expectations

There needs to be a recognition that the flyways were set up to provide different harvest strategies, based on the unique biological and harvest characteristics of each flyway. There does not have to be identical treatment of each flyway. There needs to be a return to a stronger partnership between the Service and the flyways.

Equity of harvest opportunity of such shared resources as the mid-continent population of mallards must be addressed. Presently, the Mississippi Flyway harvests three times the mallards that the Central Flyway harvests. The Mississippi Flyway also harvests three times the total ducks and has a higher mallard hen harvest rate. The Central Flyway should not be prevented reasonable harvest opportunity because of high harvest rates in the Mississippi Flyway. There needs to be a fair allocation of these shared resources.

The Point System, the half-hour before sunrise shooting time, and full floating frameworks should be restored to maximize opportunity. Attention needs to be placed on recruitment of new hunters and retention of old hunters. There needs to be a recognition of the vital role hunters have played in habitat restoration and an ending of the conjecture that hunters are the cause of the recent decline in duck populations.

The Service needs to address resource allocations, determine when hunting is not longer compensatory and becomes additive, and obtain information on mallard sex ratios to define what constitutes an excess percentage of drakes. Future harvest regulations and management programs must be set on the best data available, not the most expedient way.

There are needs for development of species-specific management plans, such as a Mid-Continent Mallard Management Plan. Such plans can identify the management and harvest strategies for the 1990s. It is hoped the Service will become active in these areas. There needs to be strong support of current plans like the North American Waterfowl Management Plan with dollars and manpower.

The Central Flyway will continue to support strong species management that protects the resource while providing maximum hunting opportunity. Every effort will be made to support the tradition of waterfowl hunting and the hunters who are crucial to the success of the North American Waterfowl Management Plan. The Central Flyway will support restoration, protection of breeding habitat and increased duck recruitment as the cornerstone of future duck populations and not undue reliance on harvest restrictions. The Central Flyway looks forward to working with the Service and the other flyways to meet the challenges of the future as a full partner in a true cooperative spirit.

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Pacific Flyway Perspectives and Expectations

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Introduction

The harvest management of North America's waterfowl resource has historically been a topic of great interest and sometimes heated debate among and between waterfowl managers and waterfowl hunters. While the fervor of the debate has been cyclical over time, current waterfowl population conditions and circumstances, have recently surged interest to the forefront.

Over the past three years (1986–88), and particularly in 1988, the subject of duck harvest management has been of special concern to all persons involved with waterfowl, including state and federal agency policymakers, administrators and biologists, duck hunters and duck hunting organizations, conservation organizations and duck habitat owners. This heightened level of concern is as evident in the Pacific Flyway as in the other flyways across the United States, and is primarily in response to the current low levels of some populations of ducks that are particularly important in the sport hunting bag, most notably the mallard (*anas platyrhynchos*) and the northern pintail (*a. acuta*).

The purpose of this paper is to present an overview of duck harvest management in the Pacific Flyway and to identify some of the specific questions and needs for future harvest management strategies in the flyway.

The Pacific Flyway and North American Duck Populations

The Pacific Flyway is unique in many respects, including the tremendous land area and geologic and climatic diversity encompassed within the flyway. A substantial part of the flyway has the lowest human population density in the United States, while the State of California has the greatest human population of any state and, in fact, has a population about equal to that of the entire country of Canada. The states consituting the Pacific Flyway are all large and very diverse with substantial temperature and elevational differences within state borders.

In its current construction, the Pacific Flyway includes, in their entirety, the states of Alaska, Washington, Oregon, California, Arizona, Nevada, Idaho and Utah, and those portions of the states of Montana, Wyoming, Colorado and New Mexico west of the Continental Divide.

While Alaska has long been included in the flyway, this state should necessarily be treated separately from the remainder of the flyway because it is uniquely situated. Even though many of the waterfowl produced in Alaska migrate through the Pacific Flyway, there are populations of waterfowl from Alaska which use other flyways. Alaska's environmental conditions, especially in terms of the timing of waterfowl movement, when combined with social considerations such as very low human population density and subsistence hunting, warrant a different approach to waterfowl management and regulations than those employed in the other states of the flyway.

During the 27-year period from 1961 to 1987, the Pacific Flyway duck harvest ranged from a low of 1.9 million to a high of 4.4 million and averaged about 3.15 million (USDI 1988). The Pacific Flyway duck harvest is only exceeded by that of the Mississippi Flyway and therefore this flyway is a substantial contributor to the total North American duck harvest.

The five most important species in the harvest and the average percent composition of the total harvest over the 1961–87 period are: mallard 35 percent; northern pintail 19.4 percent; green-winged teal (*a. carolinensis*) 14.3 percent; American widgeon (*Mareca americana*) 11.4 percent; northern shoveler (*spatula clypeata*) 6.0 percent.

During the 1981–85 period, the Pacific Flyway accounted for approximately 27 percent of the total U.S. mallard harvest and 55 percent of the pintail harvest. Northern pintails are a very important species in this flyway, and in some years, account for over 70 percent of the total U.S. harvest of this species.

While there is suspected strong integrity in terms of duck migration affinity for this flyway, mainly because the Rocky Mountains form the eastern boundary of the flyway, the origin of various species of ducks to the fall flight is not well defined. Correlation analysis of breeding duck populations and flyway harvest indicate that Saskatchewan and southern Alberta are important contributors of ducks to the Pacific Flyway fall flight (Bartonek 1981). British Columbia, the Yukon and Alaska are also suspected of being important contributors, especially for mallards, but because large portions of these areas are not included in the standardized breeding population surveys, data are too limited at present to confirm this speculation.

While northern pintails, especially from Saskatchewan and Alberta, and western Canadian produced mallards seem to have a strong affinity for this flyway, present data are not definitive, making difficult any firm determination about the potential impact of inimical factors on ducks in this flyway to the contribution of ducks in other flyways. The consensus of waterfowl biologists in the flyway is that, to the degree that harvest rates influence subsequent population levels, the harvest in this flyway has little influence on waterfowl populations in other flyways.

Harvest Approaches in the Pacific Flyway

Season length and bag limits for ducks have generally been more liberal in the Pacific Flyway than they have for the other flyways. However, over the history of Pacific Flyway harvest management there has been substantial variation, almost on an annual basis, in season lengths and bag limits. Season lengths have ranged from 107 days early in this century to a low of 30 days in the drought years of the 1930s. Season lengths began to stabilize in 1957 and seasons varied between 86 and 95 days for the period of 1957–69. In 1970, seasons were set at 93 days and remained there for 15 years until 1984.

Bag limits have exhibited the greatest variability of all regulatory elements until standardized seasons and bag limits were implemented in 1975. From the 1950s to the present, bag limits have ranged from 4 and 8 to 7 and 14. In seven years of the decade of the 1950s there were bonus limits of pintail and widgeon, but these were discontinued in 1959 and only tried once again, for pintail in 1974.

Shooting hours have basically been either sunrise to sunset in the 1950s and early 60s or one-half hour before sunrise to sunset for the period 1962 through 1987.

The significant degree of variability in season length, bag limits and shooting hours has made it very difficult to accurately assess the value of various harvest strategies for duck harvest and population management. Additionally, the consistent changes in regulations have been felt to be troublesome for hunters (Bartonek 1981).

For these reasons the Pacific Flyway Study Committee recommended, and the Flyway Council accepted, a proposal to adopt a standardized season and bag limit framework to run for five years with a concomitant evaluation as to its effect on waterfowl populations. This proposal was accepted by the Fish and Wildlife Service and implemented in 1975 and consisted of a season length of 93 days, not to open earlier than the Saturday closest to October 1 and to close not later than the Sunday closest to January 20. Seasons could be split into two equal or unequal periods. Shooting hours were set at one-half hour before sunrise to sunset and bag and possession limits were 7 and 14 respectively, with no more than two redheads or two canvasbacks or one of each daily and no more than four singly or in the aggregate in possession. This basic standard season was in effect in the flyway from 1975 through 1984.

A subcommittee of the Pacific Flyway Study Committee analyzed the stabilized regulations for the five-year period of 1975–79 (Bartonek et al. 1980). This analysis found that annual regulations had less effect on duck harvest than did the number of hunters, and that, through 1979, both the stabilized and annual regulations had had no apparent adverse impact on duck populations. This period of stabilized regulations however, corresponded with a time of relatively high duck numbers. The evaluation also found that state wildlife commissions and administrators, law enforcement officers, duck managers, and hunters favored standardized regulations. The authors, therefore recommended to the Flyway Council, a continuation of stabilized regulations for another five-year period.

At the end of the second period of stabilized regulations in 1984, a subcommittee of the Study Committee again evaluated the effect of stabilized regulations over the 10 year period of 1975–84. This analysis concluded that the existing data was insufficient to address all of the concerns regarding the relationship between duck population status and harvest in the flyway. The analysis was particularly frustrated by insufficient data concerning the origin of ducks using the flyway and the status of duck breeding populations, particularly mallards, in unsurveyed areas such as British Columbia and the Intermountain West.

Even after 10 years of stabilized duck harvest regulations, Pacific Flyway waterfowl managers have been frustrated by substantial data gaps in attempting to arrive at definitive conclusions about the relationship between duck population status and duck harvest and the real influence of harvest on subsequent duck population levels. The only definitive conclusion reached from this effort is that those involved with duck management and duck hunting liked the simplicity resulting from stabilized regulations.

With the persistent drought in the prairie region of Canada and the resultant declining duck populations, annual regulations were reinstated in 1985. from 1985–87 season length was reduced to 79 days and bag limits were dropped to 5 and 10. Not only were general limits reduced, but further restrictions were put on mallards and pintails, including the take of no more than one female mallard and pintail per day. As the population status of ducks continued to worsen, the most stringent regulations since 1950 for season length and since 1947 for limits were initiated in 1988.

Special Harvest Opportunities

Because the Pacific Flyway has traditionally had more liberal seasons and bag limits than the other flyways there has been less incentive for promoting special harvest opportunities, such as early teal or special scaup seasons. Nor has there been any strong interest in exploring point system bag limits. The only special opportunities which have been utilized in the flyway are the establishment of the Columbia Basin Mallard Management Unit and limited use of zoning and split seasons.

Due to the size of the states in the Pacific Flyway and the extreme elevational and resultant climatic variability within states, split seasons and zoning are important mechanisms in the flyway. As succinctly stated in a recent Pacific Flyway Study Committee evaluation of split seasons and zones (Smith 1989). "The northern border of California is approximately the same latitude as Des Moines, Iowa, while the southern border is approximately the same latitude as central Louisiana. Thus frameworks that did not allow zones or splits would be equivalent to requiring that Louisiana adopt season dates selected by Iowa." Similar circumstances exist in most states in the Pacific Flyway with respect to elevational and latitudinal changes and the resultant effect on duck migration.

Presently in the Pacific Flyway, the states of Alaska, Washington, Oregon, Idaho, California and Nevada employ zones. In addition to zones, split seasons have variously been used by several states in the flyway. The Pacific Flyway Study Committee evaluation of splits and zones (Smith 1989) concluded that while one would logically assume that split seasons and zones would result in increased harvest, there is currently no clear evidence to support such an assumption. The resultant position of the study committee has been that existing zones should be retained with a continuation of a moratorium on new zones and retention of the option of splitting the season into two parts. While the Pacific Flyway Council has not yet acted on these recommendations, the long-standing position of the Council (1955, reaffirmed in 1980) is that there be no new zoning for duck hunting as long as the season is more than 55 days in length.

The only true special harvest opportunity which has been utilized for ducks in the Pacific Flyway is the Columbia Basin Mallard Management Unit. While this unit at one time included all of eastern Washington, most of northeastern Oregon, and nearly one-half of Idaho, the area was reduced in 1985 to include only eastern Washington and a smaller portion of northeastern Oregon. Currently the only difference in regulations between this unit and the remainder of the flyway is an additional seven days in season length. A subcommittee of the flyway study committee performed an in-depth evaluation of harvest and duck populations in this unit (Kraege et al. 1989) and concluded that the Columbia Basin Mallard Management Unit should continue as a management tool in the Pacific Flyway duck season framework, as the extended season in the unit is having no deleterious impacts on the affected duck populations.

Recently waterfowl hunters and the Department of Fish and Game have proposed more liberal seasons and limits for mallards in California. This proposal is based on the premise that most of the mallards harvested in California are locally produced and the local populations are healthy. While this proposal merits serious consideration, the data base to support this proposal is not yet conclusive and needs to be firmed up to support such an action.

Management Issues of Major Concern

Waterfowl Habitat Preservation and Enhancement

Continued healthy populations of waterfowl are linked directly to the quantity and quality of habitat available. Habitat loss for ducks and other waterfowl and wetland-associated wildlife is a continuing problem in the Pacific Flyway, and is particularly acute in California, western Nevada and western Utah. Throughout the flyway, agricultural and urban development and associated water demands are causing continued wetland loss.

Of major concern in the renewed efforts to preserve, enhance and restore wetlands as delineated in the North American Waterfowl Management Plan is the continuing decline in hunters. Waterfowl hunters have traditionally been the backbone of support for the acquisition and maintenance of waterfowl habitat, but during the period of 1970–86 Federal duck stamp sales in the Pacific Flyway have declined 39 percent. This trend has undoubtedly been exacerbated by the substantial decrease in duck hunting opportunity available in 1988. The situation is troublesome since declining hunter participation may well result in declining incentives to preserve and restore habitat, which further reduces opportunity and participation.

While there are a number of other factors involved in the decline of hunter participation, it remains a major challenge for wildlife managers and administrators and waterfowl interest groups. On the bright side, there seems to be, stimulated by the current plight of ducks, a renewed national vigor to save and enhance wetlands, using the North american Waterfowl Management Plan as the primary vehicle to help achieve the necessary habitat preservation and restoration. In the Pacific Flyway, as in the other flyways, *habitat* is the bottom line.

Prescriptive Stabilized Regulations

With the past experience of 10 years of stabilized regulations, the Pacific Flyway Council is favorably disposed to the adoption of a set of prescriptive standardized regulations. Criteria need to be developed for such regulations which would trigger a specific set of standardized regulations at various duck population levels. For example, when breeding populations of the major duck species in the Pacific Flyway harvest are at goal levels for North America, as specified in the North American Waterfowl Management Plan, 93-day seasons (100 in Columbia Basin Management Unit) and 7 and 14 bag limits would be in effect. If breeding populations of mallards and/or pintails were below goal levels at some predetermined threshold, an overall limit reduction would occur, while at some other predetermined population level, both season length and bag limits would decrease. Threshold levels would need to be determined for all major species below which, species restrictions would apply.

Such standardized regulations would be applied for duck populations at low, medium and high breeding population levels. Such prescriptive duck regulations would be tailored to address the needs of species in decline as well as those in abundance. The major hurdle to implementing a prescriptive regulatory system is one of insufficient data regarding the contribution from unsurveyed duck production areas within the flyway and especially a definitive evaluation of the impact of harvest on succeeding years' breeding populations. This information must be gathered and assessed before such a prescriptive harvest management strategy can be implemented.

Duck Population Assessment Data Needs

As presented earlier, the best efforts of the flyway study committee to evaluate the effect of the stabilized regulations has been frustrated by a void in data, especially relative to the contribution of certain breeding areas of certain species of ducks to the flyway. This is especially true for mallards, pintails and green-winged teal. In order to hope to get to the level of harvest management sophistication which appears necessary to really manage duck harvest and ensure that harvest is not additive mortality, better data must be gathered.

The respective states, provinces, U.S. Fish and Wildlife Service and the Canadian Wildlife Service must be encouraged to make a collective decision to move forward quickly to add unsurveyed areas to the breeding population surveys. Either this commitment must occur, or we shall be forced to continue on the current trend of "best judgement" management. With North American duck populations at a crossroads, we cannot afford this kind of harvest management with its attendant erosion of the hunter support base.

The State of California, the critical state in terms of waterfowl winter habitat in the Pacific Flyway, has warned of a possible substantial decline in duck winter habitat as the result of restrictive regulations. The rationale employed is that much of the important winter duck habitat in California is on private lands, and the use of these lands is dictated by economic return, and therefore, if hunters are not willing to pay for this habitat, then it will be dewatered or put to some other use with greater economic return.

The state, in concert with the U.S. Fish and Wildlife Service and the private waterfowl interest groups in California, needs to make an effort to further document and quantify this speculated loss of habitat. If such loss is of a significant magnitude, then this habitat loss must be compared with restrictive regulations to determine the relative significance of each in affecting the size of spring breeding populations.

Regulatory Process for Establishment of Waterfowl Seasons

The processes used to establish harvest management programs for wildlife on an annual basis are inherently difficult. This is because the population biology of the species drives the process, and with some species, such as ducks, the best population status cannot be determined until mid-summer. Due to administrative procedures,this places a very tight time line on the completion of annual regulations. Such is certainly the case for the waterfowl regulatory process employed by the Fish and Wildlife Service in the United States. With 50 states "holding fire' to get final frameworks before they can establish the seasons, this process is particularly complex. In order to use the most updated population information available, provide the states and the public the opportunity for comment, and to get regulations printed and distributed to the public prior to the season, there is little opportunity for change in the current system.

If, however, we had a more definitive data base on waterfowl population breeding areas in drought as well as normal years, and if we knew more specifically the derivation of birds to flyways or portions of flyways, and if we had a definitive knowledge of harvest impacts on duck populations at different levels, we might be in a position to employ the standardized prescriptive type of regulations discussed previously.

Employing this detailed knowledge and adding to the equation habitat condition projections from the May habitat surveys, it might be possible to put in place one of the prescriptive regulations formats at a date earlier than is now possible. Such a system should be given consideration for the future.

In addition to the tight time frames mentioned above, and the very real need for greater knowledge about the duck resource and harvest impacts, some people have been concerned by the way the process has been handled in the past. If we, the Fish and Wildlife Service and the states (as represented by the flyways), are truly to be partners in waterfowl management, then some slight modification needs to be made to the regulation process.

Upon conclusion of the early August public hearing, and the development of the proposed frameworks by the Service Regulation Committee, the representatives of the four flyway councils should be asked to reconvene with the Regulation Committee to discuss the proposed frameworks and the rationale for same. At this meeting, the flyway representatives should be afforded one final opportunity to put forth arguments relative to proposed regulations. While the ultimate authority and responsibility of the Director of the Fish and Wildlife Service for setting migratory bird regulations is recognized, if this format were used, the flyway representatives would at least have an understanding of the rationale which could then be more accurately imparted to the other flyway members when the final frameworks are issued.

Conclusion

Unlike the dramatic success story of North American wildlife management with some species like white-tailed deer, elk, pronghorn antelope and wild turkey, we will never see population levels of ducks like those of 100 years ago. There has been too much irreplaceable loss of waterfowl habitat. However, with a unified and concerted effort, the duck population goals specified in the North American Waterfowl Management Plan are achievable, and at those levels there would be sufficient waterfowl to provide substantial recreational hunting opportunity and to provide fully for other, nonconsumptive uses of this resource.

While I have called for increased emphasis on data collection to allow for a higher degree of refinement in duck harvest management, such action will certainly come at a cost. The salient question is what will this cost be and will the benefits justify the cost, or would this expenditure be better placed on waterfowl habitat? I cannot answer this question now, but there certainly is a need to refine duck harvest strategies. If duck harvest management serves to be such a point of contention that it detracts from the critical job of habitat preservation, enhancement and restoration, then it may be incumbent upon us to acquire the knowledge necessary to answer the remaining questions about duck harvest management.

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Review of Data Bases for Managing Duck Harvests

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Regulating the duck harvest among countries, states, provinces, and among zones within states and provinces is, perhaps, the most complex allocation of a renewable resource in North America. Several sources of information are used in making decisions relative to the regulation of this harvest. These information sources include data on duck populations, duck reproduction, harvests, and habitat. The purpose of this paper is to review these sources of information, including their history and current use, and identify their limitations. In addition, we will mention existing, cooperative efforts to address problems and make improvements in information gathering and interpretation.

Breeding Ground Surveys

Breeding ground surveys of ducks were first initiated on a limited scale in 1947 (Martin et al. 1979). By 1955, these surveys were expanded and refined to become an operational program designed to monitor numbers of ducks using the continent's major duck breeding areas. Currently, this survey samples over 3.3 million km^2 (1.3 million square miles) of duck breeding habitat in Canada and the United States. Fixed-winged, single-engined aircraft are used in gathering this information. This program is truly a cooperative effort, involving the annual participation of biologists from the U.S. Fish and Wildlife Service (FWS), the Canadian Wildlife Service (CWS), and various state and provincial agencies.

Each May, 71,000 km (44,200 miles) of transects are flown across the northcentral U.S., western and northern Canada, and Alaska (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1987). Currently, the FWS has eight flyway biologists and eight aircraft dedicated to this work. A subsample of these aerial transects is taken on the ground to correct for ducks present but not observed by the aerial crews. These ground counts include as many as 94 air/ground comparisons in a given year and are coordinated by FWS personnel in the northcentral states and by CWS biologists in Canada. Visibility corrections are then applied to counts from the air for estimating numbers of ducks by species in the surveyed areas. In July, a smaller sample of transects (49,400 km; 30,700 miles) is flown to obtain information on duck production. Because of problems associated with censusing duck broods from the ground, these counts from aircraft are not corrected for visibility, and broods are not identified to species. This yields an index to annual production of ducks in the surveyed areas.

This breeding ground survey has been formally reviewed on two occasions by statisticians from outside the FWS. These reviews have focused on survey design and efficiency, as well as specific statistical problems encountered. Limitations of the survey program are of two types: (1) methodological and (2) design. Within the first category, most criticism has centered on questionable visibility corrections for certain species and certain areas where ground observations are difficult or impossible to obtain. A perennial problem is determining the proper timing of the survey at each latitude. Poorly timed transects can find ducks flocked rather than dispersed for nesting. Design problems include the geographical limits of the transects and the lack of quantitative information on duck populations outside the surveyed area.

The following are examples of ongoing or proposed activities to improve cooperative breeding ground surveys:

1. Improving standard operating procedures.

- The visibility of ducks from the air depends on many factors, all of which combine to produce for some species visibility corrections which can vary considerably from area to area and year to year. New procedures to address such cases are currently under review for prairie and parkland breeding areas.
- Additional air-ground comparisons have been incorporated into the design in areas such as northern Alberta. This should provide a better measure of duck numbers in an area that has become increasingly important to ducks.
- In northern, boreal forest regions, where inaccessibility prohibits counts at ground level, long-term average visibility rates determined for areas to the south of this region have been used to adjust aerial counts. In 1985, the FWS in Alaska initiated preliminary tests to assess the use of helicopters in boreal forest portions of that state to record ducks not observed from fixed-wing aircraft. This helicopter comparison to correct for visibility was extended to the Northwest Territories and northern portions of Alberta, Saskatchewan and Manitoba in 1986. Preliminary results suggest that this approach to visibility correction has promise; however, the cost of helicopters may limit their future use for this purpose.
- Some state breeding ground survey programs, such as those in Minnesota and Wisconsin, have undergone extensive review in recent years to improve statistical designs and standard operating procedures. These areas, although outside the traditional FWS-CWS surveyed area, provide important information on duck numbers annually.

2. Counting ducks outside the operational survey boundaries.

Interest in duck populations outside the current operational strata has increased in recent years. As prairie habitats have supported fewer ducks, the relative importance of duck populations in these unsurveyed areas has increased.

- In the Pacific Flyway, discussions were held in 1988 to develop a standardized means of measuring duck populations in each state. Wetland habitat inventory data and existing duck density information will be used to define sampling strata. Future surveys should establish a flyway-wide data base and yield important measures of breeding duck population trends within that flyway.
- In the Atlantic Flyway, a new survey to monitor breeding waterfowl numbers in the northeastern U.S. (north of and including Virginia) was tested on a limited

basis in 1988, using ground counts on random plots apportioned to physiographic strata and states within the region. Fixed-wing aircraft surveys have also been used on a trial basis in some areas.

- In eastern Canada, various survey initiatives have been developed and tested over the last four years, including helicopter counts on randomly located plots, to monitor numbers of black ducks (*Anas rubripes*), mallards (*Anas platyrhynchos*), and other species found in this region. Preliminary discussions have been held to develop a comprehensive, statistically designed survey effort extending from central Ontario to the Maritimes and including some states in the U.S.
- In southern and central British Columbia, the CWS is obtaining data on numbers of breeding ducks using ground counts on selected areas. Initiated in 1987, this effort should provide useful information on population trends in the region. In addition, helicopter surveys will be initiated in 1989 to assess waterfowl numbers in previously unsurveyed boreal forest regions of the province.

Winter Surveys

Since the mid-1930s, extensive surveys of wintering waterfowl have been conducted each year (Martin et al. 1979). Until the development of the operational breeding ground survey in the mid-1950s, counts of ducks in winter were the basis for establishing annual waterfowl hunting regulations. The original intent of the winter waterfowl inventory was to provide both a measure of relative numbers or population trends of major duck species and a means of describing winter distribution and habitat use. Since 1955, the winter survey has been used to follow trends in goose populations as well as duck species, such as the black duck, which breed outside the coverage of the May and July surveys.

The survey is conducted cooperatively in January by federal and state personnel, and methods presently used to count ducks vary from state to state. Over the years, the inconsistency in annual coverage and poor design have resulted in criticism of this survey. Additionally, costs associated with the survey are significant, and this has raised questions regarding benefits relative to costs.

Despite these concerns, there has been reluctance to terminate the winter survey of ducks because of perceived loss of useful information. In recent years, alternatives have been suggested to current procedures, and include such approaches as (1) restricting annual coverage to major concentrations of ducks, (2) designing annual species-oriented winter surveys while conducting the original survey at five-year intervals and (3) improving and standardizing the current design and conducting the survey annually.

In recent years, actions have been taken on a smaller scale by various state agencies and the FWS to improve the current winter survey. These activities include:

1. Standardizing data collection procedures.

In January 1989, a standardized data entry and editing program was available for use throughout the Atlantic Flyway. This system, developed by FWS research biologists, should reduce errors in the data base and improve capabilities to retrieve, tabulate, and analyze data. More importantly, it represents a significant first-step in standardizing data collection and storage procedures. In the future, we hope to expand this new system to winter survey activities in other flyways.

2. Evaluating alternative methods of data analysis.

FWS research biologists are currently assessing the reliability of winter survey data in the Atlantic Flyway. Inventory information will be analyzed using methods that adjust for effort and differential coverage of areas. Re-analysis of these data will include an evaluation of the validity of the traditional methods of analysis.

3. Evaluating alternative survey designs.

An experimental aerial transect survey, using stratified random sampling, was developed to estimate wintering black duck numbers in coastal New Jersey for two years (1981–82, 1982–83) and coastal Atlantic Flyway (Maine to South Carolina) for three years (1983–84, 1984–85, 1985–86) (Conroy et al. 1988). This survey, although discontinued at the present time, provided a means of evaluating the precision of annual counts and thus allowed statistical inferences to be made about population changes within the coastal region.

More recently, FWS biologists are using a stratified random sample of aerial transects to estimate mallard numbers wintering in the Mississippi Alluvial Valley (MAV). Preliminary results indicate the potential of obtaining useful information from this approach, provided that visibility bias in forested habitats of the MAV is negligible, or if not, can be estimated. Efforts to evaluate this source of bias will begin in the winter of 1989–90.

Considering the shortcomings of the present winter inventory, a statistically designed, reliable survey is an objective for the future. The efforts described above and others will provide a basis for such changes. Independent, state by state, approaches to the problem of counting ducks in winter will likely generate confusion and destroy what geographic and temporal comparability remains at the national level. It is our preference to bring about change in this survey in a manner that strengthens rather than destroys geographic comparability. Under the North American Waterfowl Management Plan, four joint ventures occur on wintering areas of ducks. Monitoring the duck populations in areas covered by these joint ventures will no doubt play a role in how future winter surveys are designed and conducted.

Harvest Surveys

The annual harvest survey of waterfowl was first initiated in the U.S. in 1952 and in Canada in 1966. Harvest surveys provide resource managers with various kinds of information about the annual take of waterfowl during the hunting season. In the U.S., the sampling framework centers on duck stamp sales at selected post offices throughout the country (Martin and Carney 1977). From this design, questionnaires are mailed to a sample of stamp purchasers. Some hunters are sent a supply of large envelopes in which they are asked to send to FWS a wing from each duck they bag. From those who respond to the wing collection and the questionnaire, estimates of the success of duck hunters and the species, sex and age composition of the duck harvest are derived. When these values are applied to the number of active hunters, an estimate of the annual harvest of each duck species is obtained.

In contrast to the U.S. system, Canadian waterfowl hunters are required to purchase a federal migratory bird hunting permit (Cooch et al. 1978). This permit, in turn, provides a list of potential respondees that includes accompanying names and addresses and establishes a universe from which a stratified, random sample of hunters is surveyed each year. Questionnaires and wing-collection envelopes are mailed to selected hunters, and parameters similar to those from the U.S. surveys are estimated.

Although both surveys attempt to estimate waterfowl kill each year, a pronounced difference exists between the two programs in the way the basic sample is derived. Each survey allows the detection of changes relative to previous years within the respective countries, but comparisons of the results of the two surveys are difficult. Neither survey is perfect. Each has its own attendant problems and limitations, and efforts to improve various aspects of each survey are in progress. However, the respective sampling framework continues to distinguish the two national programs. In Canada, the survey likely yields a more representative sample of hunters each year, while in the U.S., the design has resulted in a potentially nonrepresentative sample of hunters because of problems associated with obtaining names and addresses of duck stamp purchases. This topic, its problems and proposed solutions, will be presented in greater detail later in this session.

Banding

Banding is an important tool in managing duck harvests. Banding data, combined with population and harvest information from surveys previously described, provide information on survival rates, harvest rates and production rates of ducks. Also, relationships between breeding populations and harvest areas are learned from analyses of band recovery data.

The first, large-scale banding program was organized in 1922 (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1989). By the 1940s, improved capture techniques had increased banded samples and made it possible to delineate duck migration corridors, which became the foundation of the current flyway system used in harvest management. In 1946, an international banding effort was organized to address specific management objectives for ducks. Since then, large numbers of waterfowl have been banded in North America on both breeding and wintering areas through the cooperative efforts of the FWS, CWS, state and provincial conservation agencies, and non-government organizations. Detailed records of both bandings and subsequent recoveries are processed and maintained by the FWS Bird Banding Laboratory in Laurel, Maryland and by the CWS in Ottawa, Canada. To date, over 9.5 million ducks have been banded and more than 1.2 million of these have been recovered (unpublished data of the U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, Md.).

Over the years, banding objectives for ducks have evolved from a simple description of migratory behavior to the more complex application of estimating survival rates. Banded samples should represent a group of individuals that has discrete characteristics, and the usefulness of banding as a harvest management tool is increased when samples of banded ducks are representative of populations of known origin and size. Most duck banding programs today are based on one or more of the following general objectives:

1. Determine the distribution of duck harvests from various breeding areas and define breeding ground sources of birds harvested in various states and flyways.
2. Determine changes in the rate of duck harvests.
3. Determine the relative vulnerability to hunting of each age and sex cohort.

4. Determine annual, average annual, or interval survival rates for particular sex and age cohorts.

Of all duck banding efforts, the mallard program has been the most successful. More than 4.3 million mallards have been banded, and the total number of recoveries is nearly 650,000 (unpublished data of the U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Laurel, Md.). It is the most common duck in the waterfowl harvest in the U.S. and Canada, and much of what is known about the population dynamics and harvest of ducks can be traced to the success of past banding programs for this species. Unfortunately, success with other species has varied considerably, and for most, relatively little banding information is available for harvest management purposes.

There has been considerable effort to review the duck banding program in recent years. All aspects of duck banding have been considered, from successes and failures at the field level to processing and storage procedures in the Bird Banding Laboratory. The following are examples of proposed alternatives designed to improve duck banding activities.

1. Guiding banding activities.

Failures of particular banding efforts to obtain adequate, representative samples have been linked to a number of factors, ranging from problems in the field to lack of emphasis at higher organizational levels. A new banding plan has been developed recently. This plan emphasizes communication at all organizational levels during banding activities, flexibility in responding to new banding needs and priorities, follow-up on program performance, and reinforcement of the value and use of banding data.

2. Expanding operational banding into new areas.

Reviews of banding programs in the U.S. and Canada indicate that portions of important duck breeding areas remain poorly represented in the banded samples. In most cases, costs associated with accessing these areas have hampered efforts to establish new banding stations. However, renewed interest in the duck populations outside of traditional banding areas has prompted the development of proposals to expand activities. We are increasing banding efforts in areas such as Alaska, areas north of the prairies and parklands, and eastern Canada.

3. Assessing current band reporting rates.

The rate at which duck bands recovered by hunters are actually reported to the Bird Banding Laboratory has always been an important consideration in understanding an interpreting band recovery information. Relatively few measures of this variable are available, and what is available is of questionable accuracy. Since 1987, the FWS, CWS, and states and provinces have been involved in a cooperative investigation of the geographic variation in band reporting rates for mallard bands. The results of this study will be available soon, and these results will represent the best estimates ever obtained on this subject.

4. Band solicitation.

Proposals designed to increase band reporting by hunters are not new and interest in them has been rekindled in recent years. Advantages, such as improved cost-effectiveness of banding activities and increased informational return for all species banded, are obvious. Attempts to increase band reporting levels should not be pursued without a basis for evaluating their effectiveness, as well as an ability to sustain higher rates over time. Specific proposals will require careful consideration prior to any implementation of band solicitation on an international scale. Band solicitation of short duration on less than a rangewide basis for any species could easily create more problems than it solves.

Habitat Assessment

Knowledge of habitat conditions is an important component in any attempt to predict changes in the size of duck populations. The operational survey used for this purpose is associated with the cooperative waterfowl breeding ground survey described earlier. During both the May and July surveys, the number of ponds containing water along each transect in southern Canada and the northcentral states is recorded. Traditionally, these pond counts and changes in number of ponds between May and July have been important components in our annual predictions of duck production from the prairies and parklands. In northern areas, water levels show less annual variation and habitats are less subject to serious impact by human activities. Consequently, efforts to monitor the abundance and distribution of waterfowl habitat in these areas have received little emphasis. However, in recent years, as the impact of the drought extended northward, noticeable changes in wetland habitats there have become apparent. Also, we are aware that in areas currently surveyed, other environmental factors, such as the availability of secure nesting cover, contribute significantly to annual variations in duck production. Finally, the possible influence of degraded migration and wintering habitat on subsequent reproduction is even less understood.

Since 1980, the CWS has monitored habitat conditions around wetlands on 65 air/ground segments from the operational breeding duck survey in the grasslands and parklands of prairie Canada (Turner et al. 1987). Ponds are checked annually on the ground to determine the type and percent of agricultural impact occurring on each basin and margin. Upland areas associated with these wetlands are also classed according to use. Temporal and geographic trends in impact categories, such as *cultivated, grazed, burned, cleared,* and *filled*, are estimated. A companion program was initiated in 1985 by the CWS that expanded ground coverage to a series of quarter-mile sections along each of the 65 air-ground segments. Because of the intensity of this approach, including accompanying color infrared photography, each segment will be monitored only at five-year intervals. Information obtained in each of these programs allows a more realistic appraisal of changes in wetland conditions by providing the perspective of habitat quality in addition to pond abundance. Plans to expand this approach to survey areas in the northcentral U.S. are being discussed.

New approaches designed to improve our ability to estimate pond numbers are being evaluated. For example, Ducks Unlimited and FWS biologists now access LANDSAT satellite imagery to study the distribution of various wetland types on key waterfowl breeding areas (Koeln et al. 1988). These techniques, along with low-level video photography, offer potential for optimizing sampling schemes for counting wetlands. These approaches not only may improve our estimates of pond numbers, but will allow aerial observers to concentrate their efforts on counting ducks, thus increasing the accuracy of duck population estimates as well.

In the future, simple counts of wetlands each year will likely give way to more detailed assessments of waterfowl habitats. The success of these efforts will depend on our ability to obtain a better measure of habitat quality than we have had in the past, not only on the breeding grounds but also on migration and wintering areas.

Summary

Managing duck harvests is one of the most difficult tasks facing wildlife managers today. The very nature of this migratory bird resource, its distribution and movement throughout North America during the annual cycle, contributes to the complexity of assessing population status and change. Consequently, various data collection efforts have received emphasis over the years as waterfowl managers strive to maintain a reliable information base useful in deliberations on duck harvest strategies. Together, these files comprise the largest data set on wildlife populations in the world. However, each source of information has its own set of attendant limitations and sources of bias. Many efforts are presently underway to improve this information base and thus enhance our ability to manage and protect this resource. Nevertheless, we must remember that most of these surveys were originally designed to measure the more abundant species at the flyway level. In a few cases reliable information can be obtained for states or provinces. More refined measurements are possible, but not without substantial cost in additional personnel and equipment. Until such funds become available, within state, and in some cases within flyway, refinements to waterfowl hunting regulations are very difficult, if not impossible, to evaluate.

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A National Migratory Gamebird Harvest Survey: A Continuing Need

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Introduction

Regulated hunting of migratory gamebirds in the United States is now in its 71st year, having begun in 1918 with implementation of the Migratory Bird Treaty Act. Since then, appreciation for these birds and the recreational opportunities that they afford has grown steadily. The 1985 National Survey of Fishing, Hunting and Wildlife Associated Recreation (USDI 1988) estimated that 5 million Americans spent 41 million days afield and over $1 billion to hunt migratory game birds. Commitments and investments to perpetuate the migratory game bird resource are high, the monumental North American Waterfowl Management Plan being a good example. Public interest in the annual process of establishing hunting regulations is also high, with few other Fish and Wildlife Service (Service) activities generating as much interest and comment. Truly, the hunting of migratory gamebirds is a socioeconomically important activity in the United States.

Harvest management is an important aspect of overall management of the migratory gamebird resource. We must assure that harvests are commensurate with the abilities of populations to sustain themselves and that the resource is not jeopardized.

Some notable advances have occurred recently in the area of harvest management. The use of nontoxic shot for waterfowl hunting is in final stages of implementation, with nationwide use scheduled for 1991. The process of establishing annual hunting regulations has become better defined and more accommodating of public participation in the regulatory process. The Stabilized Regulations Study, reported on at this conference two years ago (Sparrowe and Patterson 1987), has provided new information on relationships among hunting regulations, harvests and the survival of birds. The Final Supplemental Environmental Impact Statement on migratory bird hunting (USDI 1988) released last summer provides the foundation for setting annual regulations in the coming years. And finally, an increased emphasis on law enforcement will help assure that undocumented, illegal harvest is not a limiting factor in harvest management.

While these recent advances in harvest management are important and welcomed, there remains one basic weakness in our ability to manage the harvests of migratory gamebirds. That is, we do not have a national harvest survey, one that is of sound design, practical, and yielding of reliable harvest information for the major groups of migratory gamebirds. The principal reason for the lack of a national harvest survey is that we have never had that most fundamental element of a good survey, a sampling frame of the names and addresses of migratory bird hunters.

Changes are occurring in the field of migratory gamebird management. Demands for more and better data are increasing. We believe that we are keeping pace in population assessment, but more must be done in the area of harvest assessment. Until now the lack of a national migratory gamebird harvest survey has been a chronic but not crippling weakness. However, we fear that this weakness is becoming more serious and eventually will limit our ability to cope with increasingly complex issues of harvest management. We believe that now is the time to reconsider the need for a national migratory gamebird harvest survey.

The Waterfowl Harvest Survey

To understand the need for a national harvest survey, it is necessary to understand the present surveys and their problems. In the case of waterfowl, the problem is lack of a sound sampling frame to support the Service's waterfowl Hunter Questionnaire Survey (HQS). For migratory game birds other than waterfowl, the problem is lack of any national level sampling frame, sound or otherwise.

Currently, HQS estimates are derived by a procedure which essentially dates back to 1952 when it was decided that a survey could be "piggybacked" on the duck stamp program that began in 1934. Because each person 16 years or older is required to purchase a duck stamp before hunting waterfowl, a record of the number of duck stamps sold at each post office is obtained from the U.S. Postal Service. Next, a representative sample of these post offices, branches, or stations is sent a supply of return post cards ("contact cards") and asked to give one to each duck stamp buyer. Duck stamp buyers record their names and addresses, indicate whether they intend to hunt waterfowl, and return the cards. When the season ends in a given state, those stamp buyers who intended to hunt are sent questionnaires that ask how many ducks and/or geese they shot, along with several other questions. The average duck (or goose) kill reported by the sample of hunters from a given state is multiplied by the number of duck stamps sold to potential hunters in that state. This figure is adjusted to correct for the kill by hunters less than 16 years old, and for exaggeration due to memory or prestige bias. The resulting figure is the estimate of the total duck (or goose) harvest in each state.

Detailed information on the species, age, and sex structure of the waterfowl harvest is obtained from the annual waterfowl Parts Collection Survey (PCS). In this survey, a sample of successful respondents to the previous year's HQS and PCS are supplied with return-addressed enveloped prior to the opening of the waterfowl season in their state and asked to return one wing from each duck and the tail feathers from each goose they shoot. They are asked to use one envelope per bird and record the date, time and place where the bird was taken. Thus, while the HQS provides an estimate of the total duck, goose, and coot harvest within a state, the PCS provides a basis for dividing that total into the species, age, and sex composition of birds taken, as well as for determining the counties, dates, and times of day where and when the birds were taken. Persons interested in information on the origin and evaluation of HQS and PCS will find more details elsewhere (Carney and Geis 1960, Geis and Carney 1961, Martin et al. 1979, Martin and Carney 1977, Carney 1984, Crissey 1984).

The many uses of waterfowl harvest data (HQS and PCS) are commonly known. The size, chronology and distribution of harvest are determined from the data. Species composition and age ratio data are analyzed prior to the setting of waterfowl hunting regulations. Data are used to evaluate past regulatory regimens. Waterfowl harvest data are also an important adjunct to population surveys, providing a check on estimates from aerial production surveys.

Problems with the Waterfowl Harvest Survey

Unquestionably, data from the HQS and PCS have been useful—essential—to waterfowl management. however, since its inception in 1952, the HQS has operated with a fundamental problem relating to its sampling procedure, and the problem has worsened steadily. The desired sampling universe is waterfowl hunters in a given political unit during a particular hunting year. Unfortunately, these hunters cannot be sampled directly, because there is presently no direct means of identifying them and obtaining their names and addressees. Consequently, they must be sampled indirectly through post offices where they purchase duck stamps and may be given a survey contact card. This indirect (cluster) sampling reduces the efficiency of the survey, but sampling through post offices was not so much a problem in earlier years when hunters purchased duck stamps almost exclusively from post offices, and when postal worker cooperation was better. This has changed, though. According to our records, the percentage of contact cards that are returned from sample post offices has declined steadily since the inception of the HQS and is currently about 17 percent. That is, at sample post offices we get names and addresses from only 17 percent of duck stamp purchasers. We believe that a substantial part of this non-response problem can be attributed to lack of cooperation by postal employees, with the problem being worse at large city post offices than at those selling few stamps.

The problem of low response rates with contact cards issued at post offices is being compounded by problems with sales of duck stamps at other outlets, for example, by sporting goods stores. If these stores obtain a supply of duck stamps from a post office that is in the survey sample, they are supposed to give out contact cards. However, this is not always done. The postal clerk may forget to offer the cards to the store, or the store may simply not wish to be bothered and refuse to accept them. If a store does take cards, clerks may not issue them with each stamp sold, and clerks have been known to simply leave them on the counter for anyone to take. A similar situation may be developing for the 1989 hunting season. In cooperation with a large sporting goods manufacturer, over 1,000 stores throughout the United States will each be selling duck stamps in combination with discount sporting goods coupons. This will require a special arrangement for contacting hunters at these stores. Duck stamps are beginning to be sold from vending machines at some post offices and possibly other locations. There does not appear to be any practical way to sample waterfowl hunters utilizing these machines.

In addition, duck stamps may be purchased for several reasons other than for waterfowl hunting. Duck stamps are now being sold at national wildlife refuges for use as entrance fees. This does not pose a serious sampling problem, but it does complicate matters. We must now ask refuges to record whether stamps used for entry fees are also to be used for hunting. Refuge visitors, however, are not required to buy at the refuge. For example, duck stamp sales at the Chincoteague, Virginia, post office increased 200 percent in 1987. According to the postmaster, the increase was due to the admission charge at Chincoteague Refuge. We do not know whether any, all, or none of those additional stamps were also to be used for waterfowl hunting. Many art houses and philatelic dealers deal in duck stamps and are reluctant to reveal the precise amount of their purchases. The non-hunting uses are all increasing, and they are complicating the estimation of waterfowl harvests.

By now it should be evident to the reader that there are significant problems with using duck stamp sales as the basis for the Waterfowl Harvest Survey. It should be kept in mind, however, that the original and still paramount purpose of duck stamps is to raise funds for the conservation of waterfowl. With the habitat problems facing waterfowl today and the need for increased revenue, it is not surprising that there are a number of procedures and programs being designed to promote sales of duck stamps, especially to non-hunters. We laud and actively support these efforts, but at the same time are concerned that they greatly complicate our efforts to determine the number of waterfowl hunters and, thus, the waterfowl harvest. We are attempting to cope with this, but it is all leading to a situation where it may become impossible to determine the number of waterfowl hunters. This, of course, means we would be unable to determine the size of the waterfowl harvest.

Harvest Surveys for Other Migratory Gamebirds

We have discussed the situation with the present Waterfowl Harvest Survey and the consequences to waterfowl management. The situation is worse for other migratory gamebirds, the *Columbidae, Rallidae*, and *Scolopacidae* (doves, rails, woodcock and others). Some of these other gamebirds are of major importance to migratory bird hunting. For example, up to 50 million mourning doves may be harvested annually. For these other species, the basic problem is no national sampling frame, not even one so weak as post offices are for the Waterfowl Harvest Survey. Because of the importance of some of these other species, numerous attempts have been made to compile data on hunter numbers and their harvest. Most commonly, data from state harvest surveys have been pooled to the extent possible. Such attempts have invariably resulted in incomplete estimates because of the disparity among state surveys. Based on past experiences, we have little hope that pooled data from state surveys can ever satisfy the need for annual, nationwide harvest estimates for the non-waterfowl species.

Service capabilities for obtaining harvest information on non-waterfowl species are very limited. The most noteworthy means is an annual subsurvey of the HQS. This subsurvey asks waterfowl hunters if they hunted other species of migratory gamebirds, and, if so, how many they harvested. While some information is obtained, inferences drawn from the subsurvey results apply only to waterfowl hunters, and, thus, are extremely limited. The obvious reason is that many, if not most, hunters of these species are not waterfowl hunters and thus are not sampled. Further, because the subsurvey is "piggybacked" on the HQS (which is "piggybacked" on the duck stamp program) results have all of the problems and biases inherent in the HQS.

Lack of nationwide data on hunters and harvests of the non-waterfowl species places significant limitations on management of these birds. The woodcock wing-collection survey, similar in many respects to the PCS, is a good example. In this survey, woodcock hunters are asked to submit one wing from each bird taken along with supplemental information on their hunting activities. Survey participants are obtained in a non-random manner from a number of inconsistent sources, the main one being respondents to the HQS subsurvey of other species hunted. The wings yield data on age, sex, productivity and other population parameters. The supplemental information indicates hunter effort, harvest chronology and distribution. While these data *per se* are good, estimates based on them are biased to an unknown degree because of the nonrandom nature of the hunter sample. Additionally, inferences that can be drawn at regional and national levels are limited, because state level data can not be weighted properly.

Lack of nationwide harvest data for these species hinders some management decisions. The woodcock provides another example. In 1985 the Service responded to a long-term decline in the Eastern population of woodcock by significantly reducing harvest opportunities through regulatory restrictions. It is believed that this measure effected harvest reductions, but this can not be determined conclusively in the absence of a harvest survey. Mourning dove management would benefit from a national harvest survey, enabling some evaluation of significant management actions such as those of 1982 when uniform regulatory frameworks were offered in all three management units. Management of snipe and other species of lesser hunter interest would be improved considerably by a national harvest survey. To the best of our knowledge, these species generally are abundant, widespread and influenced negligibly by the low hunter interest, but it would be reassuring to have more reliable information on harvests of them.

Among the non-waterfowl species, the sandhill crane is the one exception to the normal situation of limited harvest information. The Service's survey of sandhill crane hunters is operating more nearly as we would like harvest surveys to operate. This is because in order to hunt sandhill cranes, hunters must obtain a numbered permit from the state. The permit provides a source of names and addresses upon which a proper survey can be based. The crane harvest survey is not without problems, but it is superior in design, function and results to the post office based HQS.

Conclusion

The problems with our migratory gamebird harvest surveys are serious, in our view. We are attempting to cope with poor response rates at post offices and with duck stamp sales outside post offices. Our measures will allow us to maintain the present HQS for some time. However, we wonder how much further we can go in refining what has been a weakly based survey since its inception in 1952. We believe that the logical solution to our survey problems is a national migratory gamebird harvest survey similar to that of the Canadian Wildlife Service (Cooch et al. 1978). The Canadians have been able to profit from our experience and avoid most of the problems we have. Beginning in 1966, they required hunters of all migratory game birds to purchase uniquely numbered permits rather than unnumbered duck stamps as in the United States. This decision was one of fundamental importance to them, for it made possible the establishment of a sampling frame for the selection of hunters to participate in harvest surveys.

Our belief that a national migratory gamebird survey is needed in the United States is, of course, not new. This is an old issue with a substantive history beyond the scope of this paper. Readers interested in details are referred to the Service's files at the Office of Migratory Bird Management. Suffice here to say that since the 1950s, the need for a national harvest survey has been expressed on many occasions by many parties. The Service has written several proposals for a survey based on a migratory bird hunting permit. The states and the International Association of Fish and Wildlife Agencies have proposed alternatives and, together with the Service, have evaluated them. Eight bills calling for a migratory bird hunting permit have been introduced to Congress. None of this has proven fruitful, for if the need for a national harvest survey is an old subject, it has also been a controversial one.

We will not belabor the issue herein, nor do we have a specific proposal to present. The intention of our paper has been: to emphasize that reliable harvest data are essential to the management of migratory game birds; to alert the reader to growing problems without existing surveys, especially the duck stamp based HQS; and to suggest that a national migratory gamebird harvest survey be reconsidered. We strongly believe that the Service, states, and other interested parties should resolve differences on the issue, should develop a plan for a national harvest survey, and should commit to action. We must do this soon or risk losing our ability to estimate harvests of ducks and other species and incur the consequences which that loss would bring.

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Experiences with Special Harvest Management Strategies for Ducks

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Introduction

In the late 1950s and early 1960s when prairie nesting grounds were devastated by drought and populations of ducks, particularly mallards (*Anas platyrhyncos*), and duck hunter numbers, were near record lows, interest in refining waterfowl management intensified. ''Species'' management rather than just ''duck'' management was in vogue. The primary motivation was to increase harvest opportunities by identifying populations that were abundant and could withstand additional harvest. The U. S. Fish and Wildlife (Service) encouraged this in 1967 and again in 1970 by admonishing waterfowl managers to, ''continue to seek under-harvested populations of waterfowl, and try to find ways of devising more recreation through regulations that promote greater pressure on those populations'' (Gottschalk and Studholme 1970).

Given this philosophy, it should be no surprise that a multitude of special harvest strategies evolved. In this paper we review experiences with the major special strategies used in the contiguous United States, including special management units, special seasons and bonus limits, the point system as an option to the fixed-bag limit, and zoning and split seasons. We cover their history, purposes, status, some general results and concerns that have arisen, but we do not attempt to judge their merits. Table 1 identifies major special strategies used in 1987; Figure 1 identifies the years, since 1950, in which the special harvest strategies were applicable. Evaluations of many of these special regulations have been limited both in scope and rigor. Results and conclusions presented are taken from a variety of sources. For the most part they are not conclusive, but serve as a starting point for more rigorous analyses. The Service is working with the flyway councils and technical committees to further

Table 1. States having specified special duck harvest regulations in 1987.

Flyway/ state	Spec. mgmt. unit	Sept. teal seas.	Bonus teal	Sept. duck seas.	Spec. scaup seas.	Bonus scaup	Sea duck seas./ bag	Bonus mer-ganser	Spec. wood duck bag	Point system	Duck zones*	Split seas.-no zones
Pacific												
AZ												X
CA											X(3)	
CO												X
ID											X(2)	
MT												
NM												X
NV											X(2)	
OR	X											X
UT												X
WA	X											X
WY												
Central												
CO	X	X								X		X
KS	X	X								X		X
MT	X									X	X(2)	
ND			X			X						
NE	X									X	X(4)	
NM	X	X								X	X(2)	
OK	X	X								X	X(2)	
SD	X									X	X(2)	
TX	X	X								X		X
WY	X									X	X(4)	
Mississippi												
AL		X								X	X(2)	
AR		X								X		X
IA				X						X	X(2)	
IL		X								X	X(3)	
IN		X			X					X	X(3)	
KY				X						X		X
LA		X			X					X	X(2)	
MI					X					X	X(3)	
MN								X				
MO		X								X	X(2)	
MS		X								X		X
OH		X			X			X			X(3)	
TN				X						X	X(2)	
WI					X					X	X(2)	
Atlantic												
CT			X		X		X	X			X(2)	
DE			X			X	X	X				X
FL				X	X					X		X
GA			X			X	X	X				X
MA			X		X		X	X			X(3)	

(continued)

Table 1. (Continued)

Flyway/ state	Spec. mgmt. unit	Sept. teal seas.	Bonus teal	Sept. duck seas.	Spec. scaup seas.	Bonus scaup	Sea duck seas./ bag	Bonus mer- ganser	Spec. wood duck bag	Point system	Duck zones*	Split seas.- no zones
Atlantic (continued)												
MD			X			X	X	X				X
ME			X		X		X	X			X(2)	
NC			X			X	X	X	X			X
NH			X		X		X	X			X(2)	
NJ			X		X		X	X			X(3)	
NY			X		X		X	X			X(5)	
PA			X			X		X			X(4)	
RI			X		X		X	X				X
SC			X			X	X	X				X
VA			X		X		X	X	X			X
VT			X			X		X			X(2)	
WV			X			X		X			X(2)	
Total	11	13	17	4	14	9	13	18	2	22	28	20

*Number in parentheses indicates number of regular season duck zones in that state, 1987, excluding sea duck zones. Special management units, and areas such as Colorado River Zone in California and Pymatuning Area in Ohio where the state has no control over regulations, are not considered zones for this table.

explore the effects of special regulations. This comprehensive assessment should be completed by the end of 1989.

Special Management Units

Columbia Basin

The "Columbia Basin Special Mallard Area" was established in 1961 in response to a build-up of mallards in the Pacific Northwest. The "basin" or unit has generally encompassed eastern Washington, the north-central and extreme eastern counties in Oregon, and the "Panhandle" and much of southern Idaho. In 1985, all Idaho counties and seven of nine Oregon counties were dropped from the unit in response to low continental numbers of ducks and significant local decreases in wintering mallards.

The Pacific Flyway Study Committee investigated the buildup and origin of those mallards and expressed concern for potential losses of ducks through freezing and starvation and about increasing depredations (Lauckhart et al. [1961]). The Pacific Flyway Council requested and received more liberal regulations for the area. During 1961–75, the Columbia Basin counties in comparison with the remainder of the flyway had from two to four additional mallards in the bag (5 years), 10–17 additional days of hunting (12 years), and even an extension of shooting hours to one-half hour after sunset (4 years). During 1975–88, the unit had the same limits, shooting hours, and framework dates as for the flyway, but retained 7 additional hunting days.

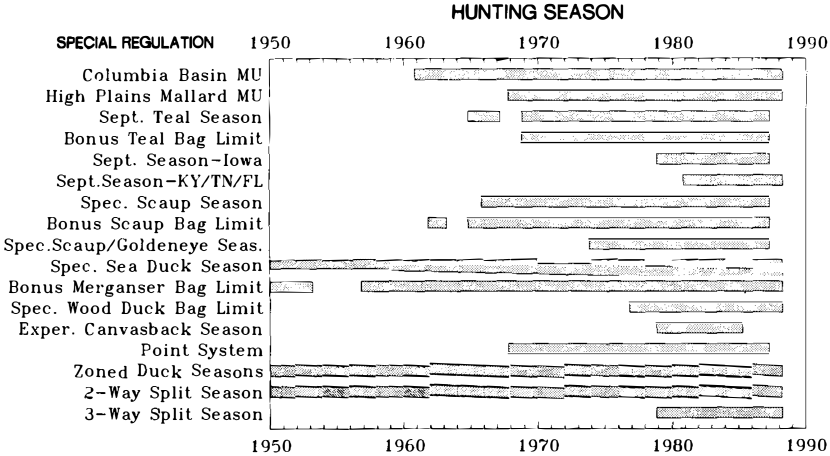

Figure 1. Chronology of special duck harvest regulations in the contiguous United States, 1950–1988.

The basin typically contains more than half (59 percent) of the flyway's wintering mallards, but there is no significant correlation between numbers of mallards wintering in the basin and elsewhere in the flyway, and except for Idaho, there were no significant correlations between winter indices and breeding population indices in surveyed areas.

During 1961–87, the annual mallard harvest for the basin at its largest size (the area in 1970–84), averaged about 34 percent of the flyway total. Mallards comprised 71 percent of the average annual duck harvest in the basin, 40 percent in counties outside the basin in those three states, and 14 percent for the flyway, excluding the basin. An estimate of the harvest rate of wintering mallards during 1961–87 suggests that average rates for the Washington-Oregon portion of the basin were about half of those for the remainder of the flyway (Kraege et al. 1989).

High Plains

The "High Plains Mallard Management Unit" of the Central Flyway was first proposed by the Central Flyway Council in 1968 in response to what was believed to be a lightly harvested mallard wintering population that had a high proportion of adult drakes (Funk et al. 1968). Since 1972, the High Plains unit has included the Central Flyway portions of Montana, Wyoming, Colorado and New Mexico and portions of all other flyway states occurring roughly west of the 100th meridian. About half of the flyway's wintering mallards occurs in the unit.

Sex ratios among wintering mallards in the High Plains and elsewhere were skewed, as suggested by surveys conducted in the Central Flyway as well as in certain areas of other flyways during the early 1970s, suggesting the possibility of surplus males. Based on a theory that mallards wintering in the High Plains were a discrete population, the Central Flyway states began winter banding in 1963. Funk et al. (1971) reported that: (1) upward of 80 percent of recoveries from mallards banded within the unit were from within the unit itself, (2) few, if any, mallards winter-banded in the Low Plains were recovered in the High Plains, (3) first-year recovery rates were low, and (4) survival estimates were slightly higher than for Low Plains mallards.

In 1968, the Service provisionally agreed to establish the High Plains Unit by granting Montana, Wyoming, and Colorado, a special 23-day late season on only male mallards. Since then the unit generally has had 12–28 more days of hunting than offered the remainder of the flyway, provided the point-system was used to direct harvest primarily toward mallard drakes and that additional days be taken on or after about December 10. North Dakota did not take the additional days until 1988. During 1963–69, 29 percent of the annual Central Flyway mallard harvest was in the High Plains. During 1971–87, a period when the High Plains Unit was fully implemented except for North Dakota, the Unit's mallard harvest averaged 27 percent of the total flyway harvest of mallards.

While harvests of all ducks have increased, the relative importance of mallards in the regular-season harvest has declined throughout the flyway. During 1964–69, percentages of mallards in the bag averaged 63 percent in the High Plains compared to 44 percent in the Low Plains (Funk et al. 1971) but were only 56 and 34 percent during 1971–87, respectively. There was considerable variation within the unit as to the relative importance of mallards in the harvest. Mallards were more important in northern areas than in southern areas. The mallard sex ratio in the High Plains harvest tended to increase after the unit was implemented, averaging 69.8 percent males during 1963–68 and 76.5 percent during 1969–84, but the latter period coincided with implementation of the point system, which also provided incentive to direct harvest toward drake mallards. The ratio of males to females in the remainder of the flyway also increased.

Special Seasons and Bonus Limits

Special seasons and "bonus" limits on designated species were initiated in the three eastern flyways in the early 1960s to implement species management. The first of these focused on blue-winged teal (*Anas discors*) and scaup (*Aythya marila* and *A. affinis*), which had larger populations and lower harvest rates than many other species. Since then, the variety of special seasons and bonus limits has grown considerably.

September Teal Seasons and Bonus Limits

The Mississippi Flyway Council first proposed a separate September season on blue-winged teal as an experiment in Louisiana in 1957, but the Service rejected it. The Council resubmitted the proposal in 1963 and 1964, with green-winged (*Anas crecca*) and cinnamon teal (*Anas cyanoptera*) included to avoid identification problems.

Experimental September teal seasons were held during 1965–67 in the Mississippi and Central Flyways. The season was discontinued in 1968, but reinstated and made operational in 1969 with the same frameworks as during 1965–67: Seasons of up to 9 days during September, with a daily limit of 4.

In 1969 and 1970, based on evidence that species other than teal were being taken in production areas, states designated as "waterfowl production states" were offered an option in lieu of a September season. The option was a bonus blue-winged teal bag limit during 9 consecutive days of the regular duck season provided the point-system was not used. Beginning in 1971, these states were no longer offered the September teal season, but could select the blue-winged teal bonus if they used the conventional bag-limit option.

In 1970, Atlantic Flyway states were offered the bonus blue-winged teal bag limit, and green-winged teal were added in 1979. In 1987, North Dakota and 16 of 17 Atlantic Flyway states availed themselves of it.

In the Atlantic Flyway, Maine held an experimental September teal season during 1970–72, but it was discontinued due to lack of hunter support. Subsequently, the teal season has not been offered in the Atlantic Flyway, and it has never been offered to the Pacific Flyway.

During 1970–87, the harvest of blue-winged teal in September seasons in the Mississippi and Central Flyways comprised 35 percent and 46 percent, respectively, of the annual flyway blue-wing harvests. The proportion of average annual blue-wing harvests occurring in September increased during the period in both flyways. Harvests of green-winged teal were relatively low, averaging about 5 percent of the total greenwing harvest in the two flyways.

Despite the additional harvests of blue-winged teal during the September seasons and as bonus bags, band-recovery rates remained low, suggesting low harvest rates as well. However, following substantial declines in breeding populations in the mid-1980s and evidence of likely poor recruitment in 1988, the Service suspended both the September teal season and bonus limit in 1988.

September Duck Seasons

Iowa. Losing the option of having a September teal season in the early 1970s because of its status as a production state, Iowa proposed an experiment in 1979 to move its early October split season segment (5 days) into late September to provide more harvest opportunity on blue-winged teal. The 5 days were proposed as part of the regular duck season and no additional days were involved. The regular duck season limits and species restrictions applied equally to both segments. Little or no additional impact on species other than blue-wings was predicted because migrant blue-wings are generally more abundant in the state in late September than in early October. The experiment continued from 1979 until 1988 when it was suspended because of declining blue-winged teal populations and poor production.

Harvest results suggest that, compared to the early-October season segment, September harvests increased significantly for blue-winged teal, remained about the same for wood ducks (*Aix sponsa*), and declined substantially for other species. Band recovery data provide little evidence of any adverse impact on wood ducks. These results suggest that the state's objectives were probably met.

Kentucky, Tennessee and Florida. In the late 1970s, Tennessee requested the option to harvest wood ducks in September, initially as part of the September teal season. The request was based on an analysis of wood duck band-recovery data by Bowers and Martin (1975), which indicated that wood ducks nesting in southern regions survive at higher rates than northern-nesting populations.

In 1981, an experimental 5-day September duck season was allowed in Tennessee, Kentucky and Florida. In Tennessee and Kentucky seasons were in lieu of a September teal season, thus, they were in addition to the regular duck season, and could be held anytime in September. The daily bag limit was 4 ducks, with no restrictions on teal or wood ducks, but could include no more than 1 of any other species. The experiment was continued thereafter until 1988. In 1986, out of concern about lower survival rates for wood ducks, the daily bag limit in Kentucky and Tennessee was restricted to two of this species. In 1988, in response to concerns about declines in blue-winged teal and other species, all species except wood ducks were excluded from the September season. The limit was reduced from four to three in Florida and remained at two in Kentucky and Tennessee.

During 1981–86, the combined annual September harvests of teal in the three states averaged 22,000, and were much higher in both Kentucky and Tennessee in comparison with the 1976–80 September teal seasons. The combined September harvests of wood ducks averaged 44,000 annually. Band recovery data from the 1981–87 seasons and results of parasite-tagging studies (Thul in press) suggest the occurrence of northern birds in the harvest was rare.

An analysis of wood duck band-recovery data (Sauer et al. in press) for 1981–85 indicated that in comparison with the pre-experimental period of 1976–80, recovery rates were higher and survival rates lower in Tennessee. In Kentucky, survival rates were not significantly different between the two periods, but only one year (1980) of pre-experiment data was available. Recovery rates of male wood ducks were significantly higher during the experimental period than in 1980. Florida could not be included in the analysis because little banding had been done there. Full assessment of these results is difficult. Banding data were inadequate for time-period comparisons of survival and recovery rates in many states. Also, direct estimates of population size, trend and annual production are not available. Without this, the significance of changes in survival and recovery rates to wood duck populations cannot be ascertained.

Special Wood Duck Bag Limits

A special bag limit option on wood ducks was first offered to 11 southeastern states in 1977. For up to 9 consecutive days between October 1 and October 15, before northern migrants arrived, there was no special bag limit restriction on wood ducks under fixed-bag regulations. For the point system, wood ducks were assigned a mid-point value. This liberalization was intended to allow additional harvest of southeastern wood ducks which had higher survival rates than northern wood ducks (Bowers and Martin 1975).

Although offered to 11 states, only Virginia, North Carolina, South Carolina and Georgia have used it, and only Virginia and North Carolina continue to select this option.

The impact of this liberalized regulation on wood duck populations has not been fully assessed. As with September duck seasons, evaluation has been hampered by inadequate banding data. Although this option continues to be offered, a major reassessment of wood duck harvest strategies is currently underway by the Service in cooperation with both flyways.

Special Scaup Seasons and Bonus Bag Limits

A bonus scaup bag limit was first offered to the Atlantic, Mississippi, and Central Flyways in 1962. Two additional greater (*Aythya marila*) and lesser scaup (*A. affinis*), singly or in the aggregate, were permitted in areas mutually agreed upon by the respective state and the Service. Areas containing concentrations of canvasbacks (*A. valisineria*), redheads (*A. americana*), black ducks (*Anas rubripes*), and mallards were avoided. These bonus bags usually could not be employed until after November 1. Pacific Flyway states and states later selecting the point system were ineligible for the scaup bonus.

Carney and Geis (1964) reported that during the first two years the bonus was offered, bonus scaup bags in Atlantic Flyway states north of Virginia consisted of 80 percent scaup, whereas in states south of Maryland ring-necked ducks (*Aythya collaris*) made up half of the bonus bag in 1962 and 85 percent in 1963. Scaup bonuses were not offered in 1964, but were reinstated in 1965, providing that states selected areas with few ringnecks. Smart (1966) concluded that the take of non-target species had been reduced with area designations. Therefore, in 1966 the taking of bonus scaup was allowed statewide in some northern states, but only in designated areas of southern states. Ringnecks were included in the bonus only in 1966 but not thereafter.

A special scaup season was first proposed by the three eastern flyways in 1962. They recommended that it be offered in lieu of the scaup bonus, follow the regular duck season frameworks, be conducted only in designated areas and be evaluated. However, the first season was not allowed until 1966 when Connecticut and New York were permitted a 15-day season for scaup and ring-necked ducks, with limits of five daily and shooting hours of sunrise to sunset. In 1967, the taking of ringnecks during the special season was prohibited. In 1968, 19 states in three flyways participated. The season length was 16 consecutive days outside the open season on other ducks, except sea ducks. Shooting hours were changed to one-half hour before sunrise to sunset. These frameworks remained through 1987.

Conditions for special scaup seasons have varied over the years but the primary criterion has been that hunting must be limited to specific areas, based on number of scaup present and the percent of all ducks present comprised of scaup. During the 1978 and 1979 hunting seasons legal species comprised 94 percent of the harvest (Blandin 1981). Prior to suspension of these seasons in 1988, nine states in the Atlantic and five in the Mississippi Flyways participated. Little information exists concerning hunter performance and the proportion of the scaup harvest that occurred during these special seasons.

Special Scaup and Goldeneye Season

In the Lake Champlain Area of Vermont and New York, a special season for scaup and goldeneye (*Bucephala* sp.) was authorized in 1974. With the exception of bag limits, this season is similar to the special scaup season. The daily limit may consist of three scaup or three goldeneye or three in the aggregate. Criteria were established in 1978 and required a minimum population of 5,000 of which 90 percent had to be comprised of scaup and goldeneye. This option is in lieu of the scaup-only season, and is not available to other states.

Sea Duck Seasons and Bonus Bag Limits

A special 107-day season on sea ducks (eiders [*Somateria* sp.], scoters [*Melanitta* sp.], and oldsquaw [*Clangula hyemalis*]) is permitted in specified areas of all coastal states in the Atlantic Flyway except Florida. The daily bag limit is seven and is in addition to regular season limits. The season is intended to provide additional hunting opportunity directed at otherwise lightly harvested species.

The sea duck season is the oldest of all special seasons. It started with a special scoter season in Maine, New Hampshire, Connecticut, Massachusetts and Rhode Island, first offered in 1938. Limits ranged from seven to ten per day. Eiders were included beginning in 1948, followed by oldsquaw in 1950.

Bonus Merganser Bag Limits

From 1944 to the present, except 1954–56, common (*Mergus mergus*) and red-breasted merganser (*M. serrator*) bag limits have generally been in addition to the regular duck limit in some flyways. Additional limits of up to 25 of these species were permitted, although hooded mergansers (*Lophodytes cucullatus*) were given protection. In 1985 only the Atlantic and Mississippi Flyways were offered an extra merganser limit—five daily in each flyway, with no more than one hooded merganser allowed. Data suggest that the percentage of common mergansers in the United States harvest may be increasing; however, existing methods of monitoring status and harvest of these species provide little insight as to the effects of these regulations on merganser populations.

Special Experimental Canvasback Season

Area closures were used to reduce harvests of canvasbacks in the three eastern flyways during 1973–82 in places where they were most abundant. In other areas where canvasbacks were few and shot occasionally as a mistake bird, a one-bird bag limit was allowed. With improvements in the status of the eastern population, new harvest guidelines were proposed in 1983. They continued the harvest of western populations without change in strategy, but for the eastern population, they eliminated select closed areas in the Central and Mississippi Flyways and proposed an experimental canvasback season in some areas of the Atlantic Flyway beginning in 1983. As an alternative to the longer season and restricted one-bird daily bags in other flyways, the Atlantic Flyway Council in 1979 requested a special season with a liberal bag limit during a portion of the duck season.

New York, New Jersey, North Carolina, Maryland and Virginia were authorized a permit-only canvasback season, ranging from 6 to 11 days, during 1983–85. Canvasbacks were part of the daily bag but could not exceed 4 daily, of which only 1 could be a female.

The experiment resulted in control of the harvest while providing additional but limited opportunities to hunt canvasbacks in a somewhat traditional manner. The season has not yet been given operational status. Since 1986, canvasback seasons have been closed in the three eastern flyways due to low breeding populations.

The Point System—An Option to the Fixed Bag Limit

The point system of regulating duck harvest exemplifies species management. First suggested in 1966, it was conceived as a way to direct harvest toward abundant species and sexes and away from those needing special protection. Unless the season is closed on a species, a hunter must only identify a species after the bird is shot and retrieved, and then determine whether or not the bird brings the total point value of the bag to the allowable limit.

In 1968, the Central Flyway Council recommended and was granted the opportunity to test the point system during an ongoing experimental duck season in Colorado. The bag limit was reached when the total points equalled or exceeded 70 with the last duck taken. Drake mallards were 10 points, mallard hens were 40 and all other ducks were 30. A daily limit could have ranged from two to seven ducks, depending on the sequence taken. The experiment continued in 1969, with some changes in point values, and was extended to include an area in Michigan. Studies were expanded during 1970–72 to include states in the Central Flyway (8); Mississippi Flyway (3) and Atlantic Flyway (2). Point categories were 90, 20, and 10. In 1973, all states in these three flyways were offered use of the system and for all practical purposes it has been considered "operational" since.

Interest in the point system has remained high in the Central and Mississippi Flyways with all but 2 or 3 of the 24 states adopting it. Only 6 of the Atlantic Flyway's 17 states ever used the system and by 1985 only Florida had opted to use the system. In 1987, 22 states in three flyways used the system. In 1988, it was suspended pending a re-evaluation.

Initial evaluations indicated that, during the early years, hunters generally liked the system, they tended to avoid high point birds such as mallard hens, harvested more lower point birds, especially mallard drakes, and total duck harvest in most states did not increase from what it would have been under a conventional bag limit. They suggested that, in general, the point system appeared to have been effective in directing hunting pressure from hen to drake mallards in states where mallards normally constitute a high fraction of the harvest, but in other states and for other species (10-point ducks, for example) redirection of shooting pressure were less clearly demonstrated. However, retrieval rates for high-point ducks were lower than for low-point ducks compared to areas having fixed-bag regulations. The bag limit violation rate was similar to that observed for fixed-bag regulations in the Pacific Flyway. (Carney et al. 1972, Funk et al. 1970, Geis 1971a, 1971b, Geis et al. 1969, Geis et al. 1971, Hopper et al. 1970, Kimball 1972, Kimball et al. 1971, Mikula et al. 1972.) Conclusions generally were preliminary and reported in the form of progress reports in most cases. No comprehensive evaluation of the point system has been published; however, the Service is attempting to accomplish this now in cooperation with the flyway technical committees.

The point system has been surrounded with controversy since its inception. Despite encouraging initial results, skepticism remained. The Service established a special multi-agency task force in 1972 to further evaluate the system. The task force identified perceived "good" and "bad" features of the system and presented a number of conclusions (U.S. Dep. Int. 1973.) It concluded that re-ordering birds, i.e., when ducks are said to be taken in a sequence different than they actually were, was a problem unique to the point system that would be extremely difficult to measure or enforce. Hunter performance during 1970–72 indicated about 32 percent of the hunters had an opportunity to reorder their bag and of these about 7 percent did so. Wanton waste, discarding of high point ducks in particular, was recognized as a potentially serious problem; but it was also a problem with the conventional system. No conclusions were reached concerning the impact on duck populations or harvest.

The task force further concluded that the point system should not be continued in its present form and recommended the following: (1) Bring point values more in line with those of conventional regulations, eliminate the 10-point category, and establish a one-duck differential in bag limit between the two systems. (2) Prohibit pre-sunrise shooting except in the High Plains Management Unit. (3) Offer the point system in limited areas, e.g., where high point birds are not common. (4) Allow a mistake bird in the bag rather than invoke a species closure. (5) Improve the data base. (6) Increase information and education efforts.

Initially, virtually none of these recommendations was adopted. The system was continued with only minor changes in point values with little additional evaluation or data collection until it was suspended in 1988. Although the system has been operational since 1973, criticism continues. The National Audubon Society recommended in 1976 either complete elimination of the system, due primarily to the problems of duck identification and reordering by hunters and related enforcement problems, or substantial modification (Anderson 1976). Anderson cited a nationwide poll of Service law enforcement agents which indicated the system was unenforceable.

Rexstad and Anderson (1988), in evaluating changes in drake and hen mallard recovery rates during pre- and post-point system periods, concluded there was little evidence to suggest that any change in recovery rates had taken place since initiation of the point system, although they recognized limitations in the data.

The theory behind the system is sound, i.e., to direct harvest toward certain species and sexes while requiring only in-hand identification. Furthermore, its use could result in a lower harvest of ducks in general, and high-point species in particular, than with the fixed bag limit system. However, its practical application has been questioned. Hunter behavior, reordering of bags, poor duck identification skills by hunters and difficulty in enforcement appear to hamper fully successful evaluation and implementation of the point system.

Zoning and Split Seasons for Duck Hunting

Zoning is referred to as the division of a state into two or more areas for which duck hunting seasons may be selected independently. The major purpose is to correct perceived inequities in duck harvest opportunity within a state caused primarily by differences in timing of migrations. Interest in zoning and split seasons as harvest management options arose out of concerns among some states that broad federal regulations caused inequities in harvest opportunities both within and among states.

Blandin (1978) described the history of zoning in the United States. Its first recorded use occurred in 1899 when New York established a separate season for Long Island. Three additional zones were used intermittently in New York in the first half of the 1900s. In the Pacific Flyway, excluding Alaska, zones were first established in Idaho during various years in the 1920s and 1930s, California in 1942, and Nevada in 1953.

The Service first allowed states to split their hunting season into two segments. Eastern states were first offered this option in 1947 (U.S. Dep. Int. 1988). Season segments had to be of equal length and, in anticipation that split seasons would increase harvests, a 20 percent reduction in season length was required for states selecting the option. The split-season option was expanded to all states in 1948. During 1952–69 the penalty for splitting seasons was 10 percent. Unequal season segments have been allowed since 1955, and the penalty for splitting seasons was dropped in 1970. Currently, any state may split its duck seasons into two segments of equal or unequal length without penalty.

The option to split seasons did not fully alleviate perceived inequities in harvest opportunity, however, and interest in zoning continued. Despite the early use of zones in the Atlantic and Pacific Flyways, there was considerable resistance to their widespread use, fearing they would result in unacceptable increases in duck harvests. Little evidence concerning this question was available. Finally, in 1970 the Service allowed experimental zoning in the Atlantic Flyway. The first experiment was initiated in 1971 in Massachusetts when the state was divided into two zones with a 5-day season-length penalty in each zone.

Following the Massachusetts experiment, New York began an experiment with additional zones in 1976. Beginning in 1977, the Service offered the option for experimental zoning, without penalty, to all states in the Atlantic and Mississippi Flyways. They were, however, required to meet specific criteria, which generally required that zones would be experimental until their effects were better understood; that no substantial changes in harvest distribution would occur among states, species or populations; that an evaluation plan would be developed; and that season length penalties must be taken if an increase in harvest was expected or occurred (see May 25, 1977 *Federal Register*, 42 FR 26671).

In that year five states in the Mississippi Flyway and one additional state in the Atlantic Flyway initiated zoning experiments. In the Mississippi Flyway, duck-hunting zones had previously been established in Louisiana in 1975 as part of a flyway-boundary study involving additional hunting days in the western part of the state. Subsequent to 1977, several additional states in both flyways began zoning. The zoning option was expanded to include the Central Flyway in 1981 when four states initiated zones, joined by three more in 1982.

Initially, zoning was an alternative to two-way split seasons. The first experiments in the 1970s were limited to continuous seasons within zones. However, beginning in 1979, experiments involving two-way splits within zones were permitted. Also in 1979, Atlantic Flyway states were offered three-way season splits in lieu of zoning to help address concern about differential migrations of species. The Central Flyway was permitted three-way season splits in 1981. Three-way splits have not been offered to the Mississippi or Pacific Flyways.

Since 1971, 28 states in the Atlantic (11), Mississippi (10), and Central (7) Flyways have experimented with duck zoning. Of these, 3 have changed to three-way splits. Of the remaining 25, zones in 9 states have been declared operational and the rest are still considered experimental. Zones in the Pacific Flyway have always been considered operational. In 1988 among the 48 contiguous states, 29 used from two to five zones each for duck hunting, of which 25 split the season into two segments in at least one zone; 7 states split their season into three segments; and 9 split their seasons into two segments.

In 1985 the Service stipulated that existing zones should not be modified and no new duck zoning studies should be initiated until the cumulative effect on ducks is better understood. In 1986 the option for three-way splits in lieu of zoning was limited to those states already zoning.

The results of zoning studies to date give no clear evidence that zoning increases duck harvests. However, interpretation is complicated by factors other than the differences in season timing in zoned states. Most experiments coincided with declining duck populations, thus increases in actual harvests would not be expected, even with zoning. Other complicating factors were differential changes among breeding populations furnishing ducks to various harvest areas, a general decline in hunter numbers, which confounds comparisons of hunter success, and a lack of data from which to determine changes in harvest *rates*, which would have been more meaningful than changes in actual harvest.

Concluding Remarks

Special harvest strategies have been a way of life for decades. Especially during the last 20 years, their use has proliferated (Figure 1) while duck populations have declined in recent years with some species achieving record low numbers. Some special harvest opportunities have undergone extensive testing and evaluation while others have only been superficially studied. Insight into the effects of individual regulations on duck harvest patterns has been gained through some of the analyses, but it has been difficult to assess the cumulative effects of the combination of special regulations on duck harvests and populations in an aggregate sense. For these reasons in particular, the Service, in its Final SEIS on *Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds* (U.S. Dep. Int. 1988), stated its intent to continue to issue annual regulations, but to modify its harvest strategy to stabilize framework regulations and control the use of special regulations such as bonus bag limits and special seasons. It is hoped that, through this strategy, the effects of special regulations, individually and collectively, can be better understood before they are implemented. Furthermore, the Service intends to work closely with the flyway councils in the coming year to complete a thorough review of all published and unpublished data to gain a better understanding of the individual and cumulative, direct and indirect, effects of many of the contemporary special regulations.

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Evaluation and Experimentation with Duck Management Strategies

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Introduction

Informed management of any natural animal population requires that the manager have specific goals, that he have the capability of taking different kinds of management actions that affect the population, and that he have information both on the status of the population and on the likely effects of potential management actions. For harvested populations, management goals generally involve both population size and size of the harvest. Many potential management actions exist for most populations and include such things as habitat acquisition and management, and the setting of harvest regulations. Historically, hunting regulations have been viewed as being very important to the management of North American duck populations (U.S. Fish and Wildlife Service 1988, Nichols in press). Information on the status of North American duck populations is obtained through several collaborative survey programs involving the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, and state and provincial conservation departments (Martin et al. 1979, Smith et al. 1989). Thus, for North American duck populations we are able to develop management goals, we have management actions at our disposal (in this paper we will focus on a particular type of management action, the setting of annual hunting regulations), and we have surveys providing information on population status each year. The subject of this paper is the remaining requirement for informed management, information on the effects of management actions.

Currently, our "knowledge" of the effects of various duck hunting regulations comes from a variety of sources including intuition, population modeling, and both objective and subjective assessments of the effects of historical changes in regulations. As is common in wildlife science, however, much of this "knowledge" cannot be viewed as reliable (see discussion by Romesburg 1981). In particular, we cannot assess the status of a duck population in the spring of year t, impose a particular set of hunting regulations during the subsequent hunting season, and confidently predict population status in the spring of year t+1. A proposed way to obtain reliable knowledge about the responses of animal populations to different management actions involves the treatment of ongoing management programs as experimentation (e.g., see Walters and Hilborn 1978, Romesburg 1981, Macnab 1983, Walters 1986).

We begin this paper with a brief historical review of duck hunting regulations in North America. We then discuss, in general terms, the basis for drawing inferences about effects of management actions on animal populations. This is followed by a discussion of what response variables are of most interest with respect to questions about hunting regulations and how these variables are estimated. We then selectively review past analyses directed at questions about effects of duck hunting regulations on these response variables. Finally, we present some suggestions about future efforts to draw inferences about effects of duck hunting regulations.

Duck Hunting Regulations in the United States

Prior to 1918, regulations governing the hunting of migratory birds in the United States existed only at state and local levels. The Migratory Bird Treaty Act of 1918 established federal authority and responsibility for migratory bird management within the United States. From 1918 until the 1930s, annual hunting regulations were simple, liberal and uniformly applied throughout the United States. The drought of the 1930s led to restrictions, but regulations remained simple and uniform. Large-scale banding programs and systematic waterfowl surveys were initiated in the 1930s and 1940s in order to provide an information base for management decisions (Anderson and Henny 1972, Hawkins et al. 1984, U.S. Fish and Wildlife Service 1988). This new information, coupled with increased state involvement and interest in migratory bird management decisions, led in 1947 to the division of the United States into four flyways for the purpose of setting annual hunting regulations. Since that time, regulations have become increasingly complex and are now set annually in a process permitting substantial state input through the flyway councils.

The primary data base for retrospective analyses directed at inferences about effects of hunting regulations covers the last three decades, and regulations in the United States have varied substantially over that period. During most of the 1960s, hunting regulations were adjusted annually based on estimated spring and predicted fall population sizes. Beliefs about the effects of hunting on duck populations changed in the early 1970s, however, and annual regulations during this decade were more liberal and exhibited less year-to-year variation than during the 1960s. The Stabilized Regulations Program (Brace et al. 1987) was implemented during 1979–84, and bag size and season length were held constant at relatively liberal levels during this period. Low duck population sizes have prompted more restrictive regulations since 1984. In any case, all of our analyses and inferences about the effects of hunting should be viewed as conditional on this historical pattern of variation in hunting regulations.

Annual duck hunting regulations in the United States can be divided into two categories for purposes of discussion, framework regulations and special regulations (*see* U.S. Fish and Wildlife Service 1988 for more detail). Framework regulations include season length, daily bag limit and the outside dates for the opening and closing of the season. Framework regulations are regarded as the core of annual regulations and are the regulations most frequently changed in response to management needs.

Special regulations are developed in response to specific management needs and opportunities, and pertain to particular areas, species or situations. Special regulations include zoning, split seasons, special seasons, area closures and bonus birds (U.S. Fish and Wildlife Service 1988). Special regulations are often implemented on a relatively small geographic scale. However, the complexity and number of such regulations have increased the complexity of annual duck hunting regulations in recent years.

The Basis for Inference

Manipulative Experiments

One way of learning about ecological and other types of systems that has many advantages, and therefore many strong advocates, is through manipulative experiments. Different authors define terms such as "experiment" and "manipulative experiment" in different ways, and we refer interested readers to Fisher (1971), Cox (1958), Hurlbert (1984) and Skalski and Robson (in review) for relevant discussions. Rather than provide still another entry to the existing list of definitions, here we simply list key features associated with our idea of what constitutes a manipulative experiment.

As the term implies, in a manipulative experiment the experimenter is able to perturb or influence the system under study and to apply different treatments to different experimental units. In an experiment on the effects of hunting regulations, for example, two very different sets of hunting regulations could be selected for application to different areas and their associated populations or subpopulations. The basic idea of the manipulative experiment is to estimate the variance among experimental units receiving the same treatments, and to use this as the basis for evaluating treatment differences. Replication and randomization are important aspects of the assignment of treatments to experimental units. Replication refers to the application of a particular treatment to more than one experimental unit and provides the basis for estimating the experimental error or error variance (the variance associated with all factors except the different treatments being tested). Randomization refers to the random assignment of treatments to experimental units. The primary purpose of randomization is to insure that experimental units receiving different treatments do not differ from each other in any systematic manner other than that associated with the treatments.

Constrained Studies

In many instances it is not possible to conduct a manipulative experiment, and we must choose between either a constrained study or no study at all. Good discussions of such constrained studies have been provided by Green (1979) and Skalski and Robson (in review). Green (1979) discusses five different kinds of constrained ecological studies, two of which are relevant to investigations of the effects of hunting regulations. Green's (1979) "main sequence 1" includes at least one "control" area (or at least one area per treatment) and requires sampling both before and after imposition of the treatment(s). Inferences are then based on the relative change between pre- and post-treatment periods on areas exposed to different treatments. Green's (1979) "main sequence 2" is restricted to one or more areas that all receive the same treatment at a particular time. In this case, inferences must be based on differences observed at different times (and thus treatments), and such inferences are limited. Skalski and Robson (in review) define assessment studies as those lacking true replication of experimental units, impact studies as those in which it is not possible to randomize assignment of treatments, and impact assessments as studies lacking both randomization and replication.

Response Variables: Identification and Estimation

A response variable is simply a variable that we are interested in and that we suspect may be affected by our treatments. All inferences about possible treatment effects must involve comparisons of estimates of response variables under different treatments. Questions about the effects of harvest regulations can arise from the manager's interest in both the harvested population and the hunter. Questions motivated by an interest in the hunter usually involve the magnitude and distribution of the harvest and hunter success (e.g., as measured by harvest per unit effort expended). Questions motivated by an interest in the bird population often involve the magnitude of both the harvest and harvest rate, and the translation of effects on these quantities into effects on survival rate and ultimately population size. Response variables for studies involving different hunting regulations thus include the following quantities: harvest, harvest per unit effort, harvest rate, survival rate, population size, and rate of population change.

Estimation of quantities associated with duck harvest and population dynamics has been reviewed by Martin et al. (1979) and Smith et al. (1989). Estimates of harvest and hunter effort are obtained from the U.S. Harvest Survey (Martin and Carney 1977). This survey has two main components: the Hunter Questionnaire Survey and the Parts Collection Survey. The Hunter Questionnaire Survey involves the mailing of questionnaires to a sample of hunters after the hunting season each year. The returned questionnaires contain information on hunter effort and the number of ducks and geese harvested. The Parts Collection Survey involves the mailing of special envelopes to a sample of hunters who are asked to mail in duck wings and goose tail feathers from harvested birds. Wings and tail feathers from this survey are then identified to species, sex, and age by appropriately trained biologists. The resulting estimates of the number of ducks harvested (from the Hunter Questionnaire Survey) and the proportional composition of this harvest (from the Parts Collection Survey) are combined to estimate number of ducks harvested by species, sex and age (Martin and Carney 1977).

Population size of prairie-nesting duck species is estimated in May of each year via an extensive aerial survey of breeding ground habitat in the United States and Canada. Transects are flown according to a systematic, stratified design, and a double-sampling approach with a ground count subsample is used to estimate visibility, or the proportion of ducks seen from the air (Pospahala et al. 1974, Martin et al. 1979). Some of these same transects are flown again in the July Production Survey to obtain information on numbers of broods and renesting activity (Henny et al. 1972). In addition to breeding ground surveys, a midwinter survey is conducted throughout the United States in January and provides, at best, an index to waterfowl abundance on the wintering grounds (Martin et al. 1979). However, special winter surveys have been designed and have been successful at meeting specific objectives (Haramis et al. 1985, Conroy et al. 1988).

Estimates of annual survival rates and harvest rates of ducks are obtained from banding and band recovery data. The U.S. Fish and Wildlife Service, Canadian Wildlife Service, and state and provincial conservation departments participate in an extensive cooperative banding program for ducks. Most banding is conducted in either the preseason (July–September) or winter (January–February) period. For a particular banding station (or group of stations combined to form a reference area), an effort is made to band birds of a particular species for a number (hopefully more than 4) of consecutive years. Band recoveries of birds shot or found dead during subsequent hunting seasons provide the data needed to estimate annual survival rates and recovery rates (Brownie et al. 1985). Annual survival rate is defined as the probability that a bird alive at the time of banding in one year is alive at the same time the following year. Recovery rate is the probability that a banded bird alive at the time of banding in one year is shot (or found dead) in the subsequent hunting season, retrieved by a hunter and its band reported to the Bird Banding Laboratory. Both survival and recovery rates can be estimated using the models of Brownie et al. (1985). An alternative estimator for recovery rate is the direct recovery rate, computed as (number of birds banded in year i and recovered in the hunting season of year i)/(number banded in year i).

Additional data are needed to estimate two other quantities of interest, harvest rate and kill rate. Harvest rate is defined as the probability that a bird alive in the preseason banding period is shot and retrieved or found dead by a hunter during the subsequent hunting season. Harvest rate is estimated by dividing the recovery rate estimate by an estimate of band reporting rate. Reporting rate is generally estimated from special reward band studies (Henny and Burnham 1976, Conroy and Blandin 1984). Finally, kill rate is defined as the probability that a bird alive in the preseason period of a given year is killed by a hunter during the subsequent hunting season. Estimation of kill rate requires an estimate of harvest rate and an estimate of unretrieved kill. Unretrieved kill is not regularly estimated, but has been estimated via a Hunter Performance Survey (Martin and Carney 1977).

We believe that it is important for the investigator to keep in mind the relationship between the selected response variable and the variable of ultimate interest. For example, one of the central goals of management is frequently expressed in terms of a desired population size or rate of population change. Survival rate is one of the determinants of change in population size, and thus is a reasonable choice as a response variable. However, it must be remembered that reproductive rate and rates of emigration and immigration are also determinants of population change. If an investigation provides evidence that certain hunting regulations lead to a decrease in annual survival rate, then it does not follow that implementation of these regulations will necessarily result in a decline in population size. Reproductive rates and/or rates of movement may be sufficiently high to maintain a stationary or even growing population even in the face of declines in survival. In some sense the utility of a response variable to future management decisions is a function of its relationship to the variable of ultimate management interest, with more closely related variables being more useful. Population size and rate of change are thus good choices as response variables in many situations.

Previous Studies of Effects of Duck Hunting Regulations

In this section we will briefly review previous studies of the effects of duck hunting regulations on harvest and population status. Our intent here is to focus on the design and analyses of these studies and to consider the relative strength of resulting inferences.

Bag Limit and Season Length

Daily bag limit and season length are generally viewed as the duck hunting regulations likely to have the greatest effect both on duck harvests and duck populations. Almost all studies directed at the effects of these two important components of regulations have involved post hoc analyses rather than experiments or assessments with some a priori design. We organize this review by the three response variables commonly used in studies of regulations and their influence.

Harvest. Some investigators have studied the relationship between duck harvest and both daily bag limit and season length. For example, the U.S. Fish and Wildlife Service (1988) reviewed previous studies addressing the relationship between mallard (*Anas platyrhynchos*) harvest in the Central Flyway and three "independent" variables, mallard population size, daily bag limit and average season length. A similar multiple regression approach to investigating the relationship between regulation components and U.S. mallard harvest was attempted by Martin and Carney (1977). As discussed by Martin and Carney (1977) and U.S. Fish and Wildlife Service (1988), such analyses do not permit unambiguous inferences because of the covariation among "independent" variables. Over the period for which harvest data are available, mallard population size, season length, and daily bag limit have varied together. During years when mallard population size estimates have been low, hunting regulations (especially bag limit and season length) have been restrictive, whereas during years of relatively high population size, regulations have been liberal. Thus, although years of high mallard harvest estimates do correspond to years with long seasons, large bag limits and high population size, it is simply not possible to disentangle the relative influences of these three variables on harvest.

From an experimental design standpoint, this situation represents one of the worst possible scenarios. First, as is common to most of our analyses, the "treatments" (differing regulations) are applied to different years rather than different areas within years (see later discussion of potential problems with this approach). Second, the two treatment variables that we are interested in, bag limit and season length, varied together, precluding any possibility of separating their effects on harvest. Third, the two treatment variables also covaried with population size, a variable which also must be related to the response variable, harvest (Trost et al. 1987). This third problem prevents us from making any statements about even the combined effect of bag limit and season length on harvest.

Boyd (1983) conducted simple correlation analyses between U.S. duck harvest and daily bag limit and between U.S. duck harvest and season length. Here, the other variables thought to influence harvest (population size and the regulation variable not being tested) are not included in the analysis, but their effects still exist and make reasonable inference impossible.

Recent harvest restrictions on American black ducks (*Anas rubripes*) have included a reduction in daily bag to one bird and various reductions in season length differing among states. Serie (unpubl. report, 1988) compared harvest estimates for five years of restrictive regulations (1983–87) to those for five pre-restriction years (1977–81). In a similar evaluation, Caswell et al. (1985) compared mallard harvest estimates for a period of restrictive bag limit and season length in Manitoba (1973–78) with estimates for periods of more liberal regulations before (1969–72) and after (1979–

83) the restrictions. Although these analyses did not suffer from year-to-year variation in hunting regulations keyed to variation in population size estimates, population size did show some variation in both cases and may have influenced observed changes in harvest. However, harvest was not the only response variable investigated by either Serie (unpubl. report, 1988) or Caswell et al. (1985), and other analyses produced less ambiguous inferences.

Recovery and harvest rates. We believe that band recovery rates and harvest rates are more logical response variables for investigating effects of hunting regulations than harvest. Number of birds harvested depends on population size, and any given set of hunting regulations is expected to result in a larger harvest when population size is high than when it is low (Trost et al. 1987). Harvest rate is the variable that we would like to influence with hunting regulations. In most cases, we must use band recovery rate estimates (from preseason banded samples) to index harvest rate. The important assumption underlying the use of recovery rates in analyses directed at effects of hunting regulations is that band reporting rates are approximately constant over time (see Conroy and Blandin 1984) and especially that they do not vary with hunting regulations.

The historical covariation between bag limit and season length has led to the recognition by many investigators that effects of these two components of regulations cannot be separated in analyses of historical data. This recognition has caused some investigators to categorize years with extreme regulations as either restrictive or liberal, and to test for differences in response variables associated with these two sets of years. This approach has been used to investigate the relationship between regulations and harvest rates (indexed by recovery rates) for continental mallards (Martin et al. 1979, Rogers et al. 1979), canvasbacks (*Aythya valisineria*, Geis and Crissey 1969), and black ducks (Krementz et al. 1988). All of these analyses produced evidence of higher recovery rates during years with liberal bag limits and season lengths and lower recovery rates during years with restrictive regulations.

Two recent investigations have focused on specific attempts to restrict hunting pressure through U.S. hunting regulations. Serie (unpubl. report, 1988) compared recovery rates of black ducks before and after recent restrictions, and Trost (unpubl. report, 1988) provided a similar analysis for mallards. Caswell et al. (1985) used a similar approach to evaluate the effects of restrictive Manitoba regulations on mallards. Evidence of lower recovery rates during the years of restrictive regulations was found in all three cases.

In both types of analysis, those focusing on specific restrictions and those investigating effects of historical variation in hunting regulations over a long period of time, the different treatments (regulation types) were applied to different years (as in Green's 1979 main sequence 2). There were no cases of different treatments being applied to different areas (and subpopulations) in the same year. Certainly, factors other than hunting regulations influence harvest and recovery rates to some degree. If these factors exhibit year-to-year variation (and most probably do), then our tests of recovery rates in years of differing regulations may be influenced by these factors. If years of differing regulations were selected randomly or were interspersed by an appropriate a priori design, then it would be very unlikely that factors other than regulations would produce low recovery rates during years of restrictive regulations and high recovery rates during years of liberal regulations, by chance alone. However, as described above, most historical regulation changes have been triggered by perceived changes in population status, increasing the likelihood of systematic differences in confounding factors among years of different regulations.

Regarding the continental analyses of Martin et al. (1979), Rogers et al. (1979) and Krementz et al. (1988), population size was generally higher in years of liberal regulations than during years of restrictive regulations. However, the limited evidence for a relationship between population size and harvest rate indicates that harvest rate may decrease when population size is large (Trost et al. 1987), making the cited regulations tests conservative. The analyses investigating anticipated reductions in harvest rates accompanying recent periods of restrictive regulations for black ducks (Serie, unpubl. report, 1988) and mallards (Trost, unpubl. report, 1988) did not suffer from major year-to-year changes in population size. However, the initial decisions to implement periods of restrictive regulations were certainly based on low population sizes, although this association between restrictions and low populations again results in conservative tests. In most of the above studies, it was not possible to disentangle year effects from treatment effects because the treatment applications were essentially continent-wide. Only the Manitoba mallard study of Caswell et al. (1985) was not constrained in this way. We believe that the inferences from that study could be strengthened by conducting similar comparisons of mallard recovery rates for neighboring banded samples (e.g., in southern Saskatchewan, Minnesota, and North Dakota) over the same time periods. Such an analysis could still be done and would represent an example of Green's (1979) ''main sequence 1.''

Another potential problem in all of the studies using recovery rates to investigate effects of hunting regulation on harvest rates is the possible association between band reporting rates and regulations. For example, it may be that hunters are less likely to report bands during years of restrictive hunting regulations. However, we have no evidence at this time suggesting that this might be true. One way to test this hypothesis would involve use of reward bands during years of very different hunting regulations.

In summary, most previous investigations of the effects of regulations on harvest rates have not involved the favored ''main sequence 1'' design of Green (1979). Even more important, treatments have not been assigned randomly to years. Instead, regulation changes have been associated with changes in population size. However, the nature of the relationship (if any) between population size and harvest rate (lower harvest rate at high population size) is such that it could not have produced the observed pattern of high recovery rates during years of liberal regulations and low recovery rates when regulations have been restrictive. Therefore, we believe that this pattern is indicative of an effect of hunting regulations on harvest rate. It is also possible that the observed changes in recovery rates have been caused by changes in band reporting rate, rather than in harvest rates. We currently believe that the observed changes in recovery rates in response to regulations changes are too large and consistent to have been caused by changes in reporting rate, but we cannot rule out this possibility.

Survival Rate. The relationship between annual survival rate and both season length and bag limit has been explored directly and indirectly. The direct approach is similar to that used to study regulations and recovery rates, and has involved comparisons of estimated survival rates during years of dissimilar regulations. The indirect approach involves investigations of the relationship between survival rates and both recovery rates and harvest rates. This relationship is interesting in its own right and is relevant to questions about effects of regulations because of the relationship between regulations and both recovery and harvest rates (evidence cited above).

Several studies of the effects of bag limit and season length on annual survival rate have proceeded as with the recovery rate studies cited above. An historical data set is examined, and years are classified as having liberal or restrictive hunting regulations. Average survival rates are then estimated (Brownie et al. 1985) for each set of years and compared. Anderson and Burnham (1976) and Rogers et al. (1979) conducted such analyses using historical data from mallards banded throughout North America, and Krementz et al. (1988) used a similar approach with historical black duck data. Neither Anderson and Burnham (1976) nor Rogers et al. (1979) found evidence of lower mallard survival rates during years of liberal regulations. Krementz et al. (1988) did find evidence of lower survival rates in liberal years. However, liberal regulations for black ducks occurred in the 1950s, whereas restrictive regulations have occurred after that time. Thus, the black duck tests involve different decades, and it is very possible that factors affecting survival other than hunting regulations also differed between the tested periods. Nichols and Haramis (1980) used this approach with canvasbacks, but their analyses were based on small samples and resulting tests lacked power.

In addition to the above analyses in which years of differing regulations were selected from historical data, there have been studies of specific changes in regulations. Trost (unpubl. report, 1988) compared survival rates of mallards for periods before and after recent regulation restrictions. He found no differences, but his post-restriction period involved only two years and his tests were likely not as powerful as we would like. Caswell et al. (1985) compared mallard survival rates during the 1973–78 period of restrictive mallard regulations in Manitoba with those from periods before (1969–72) and after (1979–83), and found evidence ($P<0.01$) that survival rates of adult mallards were higher during the period of restrictive regulations.

The alternative approach involves studying the relationship between survival rates and recovery or harvest rates (rather than regulations), and has been used by a number of investigators. Analyses using this approach with continental banding and recovery data for mallards have been presented by Anderson and Burnham (1976), Rogers et al. (1979), Nichols and Hines (1983), Burnham and Anderson (1984), Burnham et al. (1984), and Trost (1987). These analyses have provided little evidence of a relationship between survival rates and recovery or harvest rates. Similar analyses for black ducks (Blandin 1982, Krementz et al. 1988), wood ducks (*Aix sponsa*, Trost in press), and ring- necked ducks (*Aythya collaris*, Conroy and Eberhardt 1983) have generally had poorer data bases than those available for mallards. However, the analyses of Krementz et al. (1988) and Trost (in press) did provide some evidence of an inverse relationship between survival and harvest rates for black ducks and wood ducks, respectively.

The investigations involving hunting regulations and survival rates generally experienced the same kinds of problems as those involving regulations and harvest (or recovery) rates. In most cases, different regulations were applied to different years and no geographic control was possible. In such cases it is always possible that factors not related to regulations, but still capable of influencing survival rates, vary from year to year in a manner that would obscure the true relationship between regulations and survival. The historical relationship between regulations and population size is especially bothersome in this regard, as it has been hypothesized that population size during some periods of the year may influence survival at such times. In this respect, the analyses involving specific changes in regulations for several-year periods (Caswell et al. 1985, Trost unpubl. report, 1988) are preferable to those involving selection of years from periods of year-to-year variation in both population size and regulations. In the studies involving continental banding data and regulations, there is little opportunity (using historical data) to make use of geographic controls. However, the study by Caswell et al. (1985) on Manitoba mallards could have used data from nearby areas as controls, and we believe that this would have led to stronger inferences.

As noted, nearly all of these studies followed Green's (1979) ''main sequence 2'' with different treatments being applied to different years. Trost (1987) used this approach, but also tried an alternative in which treatments could be thought of as having been applied to different areas. He estimated average harvest rates (assumed to be influenced by regulations) for mallards banded in different areas of North America over the period 1975–85. He found that average survival estimates for the same period were negatively correlated with harvest rates across areas for males and young females. Year-to-year variation is of little consequence in this analysis, as all areas were examined over the same time period. Instead, we now have to worry about factors other than harvest rate that might influence survival and that might vary from one part of North America to another in a way that might obscure the true relationship between harvest and survival rates. So in the analyses most commonly used, treatment effects are confounded with year effects, whereas in the analysis of Trost (1987) treatment effects are confounded with area effects.

A final point regarding these analyses of covariation between harvest rates and survival rates involves the magnitude of the effect to be detected. When we are estimating some response variable (e.g., harvest rate, survival rate) during periods characterized by two different levels of regulations (e.g., liberal and restrictive), we expect to have a better chance of detecting a difference when the regulations themselves are very different. Small changes in regulations are expected to lead to small changes in response variables, and small changes are more difficult to detect than large ones. When we are dealing with changes in hunting regulations, we cannot usually specify an expected change in response variables with any certainty. However, if we specify a certain change in harvest rate, then we can predict the corresponding change in survival rate, at least under the extreme hypotheses of total additivity (Anderson and Burnham 1976). The degree of variation in regulations or harvest rates is a very important determinant of the power of analyses of historical data. Burnham and Anderson (1984) noted that estimated variation in mallard recovery rates was much greater in the 1960s than during the 1970s, and that the additional banding data of the 1970s were thus of limited value in addressing questions about effects of hunting on survival.

Point System

Conventional daily bag limits specify the number of birds of a particular species or other group that may be taken by a hunter in one day. The point system is an alternative approach in which ducks are assigned point values usually ranging from 10–100. The daily bag limit is reached when the sum of the point values of harvested ducks first equals or exceeds 100 (i.e., when the point value of the last duck taken causes the sum to equal or exceed 100). Under the point system, abundant birds are assigned low point values and species requiring protection are assigned high values. In this manner, the point system is thought to be useful in directing harvest pressure toward particular groups of ducks (e.g., species, sexes) and away from others.

The point system was tested in specific locations during 1968–69, tested in a number of states in 1970, and used operationally in 22 states in 1987 (U.S. Fish and Wildlife Service 1988). Investigators have addressed several different questions about the performance of the point system relative to conventional bag limits, including violation rates, hunter opinions, and relative harvest of different groups of ducks. Here, we review studies directed at the question of whether the point system provides an effective means of increasing the harvest of one group of ducks relative to another.

An intensive field investigation of the point system and two other types of regulations (a straight two-bird limit without regard to species; daily bag limit of four ducks, not to include more than one mallard, one black duck, two wood ducks, or one canvasback or redhead, *Aythya americana*) was conducted at the Shiwassee River State Game Arca, Michigan (Mikula et al. 1972). One of these three regulation types was randomly assigned to each of 70 half-day hunting periods during the 1969 season. Hunter performance observations and bag checks were used to provide data on relative harvest of different categories of ducks. Results provided evidence of lower harvest rates for high-point ducks under the point system. In particular, the ratio of drake (20 points) to hen (60 points) mallards was much higher under the point system. The restriction of this study to a single year and area certainly restricts generalization of the results of this study. However, the randomized application of the three regulation types to the half-day hunting periods make the resulting inferences very convincing for this specific field situation.

Tests in the San Luis Valley, Colorado, involved application of conventional duck hunting regulations during the hunting seasons of 1963–67 and the point system during the seasons of 1968–71 (Hopper et al. 1975). Although mallard point values varied over the point system years, drakes were always given a lower point value (10–20 points) than hens (40–100 points). Data from a special wing-collection survey provided evidence of a higher proportion of drakes among harvested mallards during the point system years. The relative recovery rates (recovery rate for males divided by that for females) for mallards banded preseason and recovered in the San Luis Valley were also higher during the point system years. From a design standpoint, perhaps the major shortcoming of this study was the application of different treatments (regulation types) to sets of consecutive years. It is always possible that something other than regulation changes caused the tendency for a greater relative harvest of drake mallards during the latter period of the study. Because this study was conducted on a restricted area, it likely would have been possible to include neighboring areas in the design. Even a post hoc analysis using data from nearby locations with conventional regulations in place during 1968–71 would strengthen inferences from this study.

Large-scale investigations including a number of states, rather than local study areas, were conducted by Geis and Crissey (1973) and Rexstad and Anderson (1988). Geis and Crissey (1973) used data from the mail questionnaire, parts collection and special hunter performance surveys for 12 states implementing the point system in

1970. Harvest estimates from 1966–70 were used to test whether composition of the duck harvest was shifted away from high-point birds during 1970. States were treated as replicates, and it was concluded that harvest of 90-point birds was consistently reduced in 1970 relative to the two previous years (Geis and Crissey 1973). Neighboring states using conventional bag limits in 1970 were not used in this analysis of harvest composition. The ratio of drakes to hens among adult mallards in the harvest was higher in 1970 than during the previous four years in most of the 10 point system states in the Central and Mississippi flyways but not in 14 states from the same two flyways employing conventional bag limits (Geis and Crissey 1973). Data from the hunter performance surveys yielded a statistic, ducks downed per opportunity, that was higher for 10–20 point ducks than for 90-point birds during 1970, but not during previous seasons. Although no statistical tests were used with these data, Geis and Crissey (1973) concluded that hunters selected the low-point birds in 1970. All of the above analyses included geographic or spatial replication as states were treated as replicates. However, in all analyses except that dealing with adult mallard sex ratios, treatments were applied to years so that the test statistic (in cases where one was computed) was based on differences between sets of years (with only one year of point system regulations). The analysis dealing with sex ratios of adult mallards was much more convincing than the others because it included a comparison of sex ratios in the harvest not only between years within point system states, but also between point system and neighboring conventional bag states during a particular year. This same kind of approach would have strengthened other inferences in the report.

Rexstad and Anderson (1988) based their analysis of the point system on band recovery rates from mallards banded preseason in areas contributing birds to harvests of point system states. Mean recovery rate estimates were compared for 10–15 years before and after implementation of the point system. There was little evidence of changes in recovery rates between the two periods for either males or females. However, there was evidence that the difference between male and female recovery rates increased between the two periods. Rexstad and Anderson (1988) noted that this increase cannot necessarily be attributed to the point system because of the lack of a true control group. Once again, the different treatments were applied to different years, with no information on different treatments applied to different areas within the same year(s).

In summary, the four reviewed studies of the point system represent several different design and testing approaches. The Mikula et al. (1972) study was convincing because treatments were randomly allocated to 70 experimental units (half-days of hunting). It is not possible to generalize these results, however, because they were obtained on only one specific area. The study of Hopper et al. (1975) was also restricted to one area. Treatments were associated with particular years, and all inferences were based on between-year differences (Hopper et al. 1975). Information on the selected response variables from neighboring areas would have greatly strengthened inferences from this study. The large-scale investigations by Geis and Crissey (1973) and Rexstad and Anderson (1988) also suffered from the confounding of year and treatment effects. Geis and Crissey (1973) did present data from both conventional bag limit and point system states for one of their analyses, substantially strengthening the resulting inference.

Shooting Hours

Shooting hours are the times of the day when waterfowl harvest is permitted. Although they are generally considered in conjunction with framework regulations, they are seldom changed and generally are not used as a means of managing harvest, at least at the federal level. Reynolds et al. (in review) conducted a special hunter performance survey designed to estimate the proportion of both protected and legal species harvested in the morning twilight period. However, this investigation was descriptive in nature and did not involve a test of different shooting hours.

Minnesota experimented with afternoon closure of waterfowl hunting as a means of reducing waterfowl harvest (Kirby et al. 1976). Kirby et al. (1983) investigated effects of these regulations on mallard harvest and survival rates by comparing average recovery and survival rate estimates for mallards banded preseason in Minnesota during years of sunset (1964–72) and afternoon (1973–79) closure. Recovery rates, estimated using all recoveries and using only Minnesota recoveries, were significantly lower during the years of afternoon closure. No evidence of differences in survival rate was found between the two periods, but power of the tests was very low, so results were inconclusive (Kirby et al. 1983). Inferences from this study were again limited by the application of different treatments to different years and the absence of control areas. Data from neighboring states are likely available and could be used to strengthen inferences from this study.

Zoning

Zoning refers to the delineation of two or more areas within a state that may have independent waterfowl seasons. There have been several attempts to evaluate effects of zoning on harvest, harvest rate and survival rate. Despite the fact that the establishment of new zones must be accompanied by an evaluation of potential effects (U.S. Fish and Wildlife Service 1988), there have been few published accounts of these studies.

The High Plains Mallard Management Unit in the Central Flyway is a large-scale example of zoning. After experimental liberalizations in 1969, a 90-day season was granted to states in this zone in 1970, with the intention that the extended late season would concentrate hunting pressure on drake mallards (U.S. Fish and Wildlife Service 1988). Hyland and Gabig (1980) tested for changes in survival rates of winter-banded mallards between years before (1963–68) and after (1971–75; 1969–70 were regarded as transition years) implementation of High Plains regulations. They found no evidence of such changes for males, but evidence (which they regarded as weak; $P=0.06$) of lower female survival rates after implementation of High Plains regulations. Hyland and Gabig (1980) noted that although they did not reject the null hypothesis of no difference between periods for females, point estimates were lower in the post-High Plains period. They recommended that "new estimates should be made as soon as more current data became available" (Hyland and Gabig 1980:13).

Recently, Nichols et al. (unpubl. report, 1989) were asked to reexamine possible effects of the High Plains regulations using more recent data. The first part of their analysis included a comparison of survival rate estimates before and after High Plains regulations. They found strong evidence ($P<0.05$) of lower survival rates for females during the years of High Plains regulations and weak evidence ($P=0.09$ for a summary test statistic) for males. However, they noted that their evidence of changes over time did not necessarily mean that these changes were caused by the change in regulations. They stated that they intend to examine Mississippi Flyway data from the same time periods as a partial geographic control in order to obtain stronger inferences.

In 1975, Louisiana was divided into an eastern zone with Mississippi Flyway affinities and a western zone with many birds being derived from the Central Flyway. The eastern zone retained Mississippi Flyway regulations, whereas the western zone was permitted five additional days early in the hunting season. Evaluation of this zoning included efforts to provide descriptive information about the proportions of the harvest and wintering populations of each zone associated with the two flyways. However, the evaluation also included the comparison of estimates of harvest and hunter effort for the period before (1970–74) and after (1975–81) zoning (U.S. Fish and Wildlife Service and Louisiana Department of Wildlife and Fisheries 1983). Estimated harvest of mallards, wood ducks and total ducks increased substantially in Louisiana after zoning. Increases were also observed in other Mississippi Flyway states, but the estimated magnitudes were much smaller than in Louisiana. Estimated hunter-days increased in Louisiana, but decreased in the remainder of the Mississippi and Central flyways. The availability of estimates of both response variables before and after zoning both in Louisiana and in neighboring states should be sufficient to permit a good analysis of the effects of zoning. However, the report presented only point estimates and no overall statistical analysis.

The establishment of most state zones has not attracted as much attention as the High Plains and Louisiana zones. Blandin (1978) discussed evaluation efforts for zones in Massachusetts and New York. Massachusetts opted for a coastal and an inland zone, and Blandin (1978) compared harvest estimates for periods before (1966, 1968–69) and after (1971–73) zoning. Point estimates of harvest were smaller after zoning for three of four species. Comparable data from neighboring states would have been useful in efforts to decide whether these apparent differences were asociated with the zoning. In a preliminary evaluation, Blandin (1978) reported point estimates of duck harvest and harvest per hunter in New York during 1976 (when New York's Upstate Zone was divided into three experimental zones) and during the previous five years, 1975–75. Point estimates of both response variables were larger in 1976, but point estimates of these quantities were also larger for neighboring states. Again, no statistical analysis was used to evaluate results.

In a later report, Blandin (1981) compared point estimates of harvest in states that were and were not zoned and found that harvests of zoned states had tended to decline more rapidly than those of other states. Initially, it may appear that these data on harvest before and after zoning in states that did and did not choose to zone should be amenable to formal analysis efforts directed at generalized effects of zoning. However, it must be remembered that zoning is not a standardized treatment. Zones are tailored to specific objectives for specific states. Therefore, it would not be appropriate to treat states choosing to zone as replicates to which a single treatment was applied.

The efforts to evaluate the High Plains zone relied heavily on banding data and resulting survival rate estimates. The Louisiana zoning report included survival rate estimates for years after zoning was initiated but included no before versus after zoning survival comparisons. Most of the evaluation efforts directed at zones (Louisiana, Massachusetts, New York) have involved simple comparison of point estimates based on the harvest survey. Before and after estimates of harvest and related quantities are frequently available both for the zoned states and neighboring states that do not zone. It would seem that reasonable analyses directed at the effects of zoning could be conducted with such data, although it is possible that the imprecision of state harvest estimates (*see* Couling et al. 1982, Geissler 1989) would result in tests of very low power. In such cases it may be more reasonable for individual states proposing zones to develop their own special harvest surveys for the period of evaluation.

Special Seasons

Special seasons have been used frequently to provide additional waterfowl hunting opportunity. Estimates of various quantities estimated from harvest survey and parts collection survey data during special teal and scaup seasons have been presented in a descriptive manner by Martinson et al. (1966) and Blandin (1981). There have been several recent attempts to investigate effects of special seasons on target and non-target duck populations, and we will discuss these below.

In 1979, Iowa was permitted to take five days of its regular season in late September, before the regular season framework opening. The season was intended to provide additional harvest of blue-winged teal (*Anas discors*), but there was concern for possible effects on locally-reared wood ducks and mallards. Hansen and Kienzler (unpubl. report, 1986) investigated effects of this early season on harvest of blue-winged teal and on harvest and survival rates of wood ducks. Analyses of state bag check data and U.S. Fish and Wildlife Service harvest estimates for the pre-experimental (1972–78) and experimental (1979–84) periods provided evidence of an increase in the proportion of blue-winged teal in the harvest, especially during the first part of Iowa's split season.

Hansen and Keinzler (unpubl. report, 1986) also estimated survival and recovery rates of wood ducks banded preseason in Iowa, Illinois and Wisconsin using the models of Brownie et al. (1985). Recovery rates were significantly ($P<0.10$) higher during the experimental years for three of the four age-sex classes of wood ducks banded in Iowa. Point estimates of recovery rate for wood ducks banded in northern Illinois and southern Wisconsin also tended to be higher during the 1979–83 period, but only in one case was the difference significant (Hansen and Kienzler unpubl. report, 1986). There was weak evidence ($P = 0.10$) of lower survival rates for young male and female wood ducks banded in Iowa during the experimental period. However, point estimates of survival rate for Illinois and Wisconsin wood ducks also tended to be lower in the 1979–83 period. The report by Hansen and Kienzler (unpubl. report, 1986) illustrates the importance of geographic controls. In the absence of recovery and survival rate estimates from wood ducks banded in Illinois and Wisconsin, we would likely have tended to interpret the higher recovery rates and lower survival rates of Iowa wood ducks during the experimental period as effects of the September season. However, the similar trends in survival and recovery rates of Illinois and Wisconsin birds cast doubt on this interpretation and point toward the hypothesis that some other factor might be responsible for regional changes in wood duck survival and recovery rates.

Kentucky and Tennessee initiated five-day September waterfowl seasons in 1981. These seasons were intended to increase harvest of migrant teal and resident wood ducks. Sauer et al. (in press) investigated possible effects of these seasons on wood duck survival and harvest rates. They compared average survival and recovery rate estimates (Brownie et al. 1985) for the periods before (1967–80) and after (1981–86) the initiation of the September seasons. Both male and female wood ducks banded in Tennessee showed significant ($P<0.05$) increases in recovery rates and decreases in survival rates in the experimental years. Banding and recovery data were sufficient to estimate recovery and survival rates for only one pre-experimental year (1980) for Kentucky wood ducks, so resulting tests had low power. Although point estimates for Kentucky wood ducks changed in the same direction as for Tennessee birds, the only significant changes involved increased recovery rates for males. The analysis of Sauer et al. (in press) thus provided some evidence of increased harvest rates and decreased survival rates for Tennessee wood ducks in the years of the experimental September season. Once again, however, inferences would have been stronger if comparable data had been available for neighboring southern states without the special season.

States in the southern portion of the Atlantic Flyway were offered an early wood duck season option beginning in 1977. Details of this option and of the participation by different states are presented by Johnson et al. (1986). The option was designed to permit additional harvest of southern wood ducks before the arrival of northern migrants. Concern for possible effects of this regulatory change on nontarget northern populations led to an analysis of harvest survey and banding and recovery data for Atlantic Flyway wood ducks by Johnson et al. (1986). They compared response variables for two periods, before (1970–76) and after (1977–83) implementation of the liberalized regulations. Treating years as replicates, they found that wood duck harvest and harvest per hunter-day were significantly higher after liberalization. They also found evidence of increased recovery rates among young male wood ducks from southeastern states, but not for other groups or areas. They found no evidence of lower survival rates in the years of liberal regulations, but reported that power of these tests was not good in some cases (Johnson et al. 1986). The preference of harvest rate or recovery rate to absolute harvest as a response variable is illustrated by this study. If recovery rate had not been examined, then the increase in harvest during the years of liberal regulations might have been attributed to the change in regulations. However, the absence of a corresponding change in recovery rate led to the alternative explanation that the increased harvest could likely be attributed to increases in wood duck numbers.

Considerations for Future Studies

Here we discuss a variety of considerations relevant to the conduct of future studies on the effects of hunting regulations. We must preface this discussion with two important points. First, our recommendations are tempered by a knowledge of some of the constraints associated with large-scale waterfowl studies. Some of our recommendations definitely involve "suboptimal" designs. When faced with the question of whether to attempt a constrained investigation or to not conduct any study at all, we frequently opt for the constrained study, although we realize that many people might disagree with this approach. We believe that weak inferences are sometimes better than no inference at all, but recognize that many statisticians likely do not share this point of view. Our second point is that our discussion will not be at all comprehensive. Books dealing with experimental design have been written by both statisticians and biometricians, and it is not our intent to review all relevant topics. Instead, we have selected a few topics that seem especially relevant based on our review of previous investigations involving duck hunting regulations.

General Design

Testing effects of management actions such as hunting regulations on duck populations can be very difficult. In order to illustrate these difficulties, we begin by considering how we might go about testing effects of hunting regulations on a resident small game species. Assume that we are interested in hunting regulations for fox squirrels (*Sciurus niger*) on wildlife management areas throughout a particular state. In particular, assume that we have a daily bag limit of 5 squirrels and that we are interested in the effects on annual survival rates of squirrels of doubling this limit to 10 squirrels. Assume that we have a large number of management areas in our state and that we are interested in applying results of any experiment to all such areas. In this situation, we could use a completely randomized design, randomly selecting from all areas within the state several management areas for application of each type of regulation (e.g., say 5 areas with limits of 5 squirrels and 5 areas with limits of 10 squirrels). We would apply our treatments (experimental regulations) in one particular year and estimate annual survival rates of squirrels on each of the 10 areas (e.g., via radio-telemetry or capture-recapture). We would then choose a simple test statistic (e.g., a t test on log-transformed survival estimates) to test for a possible difference in mean annual survival between areas receiving the different treatments. The random selection of areas receiving the different treatments from all management areas in the state protects against systematic differences between areas receiving the different treatments and also provides us with some confidence that our results are applicable to areas throughout the state.

When we try to apply such an approach to studies of the effects of hunting regulations on duck populations, we encounter several problems. In this section, we discuss these problems and possible alternative designs for two different classes of studies on duck populations: large-scale regional and continental investigations and small-scale state and local investigations.

Regional and Continental Investigations. Assume that we are interested in investigating the effects of some component of framework regulations (e.g., bag limit) on a continentally distributed duck population. It would be natural to try to simply extend the above example to a larger spatial scale. However, we immediately encounter problems with such an extension because ducks do not form discrete populations confined to specific areas. For example, mallards from breeding areas in prairie Canada are influenced not only by hunting regulations in prairie Canada but also by regulations in each of a number of states along their migration routes and in wintering areas. Thus, any investigative manipulation of hunting regulations at the regional or continental level would require substantial cooperation among a number of political units (states, provinces and countries). In our squirrel example, it would likely be possible to select management areas for imposition of differing regulations without too much dissatisfaction among state hunters. However, if we wanted to implement a similar design in which some states were assigned half the daily bag limit of others, then we might expect a high degree of dissatisfaction.

In addition, although central tendencies for migration routes and wintering areas can be identified, there is generally considerable dispersion in these routes. This dispersion makes it very difficult to identify reasonably discrete populations of ducks for use as experimental units in regional or continental investigations. For example, mallards breeding in southwestern Manitoba show detectable differences in band recovery distribution patterns (and thus in migration and wintering areas) from mallards banded in southeastern Saskatchewan. Birds from these two areas also appear to exhibit some differences in annual survival and recovery rates (Caswell et al. 1987). Thus, if we were conducting a large-scale study of hunting regulations, it would be natural to want to treat these different breeding areas (and their corresponding mallard populations) as different experimental units. However, despite these differences, mallards from these two areas exhibit substantial overlap in migration and wintering distributions. This overlap makes it impossible to assign different hunting regulation treatments to mallards from these two areas. As a possible alternative, we could consider the use of larger, more heterogeneous areas, such as flyways, as experimental units. However, there is certainly substantial movement of ducks across flyway boundaries, and, in addition, this approach would leave us with only four experimental units.

These problems lead us to conclude that testing effects of duck hunting regulations at the regional or continental scale will usually have to involve application of different treatments to different years rather than to different areas or subpopulations of ducks (Green's [1979] main sequence 2). Subpopulations of ducks (e.g., based on reference areas such as those of Anderson [1975] for mallards) would still be treated as replicates, but all subpopulations would receive the same type of regulations (e.g., restrictive versus liberal) within a given year. Consideration must then be given to the allocation of treatments to years. We know that factors other than regulations that potentially affect survival and harvest rates are likely to exhibit some variation from year to year. The most important consideration in allocating treatments to years is to avoid possible systematic differences in these factors between sets of years to which different regulations are applied. The association of regulation type and mallard population size during the 1960s provides a good example of the kind of situation we must try to avoid. Probably the best way to avoid such systematic differences is to allocate different treatments to years randomly.

Technical considerations about parameter estimation may sometimes cause modification of this recommendation. For example, survival estimates based on band-recovery models (Brownie et al. 1985) frequently exhibit non-negligible sampling covariances between adjacent years, t and $t+1$. Although these covariances are explicitly included in test statistics (Brownie et al. 1985), they decrease the power of our tests. If these sampling covariances were the only consideration involved in allocating treatments to years, then we would probably divide our experimental period in half and apply one set of regulations to the first group of years and the other set of regulations to the remaining years, leaving only a single sampling covariance between the different treatments. However, this might increase the chances of systematic differences between years in factors other than our treatments. In some cases it may be reasonable to consider compromise approaches in which different treatments are allocated to small groups of years, e.g., two- or three-year periods. Harvest and recovery rate estimates typically do not have these sampling covariances between years, so the above considerations are not relevant to studies in which they are the response variables of interest. Another technical consideration involves the fact that very restrictive hunting regulations are likely to provide very few band recoveries in the years to which they apply. This presents a potential problem, because band recoveries provide the basis for estimating harvest and survival rates. However, it is possible to develop designs that do permit estimation of survival rates even in the absence of band recoveries from some years (Anderson et al. 1987).

State and Local Investigations. In state and local investigations, we are generally interested in the effects of some special regulation (zoning, a special season, etc.). Response variables pertaining both to hunter success (local harvest, harvest per hunter day) and to the harvested population (survival rate, harvest rate) are often of interest. In this case, the treatment (special regulation) is developed by the state or local area, so there is clearly no random allocation of treatments to areas, again precluding a true manipulative experiment. However, in many cases it may be possible to treat neighboring states as "controls," permitting application of Green's (1979) main sequence 1. As described earlier, this design requires estimates of the response variable of interest in years prior to and following application of the special regulation both in the state implementing the regulation and in neighboring states. We then estimate the difference in the response variable (e.g., average harvest) between "before-regulation" and "after- regulation" years both in the state of interest and the selected neighboring states. The test statistic is then based on a comparison of these estimated differences between the initiating state and its neighbors. If it is not possible to obtain any needed cooperation from neighboring states, then it may be necessary to follow Green's (1979) main sequence 2. In this case, only estimates of the response variable within the state of interest would be used, and inferences would be based on differences among years characterized by different regulations.

Sample Size

Sample size is an extremely important topic to consider when planning an investigation. Response variables in studies of duck populations are typically quantities which must be estimated, rather than directly measured as in many agricultural studies, for example. This estimation carries a cost in terms of additional sampling variation. This additional variation, in turn, usually adds substantially to the sampling effort needed to achieve a specified study objective. In order to be sure that effort involved in carrying out a study is not wasted, it is very important to specify study objectives beforehand and to develop estimates of sampling effort needed to meet those objectives.

Sample size requirements depend on the response variable(s) of interest, the study design and associated test statistic being used, the magnitude of the effect that the investigator would like to be able to detect, and the desired characteristics of the test (significance level, α, and power, $1 - \beta$). Significance level reflects the probability of rejecting the null hypothesis of no difference when the null hypothesis is really true. Power is the probability of rejecting the null hypothesis when it is really false. Because response variables, study designs and test statistics will vary from one study to another, it is simply not practical for us to attempt to provide sample size guidelines that can be used for specific studies. Instead, we will make some general observations and suggestions, some of which will be illustrated with specific examples.

The computation of sample sizes can be a fairly complicated task. We must first specify the above determinants of sample size: the test statistic to be used, the desired significance level and power, the response variable, and the magnitude of the effect that we would like to be able to detect. For example, if we are testing for differences between recovery rates during two sets of years characterized by different regulations, then we might be interested in detecting a difference of at least 0.04 (e.g., if one period shows a recovery rate of 0.07, then we would like to be able to detect a difference if the recovery rate for the second period is at least 0.11). Alternatively, we might express the magnitude of the effect we would like to be able to detect as a proportion (e.g., we would like to detect a difference between recovery rates if the recovery rate in one period is 60 percent larger then recovery rate in the other period). In addition to the listed factors, computation of sample sizes often requires some knowledge of the variances associated with our estimates of the response variable. This knowledge of variation should include components associated both with estimation and with any spatial or, in some cases, temporal replication to be used in our test statistic.

As previously noted, the response variable of most interest in studies of duck hunting regulations (harvest, harvest rate, survival rate) cannot be measured directly but must be estimated. The sampling variances of harvest estimates can be obtained by treating post offices (the primary sampling units of the Hunter Questionnaire Survey) as replicates and selecting bootstrap samples (Geissler 1989). The sampling variances of survival and recovery rate estimates, on the other hand, are based on multinomial band recovery models (Brownie et al. 1985). Regarding the relative precision of these different estimates, the coefficients of variation (standard error of the estimate divided by the estimate itself) are roughly 0.20 for the best state estimates of mallard harvest for a given year, about 0.05–0.10 for the best reference area estimates of mallard survival rate and recovery rate for a given year. If our test statistic is to be based on replication over space or time, then we must also know something about spatial or temporal variation in the response variable. We can estimate such variation from historical or pilot study data by first computing the overall variance using point estimates and subtracting from this quantity the average sampling variance over replicates (*see* Skalski and Robson in review).

In cases where we have had to compute sample sizes, we have often used computer simulation. One simply specifies the determinants of sample size listed above and then simulates the anticipated situation using estimates from historical data or pilot studies, or using best guesses where prior estimates are not available. For example, tests of hypotheses about survival or recovery rates sometimes can be accomplished by developing alternative models which specify the competing hypotheses, and using likelihood ratio test statistics in program SURVIV (White 1983). Program SURVIV has built-in simulation capability permitting computation of empirical power estimates. Such estimates can be computed for different sample sizes in order to determine what sample sizes are required for a particular study.

In some simple situations, it is possible to approximate sample sizes analytically without much difficulty. For example, J. E. Hines (USFWS, pers. com.) has written programs for computing sample sizes needed to test for differences between mean recovery rates or survival rates from the same area for two different periods of time. The programs are based on the z test statistic of Brownie et al. (1985), and would correspond to a constrained investigation based on temporal differences within a single area (Green's [1979] main sequence 2). Recovery rates are assumed to be estimated as direct recovery rates, and survival rates are estimated using Model 1 of Brownie et al. (1985).

We have used these sample size programs of Hines to develop figures illustrating points about the determinants of sample size. In Figure 1, we assume a recovery rate for an initial period A (f_A) of 0.05, and we assume three years in each of the two periods of the study ($Y_A = Y_B = 3$). We plot annual banded sample size (the number of birds that must be banded in each of the six years of the study) as a function of Δf (the difference between f_A and f_B, where f_B is the recovery rate for the second period). The four plots in Figure 1 correspond to four different sets of test characteristics, α, and β. Required sample sizes decrease as Δf (the magnitude of the anticipated effect) increases, and as the probabilities of Type I (α) and II (β) errors increase. In band recovery studies, Type II errors are often more serious than Type I errors, as a real change in harvest rates or survival rates that goes undetected could potentially have long-term detrimental effects on the population. For this reason, investigators frequently use $\alpha = 0.10$ in investigations based on band recovery model estimates. There may be situations when dealing with tests on which management decisions are to be based, in which a Type I error is not serious at all, whereas a Type II error can be extremely serious. In such situations, it may be reasonable to use $\alpha > 0.10$.

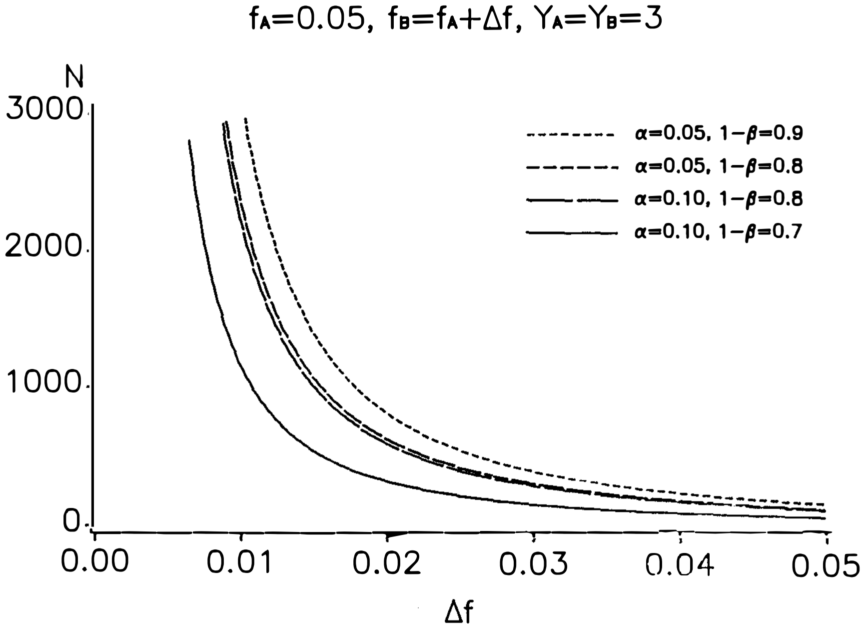

Figure 1. Annual banded sample sizes needed to test for differences in mean annual recovery rates between two periods, A and B, characterized by different hunting regulations. There are three years in both periods A and B ($Y_A = Y_B = 3$). The recovery rate in period *A* is 0.05 ($f_A = 0.05$) and the recovery rate in period *B* is $f_B = f_A + \Delta f$. The four different curves represent different test characteristics, α and β.

Figure 2 again plots annual banded sample size as a function of Δf. The four plots show different numbers of years in the study ranging from a two-year study ($Y_A = Y_B = 1$) to a ten-year study ($Y_A = Y_B = 10$). The greater the number of years in the investigation, the smaller the required banded sample size for each year. Figure 3 illustrates the influence of the magnitudes of the anticipated recovery rates. For a given relative change in recovery rate ($\Delta f/f_A$), required sample sizes are much smaller for large recovery rates than for small ones (Figure 3). To some extent, recovery rates are characteristics of the species involved in the study and are not under control of the investigator. However, practices such as the use of reward bands can sometimes be used to increase recovery rates.

Relative changes in harvest or recovery rate of a specified magnitude are expected to result in much smaller relative changes in annual survival rate, even under the completely additive mortality hypothesis (Anderson and Burnham 1976, Nichols et al. 1984). Recovery rates and harvest rates are also estimated somewhat more precisely than survival rates in many instances. For these reasons, sample size requirements are generally much smaller for testing hypotheses about recovery rates than for tests involving survival rates. Sample sizes for two scenarios presented in Table 1 illustrate this point. Under scenario 1, period *A* is characterized by five years with recovery rates of 0.050 and annual survival rates of 0.60, whereas period *B* has six years with recovery rates of 0.10 and survival rates of 0.48. This difference in annual

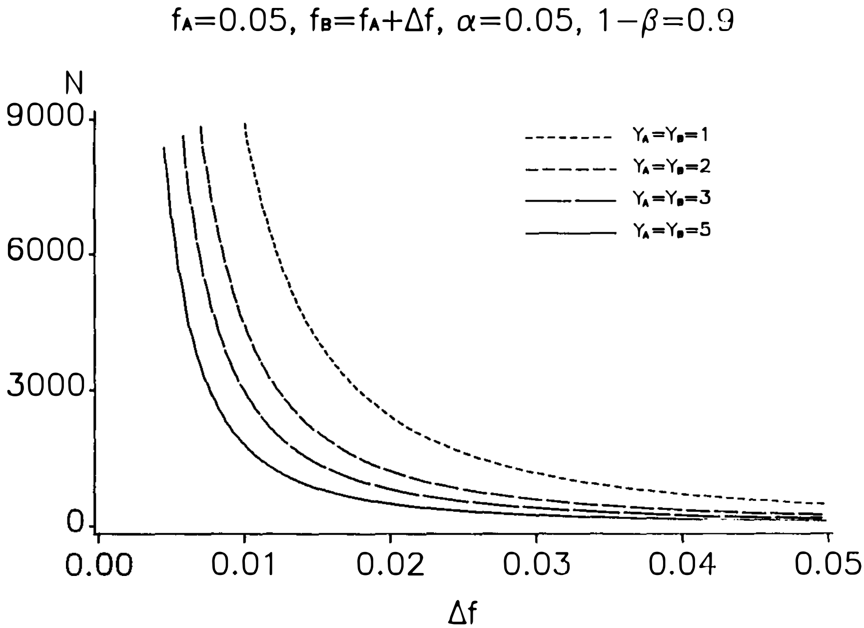

Figure 2. Annual banded sample sizes needed to test for differences in mean annual recovery rates between two periods, *A* and *B*, characterized by different hunting regulations. The recovery rate in period *A* is 0.05 ($f_A = 0.05$) and the recovery rate in period *B* is $f_B = f_A + \Delta f$. Test characteristics were $\alpha = 0.05$, $1 - \beta = 0.90$. The four different curves represent different numbers of years in the experimental program.

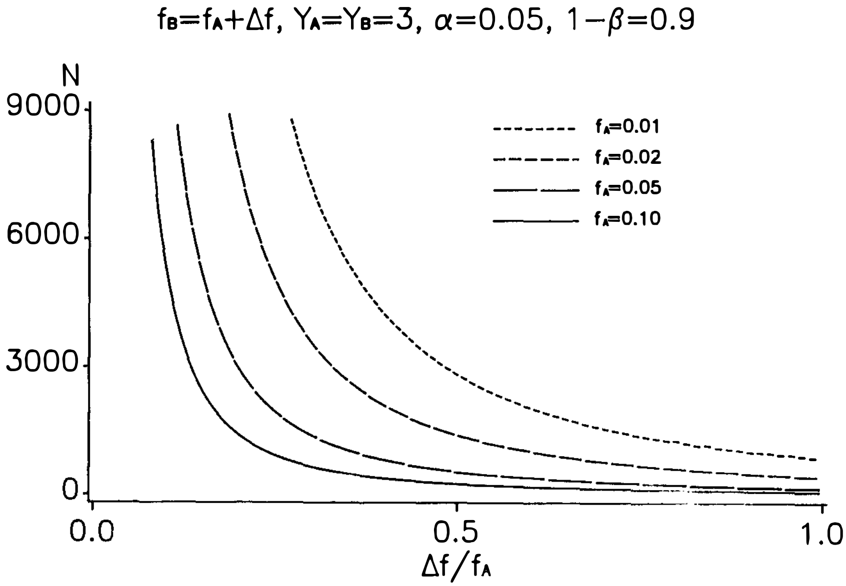

Figure 3. Annual banded sample sizes needed to test for differences in mean annual recovery rates between two periods, *A* and *B*, characterized by different hunting regulations. There are three years in both periods *A* and *B* ($Y_A = Y_B = 3$). The recovery rates in periods *A* (f_A) and *B* (f_B) are related by $f_B = f_A + \Delta f$. The four different curves represent different initial-period recovery rates, f_A.

survival rates is based on the additive mortality hypothesis with current estimates of band reporting rate and crippling loss. For $\alpha = 0.05$ and $1 - \beta = 0.80$, only about 70 birds must be banded each year in order to test for a difference between mean annual recovery rates of this magnitude. However, if we are interested in survival rates, then we must band approximately 450 birds each year. Scenario 2 shows a smaller difference in recovery rates, and hence in survival rates, between the two periods, and sample size requirements are thus larger than under the first scenario. In this case, 240 birds must be banded each year if we are testing for differences between mean annual recovery rates, but 2,250 birds must be banded annually if we are interested in mean survival rate differences.

Table 1. Annual banded sample sizes needed to detect differences between mean annual survival and recovery rates for two periods *A* and *B*, using a *z* statistic (Brownie et al. 1985) with $\alpha = 0.05$, $1 - \beta = 0.80$.

Scenario	Period	Years banding	Recovery rate (f)	Survival rate (S)	Annual banding to detect differences in f	S
1	*A*	5	0.050	0.60		
	B	6	0.100	0.48	70	450
2	*A*	5	0.050	0.60		
	B	6	0.075	0.54	240	2250

Although Table 1 provides only two specific examples, it will almost always be true that much less effort is required to study changes in recovery rates than changes in survival rates. In Figure 4 we plot annual banded sample size as a function of the difference in survival rates (ΔS) that we would like to detect, for 7-, 11-, and 15-year studies, given certain test characteristics and survival and recovery rates. Annual banded sample sizes are virtually unattainable for ΔS<0.05, and are still high even for the larger ΔS. Figure 4 illustrates one of the most important problems in studying the effects on annual survival of changes in hunting regulations. The recovery rates, $f_A = 0.05$ and $f_B = 0.10$, show a doubling of hunting mortality rate between the two periods. However, this substantial increase in hunting mortality can lead to an approximate maximum difference in annual survival rates (under the completely additive mortality hypothesis, Anderson and Burnham 1976) of only $\Delta S = 0.12$. Thus, for this situation a 100 percent increase in hunting mortality can lead at most to a 20 percent decrease in annual survival, and an effect of this magnitude can only be detected with large banded samples for a number of years.

Summary and Recommendations

It frequently is not possible to study the effects of duck hunting regulations using spatially replicated, manipulative experiments. However, we believe that constrained

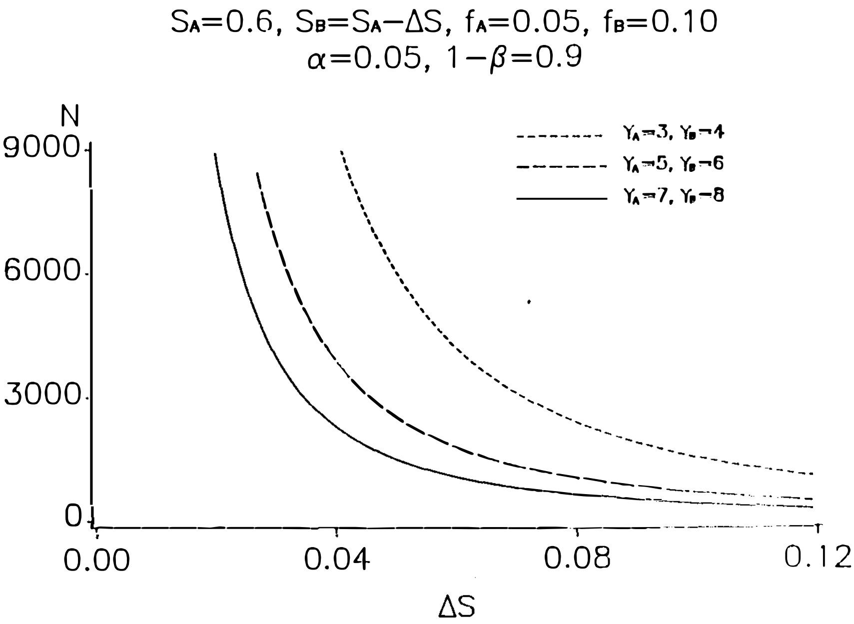

Figure 4. Annual banded sample sizes needed to test for differences in mean annual survival rates between two periods, *A* and *B*, characterized by different hunting regulations. The recovery rates for the two periods are $f_A = 0.05$ and $f_B = 0.10$, and the survival rates are $S_A = 0.60$, $S_B = S_A - \Delta S$. The four different curves represent different numbers of years in the experimental program.

investigations can still lead to useful inferences. For questions involving the effects of framework regulations at the continental or regional level, this will usually involve the setting of different regulations in different years, over the course of an investigation. To ensure that regulatory impacts are free and clear of other temporal effects, it is necessary to eliminate systematic differences between years that are assigned different regulations. For example, regulations cannot be assigned to a given year based on characteristics of the preseason population (e.g., population size). Instead, regulations must be allocated among years according to some a priori design, preferably based on random selection. We suggest, however, that data on such potentially confounding factors as population and habitat status be collected as part of the investigation, since this information can prove to be helpful in making inferences about regulatory impacts.

We recommend that the investigation of special regulations at state and local levels include comparisons across both years and areas. That is, measurements of response should be obtained both before and after implementation of the special regulations, in both the state of interest and in neighboring states not implementing the regulations. The use of information from neighboring states strengthens inferences and reduces the potential for the confounding of regulatory and nonregulatory effects.

Finally, we believe that it is essential to plan studies carefully and to compute the sample sizes needed to achieve study objectives. Sample size determination may require computer simulation, analysis of historical data, or even data from pilot studies. To detect changes in harvest and recovery rates, relatively small banded sample sizes are needed. Such sample sizes should usually be readily achievable, even at the state and local level. On the other hand, changes in annual survival rates require much larger sample sizes. We emphasize that the use of neighboring states as spatial "controls" requires that adequate sample sizes be obtained for these states, as well as the state implementing the regulations. If harvest or harvest per unit of hunter effort is used for evaluation, the imprecision of state harvest estimates from the Federal Harvest Survey may necessitate an intensive state harvest survey that targets the regulatory action.

With few exceptions, previous studies have not provided strong, informative inferences about the effect of special regulations. To adequately evaluate these regulations in the future, substantially greater sampling effort, and substantially greater commitment of resources in that effort will be required. Although the use of special regulations has often been advocated as a means of fine-tuning harvest regulations, it may well be that the intended benefits from such fine-tuning will not justify the increased cost of evaluation.

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Balancing Expectations with Reality in Duck Harvest Management

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As we near the final decade of the twentieth century, North American duck populations are in trouble. Resource managers quite likely are being faced with their greatest challenge—recovery and maintenance of all duck species to socially acceptable levels. This monumental challenge is compounded by the great diversity of habitats required by ducks, the degraded conditions of those habitats and the great philosophical differences among managers regarding the role of hunting regulations in duck management. Expectations concerning duck harvest vary from north to south, east to west, in Canada, the United States and Mexico, and among hunters, biologists and conservation administrators. However, one common thread—concern for North American duck resources--connects all expectations into a common goal that mandates sound management. Achieving that goal will require each of us, resource managers and hunters alike, to examine our expectations and be prepared to temper them with reality.

Expectation

Waterfowl hunters desire and expect higher duck populations, which provide for increased hunting opportunity and improved harvest success.

Reality

Duck numbers in North America are currently low with no immediate prospects for improvement. Long-term drought and associated habitat deterioration have resulted in record low populations for popular species such as mallards and pintails. Habitat deficiencies have dramatically reduced nesting success and recruitment rates. Recovery will be extremely difficult. Under prevailing conditions, restrictive duck harvest regulations have been imposed, harvests have declined and hunting success has been reduced.

Expectation

Managers are expected to know precisely the impacts of harvest on duck populations and establish regulations that ensure maintenance of stocks at acceptable levels.

Reality

While much is known about the impacts of harvest on some species of ducks in certain geographic regions, many questions remain unanswered. Results of some studies concerning harvest impacts are unclear and subject to divergent interpretations. Lack of agreement exists among duck managers regarding the meaning and management implications of study results. When a study concludes, "no impact of harvest upon survival could be detected from available data," managers' conclusions range from "harvest is not a factor affecting survival," to "data were insufficient to reach a conclusion." Significantly different strategies for duck harvest management would be employed depending upon the conclusion reached. Those accepting "no impact" would prescribe more liberal regulations while those concluding "insufficient data" would recommend conservative harvest rules and additional research.

Historically, duck hunting regulations have been modified annually in response to prairie habitat conditions, breeding populations and production. Generally, harvests have tracked changes in regulations, increasing with liberalizations and declining when restrictions are employed. However, it has not been possible to assess precisely the individual or collective effects of season length, bag limit and frameworks because of annual variations in migration, weather patterns, local habitat conditions, size of the fall flight, and age ratios in duck populations.

Although definitive answers are not available concerning the relative importance of these factors and their effects on duck harvest, federal, state and provincial governments annually commit substantial personnel and fiscal resources debating the issue of appropriate regulations. An even greater commitment from all agencies would be required to obtain more reliable data concerning the role of individual variables on duck harvest, and there is no guarantee, because of the complexities involved, that the desired level of precision can be achieved. The practicality of continuing the current investment of time, manpower and money in the annual regulations process is questionable. To increase that investment would come at the expense of other duck management needs, which seem to be much higher priority at this time.

Expectation

States and provinces often feel that duck harvest regulations should be based solely upon data pertaining to their flyway, with only secondary consideration given to continental conditions. Further, they desire differential regulations for sub-units within individual flyways.

Reality

Waterfowl flyways, as employed administratively, are not precise biologically defined units; they are geographic divisions established more than 40 years ago to aid in administering waterfowl management programs, including harvest. Administrative flyways were based on state-of-the-art knowledge of waterfowl biology in the late 1940s and their boundaries have remained largely intact since that time. Flyway management serves us quite well when duck populations are high and hunting opportunity is substantial. But, during periods of low populations, differing philosophies concerning the application of harvest restrictions often result in a drain of time, manpower and money to settle disputes between various interests. This situation is paradoxical. Less risk is affordable during times of low populations and duck managers should be more united in efforts to reverse downward trends.

Landmark studies have been conducted during the past three decades to define more clearly biological flyways and life histories of some duck species. These studies have been used to establish differential harvest strategies, generally resulting in liberalizations in some regions. Biological flyways are dynamic, changing from year to year or over time in response to prevailing weather patterns and habitat conditions, or perhaps due to harvest rates. If differential regulations are to be established and maintained in specific geographic regions within flyways, a reliable data base should be developed before such regulations are implemented and systems for continual evaluation should be required. Costs for reliable data to evaluate special harvest regulations are high and, in instances where regulations prescribed are more liberal than those established for the flyway, these costs should be borne by those receiving the benefits.

Expectation

Duck managers and duck hunters feel that traditional distribution of ducks in North America and associated harvest opportunities should be maintained.

Reality

Distribution and quality of duck habitat throughout the continent is changing, in some instances subtly and in others dramatically. With these changes come shifts in nesting, migration and wintering patterns. Some regions benefit through improved harvest opportunities, while others experience declining duck populations and poorer hunting. Certainly, competing land uses such as agriculture and urbanization have impacted extensive wetland habitats that once existed. In many instances, however, public wetlands, including national wildlife refuges, have deteriorated, contributing to changing duck numbers and overall distribution. Few new wetlands are being created by natural processes; therefore, duck distribution today and in the future will be influenced greatly by managed wetlands and associated uplands, both public and private. Depending upon individual and collective commitments, states and provinces, federal agencies, private organizations and landowners can influence distribution of ducks, and resulting benefits derived. Duck distribution will likely continue to change along with changing habitats.

Expectation

States, provinces, flyway councils, conservation organizations and many individuals desire input concerning duck harvest regulations.

Reality

Ducks are a public resource, and as such, opinions of all people must be considered when promulgating hunting regulations. The final responsibility, however, for establishing harvest rules for ducks in accord with international treaties, rests with federal agencies. States, provinces and hunters should remember that it is easier to make a recommendation than to make a decision. They also should understand that decisions are easier to make and more likely to respond favorably to recommendations when those recommendations are specific, well-documented and reasonable. All parties interested or involved in duck harvest management should respect the roles mandated to federal governments in Canada and the United States and recognize that ensuring the continuing welfare of continental duck resources does not always provide for local needs or desires. Federal agencies must totally accept that responsibility and remain steadfast in their commitment to sound and responsible resource management, even under pressure from divergent views.

States and provinces, through the flyway council system, can be valuable partners for federal agencies. To be effective, however, state and provincial conservation agencies must be willing to dedicate the time necessary for biologists and administrators to stay abreast of conditions affecting ducks and duck harvest throughout their respective flyways, and often beyond their flyway boundaries. State or provincial representatives to the flyway councils must consider waterfowl matters outside the two brief meetings held annually. In addition, issues receiving consideration for cooperative action at these meetings must focus on more than regulations of local or regional interest.

Expectation

All parties interested in ducks want regulations to be fully justified and easily understood.

Reality

Large sums of money, time and manpower are committed each year by federal, state and provincial agencies to collect population, distribution, production and harvest data for North American ducks. The main purpose of basic surveys and banding efforts, and the data sets that result, is to provide a sound basis for providing reasonable hunting opportunity and protecting and maintaining duck resources in North America. While this information has greatly enhanced our knowledge, deficiencies in these data still exist that limit their value and reliability in more localized duck harvest management. Substantial commitments have been made toward data collection to evaluate or justify certain special regulations applied on a localized basis. Annually, data from these sources are analyzed and debated during regulation-seting processes. Resulting regulations often suggest a degree of precision or sophistication not fully supported by available data. Such rules can be overly complicated, difficult to understand and a source of diminishing credibility for resource managers among both hunters and non-hunters. Some feel that the complexity of duck hunting regulations has reduced hunter participation rates, but the degree of such effects is unknown. In any case, hunting regulations are appropriately under review to bring them more in line with realities of data strength and the status of the resource.

Conclusion and Recommendations

Other expectations include improved hunting quality, elimination of illegal harvest and reduced crippling rates. For the most part, these are hunter ethics issues and are somewhat beyond the scope of this paper, but certainly worthy of mention when considering factors impacting duck hunting in the future.

This paper can be interpreted as criticism of past duck harvest management and some of that is intended. However, the primary intent is to challenge resource managers to examine existing processes and to discard those yielding little or no benefits, improve those that are paramount to sound duck harvest management and to employ new cost-effective techniques derived from well-designed research. No species of wildlife in North America is subjected to heavier hunting pressure or higher harvest rates than are some populations of ducks. Duck breeding populations are critically low and nesting success in broad portions of the range are less than ten percent. It is imperative that we re-examine the role that hunting plays in waterfowl management, and as managers be willing to respond with responsible regulations. This is not necessarily a call for additional research; it is a call for continued improvement and refinement of techniques for estimating time-specific survival rates and for completing banding and other requirements necessary to ensure reliability of these estimates. It also is a call for acceptance that under existing conditions of poor habitat and low duck populations, hunting mortality may be additive and not compensatory. Recent research has changed conventional wisdom concerning the impact of hunting on several game species.

Some of the challenges offered for consideration are summarized as follows:

1. While duck populations are low, managers should support and promote restrictive-to-moderate hunting regulations. Hunting publics should be educated as to the rationale for current harvest strategies.
2. In the long term, consideration should be given to accepting moderate duck hunting regulations in lieu of continuing costly efforts to precisely measure population levels, mortality and survival with the intent of adjusting seasons annually by a few days or by a duck or two in the bag.
3. Current regulation-setting schedules should be examined to determine if changes are practical. Serious consideration should be given to establishing duck regulations on three-year cycles. Habitat, population and harvest information should continue to be compiled annually for trend measurement.
4. The U.S. Fish and Wildlife Service and the Canadian Wildlife Service must take strong leadership roles in duck harvest management. Flyway councils should be full partners in this effort and recognize that welfare of continental duck resources is the ultimate goal.
5. States and provinces should increase their involvement in managing North American duck resources. This includes a broader understanding of international issues, commitment of time to flyway councils' activities and frequently a compromise of specific state or provincial priorities.
6. Serious consideration should be given to formalizing the National Flyway Council as a committee of the International Association of Fish and Wildlife Agencies. The National Flyway Council should serve as the forum for discussing issues among representatives from each of the flyway councils. An open exchange of

information and ideas would provide for strengthening and better consolidating input from the states.

7. Reliability of breeding population data and harvest information should be improved through modification of current data collection procedures. Broad resource needs related to changing habitat, species status, and capability to support international management efforts should be highest priority.

Ducks are indeed in trouble, but there is cause for optimism. The North American Waterfowl Management Plan provides the vehicle for a coordinated approach to ensure recovery of duck populations. To achieve the objectives of that plan, manpower, time and money heretofore dedicated toward annual hunting regulations' debates must be shifted to combat the real villain—habitat deterioration. It does not appear that federal, state or provincial governments can afford the high costs to both refine duck harvest management and provide needed habitat at the same time. The current priority should be obvious. If duck populations cannot be restored and maintained, expecting to hunt may not continue to be a reality.

Special Session 10. *Advancing Natural Resource Planning*

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Opening Remarks

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As most of you are aware Frank Dunkle resigned as Director of the Fish and Wildlife Service last week. Our acting Director and Deputy Assistant Secretary Susan Recce Lamson is in the process of settling in and so it is my privilege and honor to provide these opening comments to this session.

I will start right off with the headline for the next issue of the Organization of Wildlife Planners newsletter: The Fish and Wildlife Service *likes* wildlife planning. That is pretty newsworthy, it is not? Seriously, the Fish and Wildlife Service and I have believed in good planning for many years. I have seen the value of good planning both as Director of the National Ecology Research Center and in my short tenure as Assistant Director for Fish and Wildlife Enhancement. Good planning yields good results for wildlife and citizens alike. You know that whether you are a planner, budget officer, administrator or field biologist.

I am sure you caught my key qualifier—*good* planning. That is what I want to spend a bit of time on today, what I see as good planning—as opposed to what I see as a waste of public time and money that masquerades under the name planning. And I direct these observations not just to the wildlife planners here today, but to anyone involved in administering wildlife programs and projects.

I want to spend a moment to give you some background on the problems I saw and experienced in the management structure in the Fish and Wildlife Service prior to May of 1986. It was a system that I and many others had grown to know quite well from working *under* it at a regional office for several years. Let me state right here: program management *may* be a fine management system. But in the Fish and Wildlife Service it was not responding swiftly or flexibly to what it had to do—namely, conserve and restore wildlife, while staying attuned to the legitimate wishes or mandates from the Congress.

As I have said many times before, program management may be a fine way to run *some* resource agencies. It may even be a boon to *some* resource agencies. In the Fish and Wildlife Service, however, it began to take on a life all its own. As it grew, it developed a nearly insatiable appetite for paper, served up by growing ranks of planners. Planners became enslaved to the Program Management System in the Service. To its enslaver the Service offered great amounts of effort and excellent ideas but the system had grown to care too little about results on behalf of wildlife. The Service was wasting precious time and money to maintain a management system that no longer put the fish and wildlife resource first.

We were misusing some very talented people. It is understandable that a lot of our idealistic young planners became very committed to the Program Management System. But that is not what the Congress and the people of the United States was asking of them. What the people and their representatives wanted, succinctly, was exactly what our Fish and Wildlife Service statement of mission had been all along: to conserve, protect and enhance the fish and wildlife of this nation and their habitats for the continuing benefit of the American people.

Our mission statement—like any good planning endeavor—is simple, straight to the point, and accessible to all who read it. Carrying it out faithfully, of course, is the tough part. That is where the long hours, the headaches and the heartaches come in. But that is all part of the process. You cannot avoid reality by crafting more voluminous planning documents. Thus, since May of 1986 the Fish and Wildlife Service has been striving to create a planning system that is simpler, more direct and resource-based.

The Service wanted a planning system that would have its results measured in a timely and accurate fashion, a planning system that would directly translate into fur, feathers and scales—plus the increased or improved habitat requisite to support them. The planning system had to be responsive to the Office of the Director of the Fish and Wildlife Service. The Director is the chief decision maker of our agency and is held accountable to the Secretory of the Interior and Capitol Hill. He needs to know *what* the Service intended, what was accomplished and how and *why* we did it.

The old way was not only too diffuse and amorphous, it also avoided personal responsibility, something I think more planners and field biologists have come to accept. Except for accountability, most everything else will lead you to excuse making.

I mentioned a moment ago that I felt that it is essential for the executive of an agency to be its chief planner. That was and still is a foremost goal of the Service. Some of the other goals established, and some of the milestones checked off were:

- To increase the size of our field staffs and move as much decision making as possible—along with commensurate responsibility—to the region and field office level. In three years, the Service has achieved this to a remarkable degree. We are now a line-staff operation. Regional Directors can call their own shots; they can deploy money and manpower as they see fit to meet national and regional objectives. And those objectives are now, more than ever, real and measurable—such as number of wetland acres restored or lands added to the national wildlife refuge system, and the like.
- Another goal was increased cooperation with the agricultural community. The Farm Bill of 1985 gave the Service an unparalleled opportunity to help save wetland and farm wildlife habitat. The Service used this opportunity in a way

it never has before—by trying to find out what the agricultural community wants and needs from us; what they fear about us; by listening *before* we talk.

You know it worked. I think we are on the way to even better communications with virtually every facet of the farm community, from top-ranking officials at the U.S. Department of Agriculture to small, part-time farmers.

- Two additional goals of the Service were successful implementation of the North American Waterfowl Management Plan and the chance to draft and adopt a National Recreational Fisheries Policy. I will not dwell on either. You can find out more about what the roles the Service is playing in implementing both of these from other Service representatives at this conference. I reference them because both are long-term plans that call for great creativity and flexibility for the Service and its cooperators to successfully carry out.
- I want to touch upon one other point just briefly. It is the recently issued Federal Aid Strategy Document. This report and action plan represents the best aspects of planning and productive partnership. I am sure that most of you are aware of the project so I will not dwell on it. I do, however, want to take the opportunity to express my appreciation to the federal, state and private organizations that helped to make this document the valuable action tool it has shown itself to be. Their recommendations—that there be increased efforts for public awareness of the Federal Aid programs; that the states and the Service have adequate internal control systems in place; that more emphasis be placed on communicating resource accomplishments; and the rest—all demonstrate that both the Service and the states are flexible partners and cooperators in carrying out these extremely important and visible resource programs.

A key point I would like to make about planning today is this: Do not ever lose sight of people anywhere in your fish and wildlife planning processes. They are your best assets. If you do not put people foremost in your planning equations, your best plans are dead from the start. You all should recall the old dictum from your undergraduate days: "Wildlife management is 10 percent wildlife, 90 percent people." That *was* true, Unfortunately, we are now rushing headlong toward that time when the numbers will read "1 percent wildlife, 99 percent people."

Now some would construe that to mean I am saying such unseemly things as "to heck with wildlife" or "critters do not count." That is totally false. If they listen carefully, they would hear my real message, which is: "If you value wildlife, you will exert the extra effort needed to learn to deal *effectively* with your own species." I think the days of the aloof and remote wildlife expert are over—or should be. I do not see wildlife planning as an ivory tower enterprise, and I know you do not either.

Wildlife professionals—planners, line managers and field biologists—have to face some other pressing realities of the late twentieth century: time is slipping away and habitat is vanishing even more quickly; and the characteristics of our clientle, the users of wildlife, and their desires and demands are changing.

I do not believe the professional wildlife community can afford prima donnas. If wildlife professionals view themselves in too rarified a light, if they start believing they are somehow on a higher plane of existence than mere mortals, then I think the profession is sunk as well as, and more importantly, the programs we need to ensure our wildlife heritage for future generations.

More than ever, the wildlife professional has got to be a critter of the real world.

You have to meet and mix with a wide cross-section of your own species if you are serious about planning for and helping *other* species. I know that many in the wildlife profession find politics offensive. That is fine. You can make that personal choice and conduct your lives accordingly. But politics is a continuing reality in our nation—and in fact the political process has done a lot in the past half-century to assure at least a chance for a reasonable resource base. Wildlife managers and planners do not make and pass laws and fund resource efforts. More often than not, politicians do. That is our system of government.

I would hasten to note right here that I do *not* advocate direct involvement by elected officials in the management of wildlife populations. But there can and should be valid input and cross-communication. Each profession should have the right to access respectfully the other through appropriate channels. I hope no one finds that a shocking statement. Because I think all I have related is both the process and reality of how wildlife legislation is enacted and funded.

I submit that the astute planner should always acknowledge that at some level and to some degree politics, like people, will always be part of the equation.

For those who reject that I will simply pose a question. As a wildlife professional—what do you want—do you want a clique or do you want clout? And if you want clout, it should not be for yourselves or your colleagues, but for the wild critters and the citizens who have entrusted those critters to our care. I thank you for this opportunity to be here today. As I had indicated to Spencer Amend, I would entertain a question or two.

Agency Directors on Planning

Spencer R. Amend
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Punch Lines

Here are a few of the punch lines as to what this panel is all about.

First of all, this session isn't just about planning. It's about applying good management science to the fish and wildlife business.

Secondly, managers need to behave in a manner consistent with what they say. There is a lot known about organizational management that isn't being applied in fish and wildlife agencies. One of the most important things is being conscious of the signals sent to others. Most managers will agree with much of what we say here today. But what is needed is for many to change behaviors to be consistent with what they say they believe—to be aware of the signals sent by their behaviors. What managers say is important, but what they do sends far more powerful signals.

Please don't tell me, "If it ain't broke, don't fix it." With the changes going on in the world, we'd better adopt a rallying cry of "Anything can be made better!" and we'd better behave that way—not just say it. Because even if it ain't broke, it ain't likely to be good enough for tomorrow. As the problems and challenges we face change, the solutions must change, too. The very survival of our profession is at stake!

Background

The Organization of Wildlife Planners (OWP)—the sponsor for this session—was formed following a meeting in Wichita, Kansas, in March 1979. Initially, the OWP served as a mutual support group/network for those individuals dubbed "planners" in fish and wildlife agencies. As the organization gained members and confidence, we began looking for additional ways to improve the management of our respective agencies—more of a total systems approach. Our sponsorship of this session is one such effort. We also offer training courses dealing with development and implementation of planned management systems. (Let's not get hung up on terminology: By "planned management system" we mean doing business in an "integrated system of agency operations including all activities leading to the development and implementation of goals, program objectives, operational strategies, budgeting and progress evaluation.") And we offer technical assistance and advice—to agencies requesting help—on improving specific management/planning situations.

More and more, the appropriate emphasis seems to be on improving all aspects of agency management—in addition to plans or planning. Since 1985, we've been directly involved in providing management assistance to more than 20 agencies at their request. We've observed that things holding many agencies back deal as much with management science issues as with planning, per se. Examples include: learning to work as a team, public involvement, evaluation techniques, defining a preferred vision of the future, making conscious, explicit choices—setting priorities, reflecting these priorities directly in the agency budget, top management application of management science concepts and techniques, and resistance to change. Successfully dealing with these problems has much to do with agency effectiveness and forms a sound basis for "planning."

Most everyone we know is too busy. And they generally seem busy doing important things, things related to the conservation of natural resources. But we notice that an awfully lot of people seem puzzled about what things are more important than others and why. Too few seem to look at the notion of setting priorities on what they *should be* doing instead of just what they *are doing or could be* doing. Too much emphasis is put on doing things right rather than on doing the right things.

Something else is relevant to the subject of importance. It's how much someone really cares; there has to be someone who cares enough to get down and dirty with the details of making something happen! Peters and Waterman talked about it in terms of needing champions for ideas. If people don't care enough to get involved in finding answers, very little will happen to change anything (and the importance of the problem couldn't have been that great anyway). Few things ever change or get better as a result of lip service.

Futures

I recently ran across a quote from Peter Drucker that brought me up short. He said, "Long-range thinking and long-range planning aren't about tomorrow's decisions. They're about tomorrow's consequences of today's decisions." I think he's saying we have to somehow drag our thinking into the future! To me this serves as a reminder that if we fail to consider tomorrow's needs and conditions in today's decisions we run considerable risks.

In preparing for this session, I wanted to examine some indicators of trends in issues relating to fish and wildlife management. There are a lot of trends in more general aspects of society, but I haven't seen many analyses of what is going on in the fish and wildlife business. I wondered if perhaps we'd escaped the changes occurring in the rest of the world. In search of evidence for trends in the fish and wildlife business, we examined topics discussed at North American conferences (since 1967) and at meetings of the International Association of Fish and Wildlife Agencies (IAFWA)—especially the annual presidents' addresses (since 1973). My thanks to Mark Reeff for providing unpublished information from several recent IAFWA meetings.

Based on the items examined, there appear to be several trends in the fish and wildlife business; some are positive, and some are a bit disturbing. But we'd better be paying attention! One trend that many in this room may find disturbing is the turnover rate of fish and wildlife agency heads—it is getting quicker. Actually, I think this probably represents the trend for greater accountability in government—and perhaps in a way reflects the growing concern for the environment. I'm not suggesting that the answer to stabilizing agency head turnover lies in improving the way agencies do business—but I know a couple of agency heads who might believe it. Having a good management system does not mean you can please all the various competing interests, but having a credible way of doing business can keep some of the emotion about good versus bad management in better balance. The point is you shouldn't wait for the cries from your watchdog constituents to begin to do something about it. Take the initiative before it is too late!

Another trend we don't like is the decline in dollars for wildlife programs at both the state and federal levels. Nearly every state I know of has encountered declining revenues. And the federal budget deficit bodes ill. I don't think fish and wildlife can compete with Social Security or with money for starving kids when it comes time to cut programs. Thus, the idea becomes how to get more for the money you put into a program or agency. How? Through better management—*planned* management.

There seems to be a trend from more specific topics toward more general items. I'm excited about this if it means people in this business are becoming concerned about considering things within a broader universe. We frequently use something called the ESP Model to evaluate agency decision-making risk. Simply stated, it says that any important fish and wildlife decision must consider the economic, social, and political, in addition to the biological (factual), and institutional aspects to be effective and implementable. If any ESP component is overlooked, risk for the decision is high. And if things are bad (hot) enough, I guess the agency head might be replaced, so maybe improving agency management systems is important . . . .

There were several other trends suggested, but I can't talk about more now. I've got to wrap this up so I can introduce our panelists. The last thing I'll mention before moving on is that the resource management business has certainly been blessed with dedicated and insightful leaders. In going through the IAFWA proceedings, I read the annual presidents' addresses carefully and was amazed at the far-sightedness of these leaders. What I am less impressed with is how little has been done about many of the insights these leaders offered. Again, sort of the "doing something about it" notion I mentioned earlier.

Insofar as answers are concerned, many of the items we looked at identified some aspect of improved communications as the way to deal with problems. Many of today's important trends point to a need for agencies to take public attitudes and needs into consideration. But a big challenge to doing so may lie in agencies attitudes and philosophies; there is still more than a remnant within our profession guilty of not wanting the public involved. Their attitude is: We know what is needed and what should be done; that's why we went to school to get those degrees in wildlife resources management.

In summary, what I hope you get out of this panel is that there are steps you can and should be taking to improve your agency's effectiveness. Prioritize what you are doing and see to it that your budgets reflect your priorities. Stimulate members of your group to become champions for change and for new ideas. Pay attention to the future. Use the ESP model as a reminder that the fish and wildlife business has many facets. And if there is anything the Organization of Wildlife Planners can do to help, please let us know; we may have encountered a situation elsewhere that can suggest possible strategies for you.

Panelist Introductions

Our three panel members are true leaders in bringing improved management to their agencies. By a "leader" in this case, I mean someone who operates successfully in a changing, challenging environment, as opposed to someone who is only capable of monitoring a stable environment and tries to maintain organizational equilibrium. By the time they have finished, I know you will each want to try and do something to improve management in your agency. Remember, anything can be made better!

Implementing Strategic Plans: The Wisconsin DNR Experience

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As we approach the turn of the century, we're facing the most fundamental changes the world has seen since the beginning of this century. Anticipating and coping with those changes is the major challenge facing all resource management agencies.

Some of the most significant changes are:

- Worldwide economic pressures resulting in significant ecological changes, potential climatic changes and a realization that we are a global environmental community.
- Perplexing problems resulting from long term abuse of man-made chemicals.
- Basic population and societal value changes.
- Outdated governmental structures and approaches to deal with major changes.

We simply cannot afford to rest on our laurels. The successful resource management agency of the future will be a very different mix of people with outreach skills who enjoy interacting with the public, seeking their support and urging their active participation in planning and implementing programs.

Wisconsin's Strategic Management Approach

In Wisconsin, we've used strategic planning to prepare our agency to meet these challenges. Our interdisciplinary Trends Analysis Group continually assesses the changes that will affect us. Our top level management team of central and district office managers meets regularly to interpret how we should adjust to those changes and fine tune our strategic management approach. We've agreed upon a basic philosophical approach and established visionary goals for the future.

The major strategic management themes we're emphasizing are:

- *Sharing responsibility* with others to enlist their support and stretch our limited resources.
- *Preventing problems* by educating and seeking behavior changes.
- *Interdisciplinary management* through teams of varied disciplines focusing on complex problems.
- *Maintaining a progressive work climate* that emphasizes and rewards innovation, creativity and risk taking.
- *Stressing long range thinking* to be sure our perspective considers the needs of future generations.

Manager's Role

The key to implementing any departmentwide management approach is the extent to which your managers accept and can apply the concepts consistently. The development, communication and reinforcement of simple common themes are the most important elements to implementing strategic change.

Basically the manager's role at all levels is to:

- Assist in developing the strategic management directions. While upper management has the key responsibility for developing the overall management directions, involving middle and lower level managers will assure understanding, support and feasibility of implementation.
- Stay alert to external changes potentially affecting the organization and opportunities to implement strategic change.
- Communicate the common themes of the department's strategic management directions and take every opportunity to reinforce the message.
- Make management decisions consistent with the strategic directions, i.e., send consistent signals.
- Make tough choices, particularly in setting budget and work priorities, and encourage risk taking.
- Identify and remove internal barriers which frustrate the implementation of strategic direction—e.g., streamline processes, emphasize delegation, reallocate budgets and reorganize where appropriate.
- Reward creative actions consistent with strategic directions. Provide whatever incentives you can to encourage the desired behavior.
- Provide feedback to upper levels on successes, failures and needed changes.

Major Dilemmas of Change

Achieving strategic change in a large organization is not easy. Here are the major conundrums we continue to deal with.

- The public and politicians are used to dealing with shorter time frames and find it difficult to cope with long term decisions. Administrations change frequently and it's difficult to maintain a consistent approach over a longer time period. Frankly, without the insulation and support of our Natural Resources Board, it's doubtful the we could have undertaken much less achieved the types of long term changes we have embarked upon.
- How much change at one time? Although we've been a fairly progressive agency, we are facing significant strategic change which people are not comfortable with. Some units of the organization adjust better than others. You need to implement enough changes as soon as you can to convey that you're serious about the plan but not so much that everyone feels overwhelmed and unsettled. It's a constant balancing act, but remember a good strategic plan is a long range plan which will take some time to achieve.
- Strategic choices are tough ones—it's not easy to get people to give up what they're used to doing and take on new priorities. However, persistence pays off.
- Periods of budget cutbacks are the most difficult times to achieve change, yet they offer the most opportunity for doing things differently. Again, persistence pays.
- A blending of informal and formal approaches is needed. Informal cross-discipline teams work best for trends analysis, developing plans and goading the formal organization into taking risks. However, the formal organization must implement, even though some reorganization may be required.

Key Results

We've undertaken some significant changes in the past few years. The basic philosophies and directions of the department's strategic plan have been communicated departmentwide and incorporated into division and bureau plans. The approaches are being reflected in all of our management processes including hiring, training, personnel and program evaluation, and decision making.

We've used the budget process to reinforce strategic directions by reallocating funding to them. Some examples are:

- Wildlife management and forestry have redirected resources to emphasize private land management. Forestry is increasing marketing efforts for the private sector. Municipal sewerage treatment programs are emphasizing compliance maintenance and converting from grants to loans. Water and air quality programs are directing resources to nonconventional toxic pollutants.

We've reorganized to streamline management and better respond to new needs. For example:

- We eliminated a field management level called the Area Director and shifted those managers to other priorities. This reduced the number of management layers, simplified communication and enhanced delegation.
- We merged several existing operations into a Property Management Bureau to help integrate management efforts on all state properties and provide better support from the central office.
- We've reassigned managers selectively at upper, middle and lower levels to make better use of their talents and infuse new life into organizational units.

We've adopted new approaches to dealing with complex issues. Some examples are:

- Use of interdisciplinary technology teams to assist certain industries. A paper mill technology team is working with industry and other agencies to locate potential environmentally acceptable sites and approaches to make better use of our surplus forestry resource.
- We've adopted a multi-disciplinary approach to managing whole river systems or significant watersheds. A Lower Wisconsin River Commission is proposed to assist the Department in protecting a 92-mile undeveloped river segment through implementing scenic standards on private land in combination with traditional land acquisition and management of public lands.

A major indicator of our success is the good response from our employees. They seem to appreciate that this is not just another planning exercise. This one carries with it a top level commitment.

Thoughts on Change for Resource Managers

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Introduction

Much has been written and spoken about change in our society. Yet we appear scarcely able to appreciate the full impact of its speed and complexity upon the work we do and the agencies that employ us. The impact of change is a product of many factors. First, there is the information explosion which confronts us not only with huge volumes of information but also with a continuous stream of it at ever increasing rates of flow. Then there are the impacts connected with demographic changes in our populations. People are living longer; a large portion of our populations are in the ''seniors'' category. Seniors have more discretionary income than other groups and have unique spending patterns (The Royal Bank of Canada 1988).

Post-war ''baby-boomers'' are now young adults and their influence is becoming apparent. This group is characterized as being affluent, usually with two incomes per household. Many have no children or have postponed child rearing. They purchase foreign automobiles, designer clothes and upscale mail order children's paraphernalia.

North American socieities exhibit a preoccupation with health, fitness and nutrition. There has been a proliferation of health stores, spas and fitness publications. Supermarket preferences have turned to yogurt and mineral water. There is a decline in adult cigarette smokers and an increase in sales of low alcohol beverages. The travel industry has revolutionalized. There is now a plethora of ''frequent flyer'' programs, VIP credit cards, integrated hotel, transportation, recreation and business packages. Endurance sports such as cycling and long distance running are popular along with dangerous, thrill seeking activities such as white water rafting, hang gliding, motorcross racing and corporate training based on principles of risk, danger and mutual dependency.

Employment patterns have changes. The year 1956 was a watershed because for the first time in American history, white-collar workers outnumbered blue-collar workers (Naisbitt 1982). Between 1951 and 1985 the percentage of people employed in the ''service industry'' rose from 47 percent to 70 percent while the proportion employed in ''goods producing'' industries dropped from 53 percent to 30 percent. This is significant because most of the traditional wildlife clients in Canada were employed in the latter (goods-producing) category.

Our client base is changing markedly. Immigration, particularly from Indo-Asiatic and Pacific rim countries has brought into Canada people with very different wildlife use and conservation perspectives and traditions. New, often temporary, alliances are appearing for the purpose of challenging environmental alterations. Women exert more power in the marketplace and the boardroom; human rights and native rights are concerns which overshadow resource decisions in an unprecedented way.

All this, coupled with a remarkable shift from rural to urban living, has resulted in a Canadian populace which is becoming bereft of an understanding of the land, the cycle of life and death in nature, and of the mentor who we took for granted would be there to inculcate outdoor ethics and resource values into succeeding generations. The concrete canyon ecologist, replete with misty-eyed visions of vicarious outdoor experiences in eden-like environments, is now more than ever before the piper who calls the tune by which resource agencies must march.

The Canadian Scene

Although the foregoing changes are hitting Canadian natural resource agencies with the same force and speed as in the United States, Canadian laws, traditions and environmental imperatives are different from those of the United States. Many of these differences are subtle, and to the extent wildlife managers have ignored them, a price for our insensitivity has been extracted.

The role and availability of firearms in Canadian society, the accessibility of public land, the availability of farm game, the system of allocating public monies for wildlife management, the urbanization of the Canadian population, the lack of women among Canadian hunters and the impact of Treaty Indian hunting rights are factors which distinguish Canadian from American wildlife management.

How Managers React

Subtle differences between our countries, coupled with the bewildering speed and complexity of change has kept wildlife planners off balance at best and woefully out of touch at worst. Recent appreciation of the importance of these factors has compelled discerning wildlife agencies to apply good business practice to wildlife management in order to recapture and sustain public support, capitalize on future trends, improve productivity and save money.

However, all managers do not react skillfully to change. Some do not realize or appreciate that society is changing and, therefore, manage as if in a static system. Others recognize change is occurring but try to ignore it, hoping that the situation will stabilize and perhaps even revert to "normal." A third group of managers acknowledge change and, in trying to be all things to all people, get lost in a blizzard of program shifts and reorganizations, reacting like a spinning weathervane to every new societal direction. The fourth group recognize and embrace change, responding not to symptoms but to major trends and basic issues, planning and managing toward the longer view, foregoing the urge either to do nothing or to react to ephemeral, transitory circumstances. It is the characteristics of this latter group of managers that I wish to examine further.

Managing in a Changing Environment

How do leaders keep their organizations out in front in today's every-shifting circumstances? Contemporary business writers (Peters and Waterman 1982, Peters and Austin 1985, Peters 1987) identify one factor which, above all others, seems to characterize today's successful managers and leaders. Leaders invariably have a vision of how the enterprise wishes to make it's mark. Leaders articulate and define what has previously remained implicit or unsaid. They do this clearly and forcefully on every occasion; leaders live their vision convincingly and passionately.

Visions are aesthetic and moral as well as strategically sound. They are enabling and empowering, specific enough to guide actions and general enough to facilitate bold initiatives in today's changing environment. However, the degree to which an agency's vision is really adopted and modeled by it's employees will be a reflection of the ''core values'' or core philosophy of that organization.

Core Values—Importance of an Agency Belief System

Vibrant, responsive, successful organizations characteristically have a set of ''core'' values which are so basic, so fundamental to the existence and well-being of the organization as to be virtually immutable. These are distinct from organizational objectives, mandates or goals. These latter will likely change from time to time, depending upon fiscal circumstances or the philosophical or political orientation of the administration. However, organizational or core values will constitute a belief system upon which all of its policies are premised. These core values almost always will be stated in qualitative rather than quantitative terms. They give distinctive identity to the organization. An organization must be prepared to change anything and everything *except* those beliefs; institutional survival is a matter of maintaining these distinctive values (Peters and Waterman 1982).

Superior organizations have defined their organizational values and enunciated these by way of a published statement or agency creed. A creed has several important purposes—particularly in rapidly changing, turbulent times.

- It tells people what the agency stand for and believes in.
- It provides a common base of understanding among all members of the organization.
- It sets standards of conduct and levels of expectation for those within the organization as well as those it serves and those who serve it.
- It provides a ''corporate identity'' which helps bind members of the organization into a ''team'' or ''family unit''.
- It helps people exercise good judgment and render superior service in the conduct of their work.

In essence, an agency creed becomes a reliable, touchstone to guide plans and programs in times when agency leaders and their personnel are being harried from pillar to post trying to cope with ever increasing change in an environment of inconsistency, fickleness and often, mediocrity (Goulden 1987).

A word about agency creeds and core value statements: expect some people (at all levels) to complain about constraints on their freedom of thought, expression or action. Expect complaints that the organization is imposing its values upon the individual, making company eunuchs or stifling creativity. Upon examination these concerns will be shown to be groundless and their exponents fearful only of knowing what their employer, peers and clients expect of them. Anyone strongly at odds with the agency's belief system is not likely to deliver that agency's programs in a sensitive, effective manner. If the enunciation of the agency's fundamental belief system unearths this discrepancy so much the better.

Core Values—The Basis of Good Planning and Management

I submit that knowing and adhering to its core values is axiomatic in developing agency plans and serving agency needs. Such commitment will:

- Guide human resource development.
- Determine accountability.

- Set parameters for public policy.
- Establish the philosophical basis for its client/customer service.

Successful organizations realize and act as though their people are their most important asset. Their human resource development programs will be based upon the tenets of the agency creed and these will be adhered to religiously in all dealings between management and workers. Accountability lines will be clear, simple and understood by all concerned. Two-way accountability will be accepted and exercised between co-workers, between workers and supervisors and between clients and service providers.

The core values of a wildlife agency, when clearly enunciated, thoroughly understood and followed in practice will set parameters for public policy that will guard the public interest and permeate all agency plans and programs. Moreover, a creed declared and practiced in this way will form the basis for a sensitive client service philosophy which will yield plans and programs with higher than normal acceptance ratings and fewer staff disappointments and frustrations.

Successful agencies are a product of superior leadership. Superior leaders invariably recognize that an agency's plans and management programs will reflect the ingenuity, creative strength and determination engendered in its staff. These characteristics, in turn, will result from clear managerial direction, a realistic reward system, glorification of idea champions, celebration of agency successes, willingness to risk (with protection of the risk taker) and an all-pervasive sense of fun in striving for the corporate goal within a ''family'' atmosphere.

Future Managers

Skills and Abilities

As the onslaught of change continues to bombard us, as planning and managing appear bewilderingly more complex, we would do well to reflect upon the poem simply titled ''If'' by Rudyard Kipling which begins:

> *If you can keep your head when all about you*
> *Are losing theirs and blaming it on you,*
> *If you can trust yourself when all men doubt you,*
> (Beecroft 1956)

Described in the full text of that poem are most of the qualities future managers will need. They are not new. Perhaps, however, one could underscore selected skills and abilities which will be necessary more in the future manager than was the case in Kipling's time.

I submit that skill in trend forecasting, consensus building, environmental mediation, risk assessments, conflict resolution, understanding sociological interactions and lastly, the capacity to apply new technology creatively will be hallmarks of superior wildlife managers in the future. Even moreso than today, they will be characterized by a capacity to manage time effectively.

Crisis management will be necessary on occasion but it will never totally supplant or de-rail long-range tasks that are basic to an achievement of the goals of the organization. Thus, long-range planning will be carried out incrementally, reflecting the core values of the organization yet being flexible enough to accommodate emerging realities. The grand plan as we once prepared it and pursued it appears to be obsolete. It is simply too time consuming, rigid and insensitive to emerging events and not implementable by front-line practitioners.

Conclusion

- Are you giving good public service?
- Are your clients satisfied?
- Do you have an outward-looking "customer orientation?"
- Are staff highly motivated?
- Is there high flexibility in plans and programs?
- Is the public integrally involved in their development?
- Is there easy communication up and down the organization?
- Are your plans and management programs effective on the ground?

Our answers to these questions will determine the efficacy of our planning and management in natural resources. In short, our ability as managers to direct programs and agencies in these turbulent, uncertain times will truly test our leadership mettle. When all else appears fluid we must have a modicum of certainty. And this we will have to draw from within as much as from outside (Berry 1988). That certainty will be the core values to which we subscribe and by which we unashamedly ask our employees to be governed. Knowledge of and adherence to a clear, unequivocal set of values will not only release us from the fear of change but actually enable us to enthusiastically embrace it, thereby yielding enormous creative opportunities. In this case, to the assured will go the prize—and as well, we will have put the fun back into management.

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Planning as a Tool for Agency Management During Rapid Change

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In July 1987, the Kansas Fish and Game Commission and the Kansas Park and Resources Authority were merged to become the Kansas Department of Wildlife and Parks. This new agency was formed by an Executive Order and charged with the management of the state's natural resources and recreation. For the first time the department became a cabinet-level agency in state government.

Secretary and Assistant Secretary positions were established. Both are political appointments. The new Department consists of five divisions: Parks and Public Lands, Fisheries and Wildlife, Law Enforcement, Education and Public Affairs, and Administrative Services.

The Executive Order established a new seven-member Commission which has responsibility for adopting, modifying or rejecting regulations proposed by the Secretary. The Commission also serves in an advisory capacity on other matters. The Secretary has broad powers and discretion in creating and modifying existing structures and positions.

Reorganization presented a unique opportunity to improve our services to the public and our capabilities to protect and develop resources by improving efficiency, economy and coordination of operations. To minimize the disruption of services and allow an orderly transition, reorganization was to take two years. The process required a cooperative effort among the Governor, agency administrators, commissioners, staff, the legislature and the Department's many constituents.

The intention for reorganization was to combine the two former agencies into one Department, rather than to simply put an umbrella administrative structure over the former two agencies and allow them to keep operating in the manner of the past. This meant a complete reshuffling of the responsibilities of the organization and a rethinking of the method of doing business. The intention is to have employees work on a variety of projects that are variable in nature and diversified in order to make the best use of the creativity and innovation skills of individuals.

It is difficult to describe the amount of change the agency is undergoing, but nearly every position description in the agency will change in order to break down some traditional barriers. These extensive changes are based on the belief that if we don't adapt to the new world around us, our agency will face virtual extinction. This type of change is going to be necessary in many states over the next few decades. In our view, such change is desirable. A good planning process should serve as a catalyst to change.

This reorganization effort was designed to help produce a better product—a department that not only was changed into a new animal, but one that is capable of continuing change as the world around it changes.

Reorganization Goals

While Kansas is thought of as a rural state, it isn't. Kansas has an urban-based population with over half of the population living in urban areas. The source of our wealth is changing away from agriculture and other traditional areas, such as oil and gas, to manufacturing, product development and service industries. Agriculture is undergoing a revolution in Kansas and nationwide. Farm support programs are phasing out and conservation-based programs are moving in. Water use problems continue to intensify. Large segments of the population are reacting to the impact of toxic contamination and other environmental problems. People have more recreational time and tourism is increasingly a major industry in rural areas. Minority groups are speaking out and expect their fair share of attention. The population is becoming older and seeking new things to do. Traditional constituencies, such as hunters and fishermen, are declining both in percent of the population and in actual number, and non-traditional constituencies, such as appreciative users, are increasing.

Our Department now operates in a more competitive market. We have lost market share as people have turned to video games, exercising and other new pastimes. We have recognized the need to diversify and use new approaches in developing and maintaining people's interests in the out-of-doors, environmental protection and conservation. Our main goal is to provide a broadened constituency for natural resources in Kansas. We hope to do this by tackling projects that are important to the people we currently don't reach.

We are looking at urban programs to work with people. This means increased urban fishing programs, backyard habitat efforts, developing urban parks in cooperation with local government, education programs and construction of urban education centers, stronger information programs and campaigns, increased attention to environmental monitoring and environmental concerns, and a lot of other efforts.

We expect to initiate major land acquisition programs that focus on these new markets. Kansas has little public land and one of our key directions will be to provide more areas for recreational uses of all types.

We do not intend to abandon our traditional constituents—the hunters, trappers and fishermen. To the contrary, we are looking at efforts to strengthen our traditional groups. But we need to go beyond that and reach people who never have and never will own a shotgun.

One of the mechanisms we intend to use is the concept of "Resource Focal Points." A resource focal point is a rallying vehicle that the agency, working with constituent groups and others, can use to capture the public's attention and gain broad support. For instance, in Kansas we have a natural resource focal point in Cheyenne Bottoms. This 41,000-acre area is almost a religious mecca to many people, especially to hunters and birders. It has been designated a wetland of international importance due to its shorebird and endangered species use. We are using a plan to restore and improve Cheyenne Bottoms as a vehicle to mobilize constituents. This is an extremely important effort, but the broader point is that it will allow us to develop an active supporting constituency.

By using these types of resource focal points we hope to have a spillover effect on the many other resource issues that we must tackle. By doing these things and others, we can strengthen our agency, develop new funding sources and become stronger politically. These strengths will allow us to do a better job of protecting and managing natural resources.

All this is in stark contrast to the way the previous agencies operated in Kansas. It was almost as if the earlier agencies felt that if they didn't change, the world in which they operated might not change either. The former agencies were stuck in a rut and they hadn't changed direction significantly in 20 years. As a result, they had little control over their destinies. Each agency had done little more than provide lip service to the tremendous change that Kansas, and the rest of the U.S., is undergoing.

The Kansas Planning Process

One of the most difficult parts of the reorganization process was trying to integrate two independent planning systems. This, plus the fact that reorganization itself was an "unplanned" event, makes it difficult to describe the effect our planned management system has had on reorganization.

The Park and Resources Authority had its own form of planning, called the Statewide Comprehensive Outdoor Recreational Plan, or SCORP. The SCORP consisted of an inventory of outdoor recreation resources and projected needs in Kansas and identified issues related to outdoor recreation. However the process was very weak in the implementation of strategies. This was partly because the Park and Resources Authority utilized a system where a few individuals ran most of the functions in the agency. Park managers who delivered all programs had little autonomy or ability to plan and manage their own functions. The agency had no real plans or direction other than that given to it by the legislature each year. Needless to say, this system did not lend itself well to change as a part of the reorganization process. The SCORP process has been maintained, but it is now integrated into the rest of the planning system.

The Fish and Game Commission had used a well-established system of planned management since 1978. This planning system has served as a model for several other states, since Kansas is one of only five states (Kansas, Maryland, Tennessee, Wisconsin, and Wyoming) using the "Comprehensive Planning Option" for Pittman-Robertson (P-R) and Dingell-Johnson (D-J) federal aid. Under the "Comp. Plan" option, we are able to treat all of Kansas as a single P-R/D-J project and assume responsibility for many federal requirements. The strengths of this system were obvious very early in the reorganization process, and our Department adopted this planning system with some modifications.

The comprehensive planning system is mostly a "bottom up" system for planning and budgeting. It gives employees an internal mechanism to suggest projects and to see that, once these projects are funded, they are carried out. The keystone of the system is to give each employee the opportunity to develop ideas into full-blown proposals that receive consideration through an internal evaluation system. The system allows each employee to prepare his/her ideas in a manner that enables others to evaluate them in detail and to rank them according to a system of priorities that are laid down by the administrators of the agency. This system was an adjunct to the normal state government systems. No other agency of Kansas state government used such a system, including the Park and Resources Authority.

The planning process contains four sub-components:

1. *Inventory*—Through an inventory process we monitor status of our products, which we refer to as "programs," such as small game, reservoir fisheries and state parks, and "customer" demand. We monitor trends such as recreational use, harvest and populations to see "where we are."
2. *Strategic Plan*—The strategic plan builds upon this inventory, evaluating where we are in each program and setting the direction for where the Department needs

to go. Many would refer to the Strategic Plan as "management by objective," in that it sets quantifiable objectives which are used to measure progress. The planning process also looks at factors affecting each program that either enhance or hinder our program objectives and proposes broad strategies for accomplishing our objectives. This is an issue identification process.

3. *Operational Planning*—This is sometimes called our comprehensive planning process. In its simplest sense, operational planning describes a detailed budgeting process that focuses on readily identifiable project units such as a state lake or wildlife area. These projects are cross-divisional and are managed at the field level. In addition, the budget and project system is backed up by a detailed cost accounting system that allows the Department to track expenditures at a variety of levels.
4. *Evaluation*—This overlaps somewhat with the inventory process in that we measure whether we've made any progress toward our goals. The cost accounting system allows evaluation of expenditures by program (e.g., species group). For example, we can report how many dollars our Law Enforcement Division spent supporting the pheasant, deer, and boating programs. Not very many states have this information. It allows our agency to see if our expenditures match our stated priorities.

The entire process is intended to allow critical evaluation of agency actions in relation to stated goals. It establishes a consistent process for setting agency direction and prioritizing efforts. It is also very strong on accountability, allowing the Department to make sure its efforts are consistent with its stated goals.

Planning in Reorganization

This planning system provided a good starting point for reorganization. The planning, prioritizing and administration of day-to-day operations was well organized. Yet, although the planned management system was conceptually very good, it left much to be desired on the ground. Some administrators tended to use the system as a shield and an end in itself. As a result, the established system had started to stagnate and was not prone to change or rapid movement of any type. While this may have been due to administration more than the system itself, the agency had bogged down and was finding it difficult to move.

Without the cost accounting system, which is an integral day-to-day part of our planning system, it would have been nearly impossible to combine the two former agencies in the manner in which they now exist. Because we have purposely broken down many organizational "walls" and combined all traditional park and wildlife land-management functions under a single field concept, the ability to separate costs of various functions is crucial.

The cost accounting system allows us to assign people from several divisions to work on projects with a diversity of funding sources. We can mix funds on any project, such as a land acquisition effort, without creating a diversion of funds. The system allows us to track spending in a simple way without any particular problems. The cost accounting system also provides a powerful management tool since it enables us to determine how much effort our agency puts into different functions each year, which, in turn, enables us to plan better for the future.

The strategic planning process is a good effort in that it involves large numbers of staff and others in making extensive analysis of the "big picture." However, without leavening the plan with reality, many tend to look at it as only a broad, desirable direction, rather than a living document that can translate into action on the ground. One of the greatest weaknesses in our existing system is our difficulty in translating the strategic planning process into a vehicle that makes things happen on the ground to carry out the direction of the plan. This might be corrected through a project selection process that places more emphasis on strategic plan goals and by implementing area management plans at the field level.

Without the continued support *and use* by upper management, a strategic plan tends to be completed, forwarded to the appropriate federal agency and left on the shelf until it is time to redo it. The document is seen as the product rather than a guide to action. And once completed, the plan can become static and unable to change with the times. In our case, we need to bring the strategic plan into a more prominent role in the agency decision-making process.

As a result of some of these weaknesses, it can be very difficult to convince some staff and others who have little or no understanding of the planned management system that it is worth the effort and that it will work if given a chance. In many cases, people are unwilling to participate in what they see as an exercise of limited practical application. Rather they look at the strategic planning process as a hurdle to get over so they can do their jobs the way they have always done them.

In addition, the process is complicated and can intimidate people, including employees, who need extensive training in the process of developing a strategic plan.

As new administrators move into the agency and attempt to create change, the system can be an impediment, but this may be to the agency's best benefit over the long term. Over the long run it probably is useful to stability and making accomplishments in several areas, but it also has limitations. The most severe limitation in our department would appear to be the difficulty that we are facing in trying to create an agency that is flexible and open to continuing change. Our desire is to have an agency that eventually will create change rather than simply respond to it or resist it as it has in the past. In other words, we have found that an agency with a planned management system may be no more conducive to change than any other agency unless the top administrators themselves are open to change.

Unless it is used properly, a planned management system can override opportunism when it presents itself. Innovative ideas may be discarded because they don't fit into the long range priorities and because there is always a backlog of new projects waiting to be done.

The system can also punish risk-takers because they don't always have all the answers about how things are going to work out, how much time implementation will take, and how much it will cost. The system does an excellent job of identifying projects that have uncertain outcomes or incomplete data. And, if used properly, the planning system can allow an administrator to make an informed choice, knowing that risks are there and deciding whether to accept these risks. Reasonable risk-taking is the lifeblood of any good organization. Risky projects will fail on a regular basis, but they also will often result in leaps to new heights. These leaps are necessary to keep any agency or business in a position of leadership. The system must allow some subjectivity; any purely objective "project scoring" system will always select "safe" projects. It is good to have a plan, but any plan must be flexible when the environment changes or when a staff member identifies an especially creative, albeit risky, undertaking.

How does one fix this? Even with its faults, a planned management system is much better than no system at all, which tends to leave an agency rudderless or dependent on strong personalities for all direction. The system must be recognized for what it is. *The planned management system is a process or a tool that must be used to make things happen rather than be an end in itself.* While many people in an agency are prone to thinking of the process as a product or a goal, it is not. Administrators must use the planned management system as a flexible and responsible tool to address the needs of the public and the resources it is designed to manage. This will require administrative involvement in the process and a deft ability to know when to circumvent the planned management system (and the agency planning staff) and let the risk-takers seek a higher plain. Risk-takers and your most creative staff may be constrained too easily by bureaucracy or resentful of process. They may be good at execution, but they tend to have a vision of a goal rather than a carefully determined road map to reach the goal. Top administrators and the planning system must be sensitive to their needs and make sure they are not smothered by the system.

Conclusion

In short, the planning system in place in the Kansas Department of Wildlife and Parks has its weaknesses, yet it has also filled a very critical need for stability and accountability in our reorganization. At the same time it must also be fine-tuned to be more flexible and responsive and less reliant on procedure rather than innovation.

We want to make it clear that we strongly support the planning process. Many states would benefit from a planning system like ours. But it is important that everyone realize that implementing a planning system will not make problems go away. If anything, it heightens the awareness of an agency's shortcomings. Our Department has been through one cycle of planning as a new agency, and it is still too early to judge the effect of the planning system on reorganization. Reorganization is not through yet; it may never be. We started off at a disadvantage, with an unexpected reorganization. Not everyone was aware of the new direction of the Department at the time we began revising the strategic plan. Our next planning cycle, which will begin shortly, will be a better proof of the system.

Adventures In Improving Agency Management: How To Survive and Succeed

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Managing work is described by Drucker (1974) as composed of five basic functions. "A manager, in the first place, sets objectives . . . Second, a manager organizes . . . he classifies the work and further divides the activities into manageable jobs . . . Next, a manager motivates and communicates . . . The fourth basic element in the work of the manager is measurement. The manager establishes yardsticks . . . Finally, a manager develops people, including himself."

Those of us involved in management of resource agencies should be performing these five functions as surely as any profit-oriented business does. Restructuring a system of management to systematically integrate each of these functions can provide great benefits to the natural resources we manage. A systematic approach to management can increase program effectiveness and agency efficiency and enhance agency accountability to both the public and the legislature. The authors of this paper are firmly convinced that some of the most significant advances in managing natural resources will come about through advances in agency management rather than just through application of better biology.

Most of us with natural resource backgrounds receive little or nor formal training in how to manage an agency. Many former agency biologists were promoted to the managerial ranks on the basis of their abilities to manage the *resource*, *not* because of their skills in managing an *agency*. All too often, success in managing agency operations is left to chance. Success is sometimes achieved when agency managers are fortunate enough to learn through on-the-job training or by emulating other successful managers. Most struggle mightily, sometimes succeeding through trial and error, sometimes not. The management practices of an organization usually reflect the diversity of background and experience of its managers (Hickman and Silva 1984), which do not necessarily result in a well-organized, logical process of making management decisions.

Comprehensive Planned Management Systems

One logical, cohesive process for conducting effective management of an agency is often referred to as a comprehensive planned management system (CPMS). An effective management system can only be developed through conscious efforts to systematize the way the agency functions and "thinks" about its work. Consequently, management systems permeate all levels of management and relate to the interactions of all five of Drucker's management operations. The comprehensive planned management system has been described as the process by which an agency addresses four major questions:

(Crowe 1983)

1. Where are we?
2. Where do we want to be?
3. How do we get there?
4. Did we make it?

"Where are we," includes an inventory of the current resource status and identification of issues and problems facing the agency in management of these resources. "Where do we want to go," includes formulation of goals, objectives and strategies for the agency's resource management program. "How do we get there," addresses implementation of strategies directed toward problems which could hinder attainment of program objectives. This phase outlines day-to-day operations of the agency, most easily recognized in the form of work plans and project proposals. Evaluation of work efforts and project results is the phase that answers the question, "Did we make it?" End-of-year project reports and personnel performance appraisals are two of the most universal vehicles used by agencies to evaluate their operations.

The Difficulty of Improving Agency Management

Adoption of a comprehensive planned system of management is an evolutionary process. No matter how well a system is initially designed or how well an agency is currently managed, successful management requires continual fine-tuning and adjustment to adapt agency operations to a changing world. However, changing the way an agency currently does business is *not* an easy task. Machiavelli (1950) summed up the dilemma facing those who attempt to implement a new way of doing business when he stated:

> *There is nothing more difficult to take in hand, more perilous to conduct or more uncertain of its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new.*

The authors of this paper have been members of the Organization of Wildlife Planners (sponsor of this special session) for several years. One of the main objectives of our organization is to assist and provide support to agencies that are involved in the development and implementation of their own planned management systems.

Several state resource agencies are successfully operating under comprehensive planned management systems (CPMS). Each of these agencies encountered unique challenges in the process of implementing a new way of doing business. However, there is a degree of commonality in the kinds of hurdles faced by those attempting to improve management of their agencies. Our objective here is to highlight some of the most common potential pitfalls using real-life examples from our own respective home states, as well as experiences of our colleagues in other states.

Implementation is Key

The manner in which perceived "new wave" management is implemented is paramount to its success—no matter how sound, straight-forward, or minor proposed management changes may be. Formulating the ideas for a better way of doing business is not nearly as difficult as convincing others of their merit and actually getting the change enacted by all involved. People in positions of authority know that they can direct employees only within the directive latitude those employees determine for themselves. Administrators also realize that there is no field manager worth his/her salt that can't figure out a way to avoid or circumvent directives that he/she doesn't agree with!

Robert H. Waterman, Jr. (1987) emphasized the implementation hurdle in his book *The Renewal Factor* with the statement: "The concept is easy; implementation is a bitch!" So, how does one go about successfully implementing change? Five major challenges often stand in the way:

1. Coping with fear, the common initial reaction to change.
2. Creating a shared vision of where the agency is going and why.
3. Building ownership in management changes.
4. Failure to accommodate failure.
5. Sending the proper signals.

The better job an agency does in meeting these challenges, the more likely that implementation of management changes will be successful.

Coping With Fear of Change

Fear of change manifests itself in many ways ranging from withdrawal from the implementation process or passive resistance to open hostility and subversive attempts to sabotage the system. Fear arises from uncertainty: uncertainty about how the new change will affect "*me*," "*my*" job security, "*my*" level of authority and responsibility in the agency, etc. Communication and knowledge are the keys to overcoming fear of change.

The experience of Montana's Department of Fish, Wildlife, and Parks (MDFWP) and Wisconsin's DNR in coping with fear of change is fairly typical. When efforts were begun to implement a planned management system there was great concern among field people and managerial staff (especially mid-level managers) regarding this new "system." Misinterpretations and misunderstanding were rampant. Some managers simply maintained that it would not work, while others were openly hostile. One crusty Wisconsin field manager said, "If you took all the planners in the capitol and laid them end to end, it would be a pretty good idea . . . especially along the interstate."

Several techniques can be used to address this initial resistance to change. Proper pacing is one. The degree of change and the pace at which it is introduced must be calibrated to match peoples' comfort levels. Montana began to prepare for implementing its comprehensive planned management system by reviewing and updating its existing strategic plan. Most agency employees were relatively familiar and comfortable with the existing planning document. After some small successes had been achieved during revision of the plan (and comfort levels increased concurrently), the pace was increased. Implementation of written work plans for all agency projects came next, but only *after* comfort levels had been raised amongst agency staff. Two key approaches to overcoming fear of change are:

1. Sometimes one must go slow to go fast.

2. Often it is best to tackle smaller tasks first and build successes (and credibility concurrently) before tackling more major tasks.

Creating a Shared Vision

Misunderstanding and misinterpretation of how and why an agency is changing its old way of management are common problems. The challenge is to create a shared vision of how the agency can be better managed, what changes are to be made, and what benefits will result. If there is no common understanding of exactly what is to be changed, how it will occur and most importantly why, then it becomes impossible for those within the agency to support or work constructively toward a common goal. Confusion and frustration result.

One common source of confusion and misconception for managers and administrators is a tendency to focus on only one small part of the total management system at a time. Many managers in both Montana and Wisconsin for example, thought that "the job was done" once the strategic planning document was written. The linkage between strategic planning and organizing the actual work, setting priorities, allocating funds, and measuring performance escapes many managers in the early stages of implementing a management system. As a consequence, many managers felt threatened and attacked the system when it suddenly became apparent that the strategic plan would become the functional basis for prioritizing and funding their work projects (i.e., that the strategic plan would effect *their* work).

Internal communication is critical to creating a shared vision of what a management system really means to a manager's budgets and day-to-day field operations. This is a continuous effort taking many forms. Kicking off major management changes with focus groups, training sessions, workshops, in-house videos, internal newsletters, and face-to-face, one-on-one meetings are some of the communication methods employed by MDFWP, the Wisconsin DNR, Maryland Forest, Parks, and Wildlife and others to develop a shared vision.

Creating a Sense of Ownership

The most traditional (and outdated) management model is based upon a strong hierarchy with those at the top making the decisions and those below carrying out those decisions. This type of "theory X" management (McGregor 1960) works well only under conditions of slavery or in environments with strong and continually emphasized hierarchical roles amongst employees and managers. Management of today's natural resource agencies doesn't occur in such an environment. A major component of today's work force consists of independent and highly trained professionals with scientific backgrounds. Professionals object to dictatorial management styles and demand involvement in decisions which impact their professional roles and responsibilities.

Decisions made with involvement of the work force are generally the best decisions. The expertise of the workers is included in the decision and, after all, at some level of detail, the workers know more about their work than do their administrative managers. This approach is fundamental to the spectacular success of Japanese business philosophy. In addition to better management decisions, employees find it easier to support and effectively implement decisions they took part in making. It's basically human nature to be most committed to our *own* ideas! Decisions made solely by someone else and delivered as directives are a sure bet to be attacked or rejected—a phenomenon called the "not invented here" (NIH) syndrome (Waterman, Jr. 1987).

Successful implementation therefore requires identification of all potential "stakeholders" and "naysayers" in any particular phase of a management system and making sure that they are included in the process of developing a shared vision of what the new system is intended to achieve. This does not mean relinquishing decision *authority* in return for a democratic voting system, but it *does* mean really listening to those affected prior to making decisions. A guaranteed recipe for failure is for a few staff (planners) to design changes in the way the agency does business and *then* ask everyone else their opinions. Or worse yet, just dictate the changes to all employees.

Failure to build a shared vision with participation of managers and field people can doom any initiative. One manager in Wisconsin summed up an early failure with the comment, "I did exactly what you told me to do, even though I knew it wouldn't work."

Another classic example of the NIH syndrome involved implementation of a method for reporting management information in Montana. In 1977, MDFWP implemented a reporting process entitled Employee Activity Reporting System (EARS). It was a well though out concept for collecting and tracking needed management information for department work efforts except that only a few higher level staff had been involved in development of EARS. Consequently, there was little understanding and no ownership in the new reporting system among rank and file employees. Top management implemented the new reporting system by directive and distributed new report forms, a users manual and numerous informational memos to all employees. As would be expected, employees expressed confusion, lack of understanding and bitter resistance to the new reporting process and it was implemented with great difficulty. Not surprisingly, the Department dropped the EARS system within the year, primarily due to resistance to implementation.

Montana's "EARS" reporting system was evaluated and subsequently adopted by the Kansas Fish and Game Commission. However, the Kansas approach to implementation was quite different from Montana's. Those working with the Kansas reporting system held numerous information exchanges with employees before implementation was attempted. Input was solicited from every employee of the agency. Only after this effort to include and gain support from agency employees was the EARS system implemented. Due to the ownership Kansas employees gained in developing EARS, there was strong support for the management change and the reporting system has been working successfully for Kansas since 1978. The concept was the same in both states but its success or failure was greatly influenced by the approach used for implementation.

Simply dictating change is seldom successful. However, even when not in a position to dictate change, ignoring the need to include all important stakeholders early in the process is one of the surest ways to guarantee failure. Not long ago a group of mid-managers for a fish and wildlife agency got together and worked themselves into a frenzy over the need for change in their agency. They discussed ideas and decided on changes to suggest. But the route they chose to implement their enthusiastic ideas was to write up a formal proposal which they sent directly to the agency head *without any discussions with their colleagues and cooperators!* When their colleagues saw the formal proposal for the first time (when they received copies of what was sent to the director), they felt very left out, hurt, resentful, and angry. Many of them reacted rather violently by marshalling their political powers to convince the director of the stupidity of the new proposal and all the reasons why it wouldn't work. What would have happened if the initial little group had seen fit to visit with colleagues privately—to ask for their ideas—*before* the proposal was written and sent? The moral of this story: Just being well intentioned or "right" is not enough!

Ownership within an agency must not be limited to stakeholders beneath the top decision maker. The agency director must be willing to display personal ownership as well. This case example involved an agency executive director who seemed sincerely interested in improving his agency's management procedures. In fact, he took special courses to help him learn good management techniques. He talked loudly and often about his commitment to improving his agency's management system. But then he did two things which sent signals to the troops that were inconsistent with his own exhortations: (1) To his already busy and "feeling overburdened" troops, he wouldn't give any indication of what his new, "top priority" enterprise was to displace. "Just work a little harder; let the agency take greater advantage of your energy and efforts!" was his *real* message. And (2) he capped things off by letting his own deadlines for producing his parts of the effort slip. The message here? "Everybody else jumps but me. I have more important things to do." This individual's motivation seemed to be sincere but his failure to exhibit personal ownership in the process sent his employees a message that was incongruent with what he wanted to accomplish.

Accommodating Failure

Professionals in the wildlife and fisheries fields set high standards and expectations for themselves as well as for others. They exhibit characteristics described by Lea and Brostrom (1988) for professionals in high technology fields: "Being 'right' is important in technical work groups and making mistakes is embarrassing. . . .Because these professionals are so task-focused . . . there's often a lot at stake for them professionally." This is commendable and leads to a high degree of self-motivation.

However, too much of a good thing can have negative impacts. In many organizations, someone who has strived hard and failed at an undertaking is still labeled as a "failure" with all the negative connotations of our success-oriented society. This attitude, when part of our agency culture, discourages risk-taking by employees, thus discouraging new ideas, creativity and ingenuity. Such a parochial agency culture promotes an overly conservative low-risk approach: don't take risks; don't try anything innovative or new. The old adage, "If it ain't broke, don't fix it" should not apply in resource management where doing what succeeded in the past is vulnerable to failure in the future. Our natural resources would be better served by agencies which observe the adage that, "He who has never failed, has never tried to do very much" (anonymous).

H. Ross Perot, who began in 1962 with $1,000 and built a $750 million company, was recently quoted in *"Inc." Magazine* regarding his philosophy on mistakes:

> *We teach people that mistakes are like skinned knees for little children. They're painful, but they heal quickly, and they're learning experiences. All over corporate America, you get to be chairman of the board by keeping your nose clean and not making mistakes. My people are covered with the scars of their mistakes. They've lived out in the field; they've been shot at; they've been hit in every part of their bodies; and they're real. By the time they get to the top, their noses are pretty well broken. The chances of them getting there with a clean nose are zero. Because they get there by producing, and the by-product is to make mistakes.*
>
> (Burlingham and Hartman 1988)

Failure to allow for failure can have devastating effects when developing new management processes. *No* system will work perfectly when first implemented! Rather, successful systems are those resulting from experimentation with various approaches and methodologies. They evolve over time as a series of proven processes rather than a one-shot implementation of a grand design in its entirety. The perpetual process of fine-tuning a management system requires identification of what does and doesn't work and learning from our failures as well as our successes in the process. Agency managers must not succumb to the initial impulse to "throw the baby out with the bath water" when something doesn't work the first time.

Management systems in operation in Kansas, Wyoming, Wisconsin and Montana look significantly different now than they did when each was first developed and implemented. Each of these states continually evaluates and fine-tunes its system, readily learning from mistakes and building on what *is* working. In these states, the new adage is, "If it's broken, fix it; if it ain't broken, build it better!"

Sending the Proper Signals

Agency administrators must be cognizant of signals they send throughout their agencies in the form of real or perceived rewards and punishments associated with complying with new management changes. A sister agency of ours was working very hard to implement a new budgeting process which required breaking large budget requests into smaller units to improve budget allocation decisions. Six regional managers met with top administrators at an annual budget meeting to present their budget requests. Only one manager had followed the directive to break his overall budget request into smaller project units. The other five managers, refusing to submit their budget requests to detailed scrutiny, arrived at the meeting with their budget requests in the same "lump sum" format as in the past.

Each manager presented and defended his budget request in the same manner as in past years except for the one manager who had worked to break his budget into more specific project units. As he presented the specifics of his budget, the other managers challenged the merits of each project and the budget amount requested for each.

How did top administration react? They assumed that since there was controversy over only one manager's budget, there must be something wrong with it. The manager who had followed the new budgeting process was allocated the *smallest budget ever*!

Will any of the managers party to this episode be willing to subject their budget requests to detailed analysis in the future?

If an effort to improve agency management procedures is to succeed, employees *must not* be penalized for their good faith efforts and participation! In fact, they should be rewarded somehow if possible. Employees are very sensitive to conflicting signals sent by their supervisors and leaders. Conflicting signals will quickly destroy commitment, cooperation, and any effort at all on the part of employees to do the work required to implement an agency initiative. Administrators and managers must bear in mind that their actions are much more powerful cues than their rhetoric; ''read my lips'' just won't suffice to change how an organization conducts its business!

Summary

Overcoming fear of change, the shared vision that a strategic plan provides, ownership in management processes, continual fine-tuning (not expecting perfection the first time), and attention to sending the proper signals are the factors which drive evolution of successful management systems. While the basic components and principles of a comprehensive planned management system are fairly standard, there is no universally adaptable ''package'' which can simply be ''plugged into'' any organization. We previously made the point that an agency's culture and management traditions arise from the cumulative background and experience of its managers. Management system components therefore must be tailored to accommodate existing cultural features such as organizational structure, lines of authority, management style and traditions.

We haven't shared our experiences and observations to be critical of ourselves or others. Rather, we hope that by highlighting some of the most common pitfalls we and our colleagues have encountered and survived, others can learn from our experiences and be more successful in developing and implementing management changes.

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Are We Barking Up The Wrong Trees? Illusions, Delusions and Realities of Communications in the Natural Resource Management Mix

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Introduction

Communications efforts—information and education, public affairs, etc.—have been part of natural resource management agencies and organizations since they were created. This paper takes a critical look at communications in the natural resource management mix in the United States by examining three questions:

1. How important is communication in natural resource management?
2. How well are we addressing the communications function?
3. How can we do better?

Because most of my experience has been with fisheries and wildlife related agencies, organizations and issues, the examples and emphasis in this paper are from those fields. However, based on my observations, the same problems and opportunities in the fisheries and wildlife fields apply to the broader natural resource field. Also, for brevity, I will include fisheries in the term wildlife.

The terminology used to describe the communications function in the wildlife field is confusing. If it is any consolation, the same confusion exists in the business community. Communications is used here as an all-encompassing term that includes the various disciplines of public relations, advertising, marketing, legislative action, human dimensions, citizen participation, information and education and public affairs. Although each of these have different meanings to different people, the context in which I talk about them today will be essentially the same. Agency and organization functions such as hunter education, boating safety and communications within the agency (internal communications) are also included.

How Important Is Communication?

If asked the question "Is communication important in wildlife management?" most of us would answer, yes. But how important is it? Wildlife professionals for nearly 60 years have described communication as one of the critical elements in the wildlife management process.

The American Game Policy of 1930 identified the need for "public education" on wildlife resource management and outlined strategies for "a larger educational machinery" (Leopold 1930). Aldo Leopold talked extensively about the need to educate the landowner and the public in general about land conservation (Leopold 1933, 1940, 1942). In his presidential address to The Wildlife Society in 1940 (Leopold 1940) he said "We find that we cannot produce much to shoot until the landowner changes his ways of using land, and he in turn cannot change his ways until teachers, bankers, customers, editors, governors, and trespassers change their ideas about what land is for.''

The 1973 North American Wildlife Policy (Allen 1973) was more explicit in describing the critical role that public relations and education play in wildlife management. They said communications efforts at the time were characterized by thinly spread support and minimum services.

Langenau and Ostrom (1984) developed a model for displaying relationships between public demand, wildlife resources, organizational and political factors, and public benefits from wildlife. Their research identified a number of changes that would be expected to increase recreational benefits from wildlife. Specifically, they listed four areas of work for increasing hunter-days:

1. Comprehensive planning.
2. High field-to-staff ratios among civil service employees.
3. Increased efforts in information and education.
4. Increased state and federal revenues from hunters.

Communications and contact with the public plays a critical role in all four of them.

The mission statement or goals of almost every wildlife agency and organization in the country mentions the need to communicate with wildlife constituencies. For example, one of The Wildlife Society's four principal objectives is ''to increase awareness and appreciation of wildlife values'' (The Wildlife Society 1988). Increased information and/or education efforts are specifically listed in 12 of the 24 conservation policies of The Wildlife Society. Their policy on conservation education says it ''is of paramount importance'' (The Wildlife Society 1988).

Numerous authors on diverse subjects from waterfowl hunters (Smith and Roberts 1976) to anti-hunters (Decker and Brown 1987, Todd 1980) to wetland conservation (Conservation Foundation 1988) point out the crucial role that communication efforts play in solving wildlife and wildlife habitat conservation issues.

In their final chapter, entitled ''Wildlife 1985–2000: ''The Profession and Management'' Gilbert and Dodds (1987) listed three factors that will force more intensive management of wildlife populations:

1. Declining habitat in all countries.
2. More people with highly diverse interests in the resource will be using it and will demand that their interests be met.
3. The need to justify expenditures.

They believe this more intensive management will result in an increased importance for communications because, among other things:

- The North American hunter will need to be more knowledgeable about wildlife and will be expected to assume a more responsible role in managing the species.
- Wildlife managers will have to extract data from their programs to inform and education the public, planners and policy makers so that management practices and programs can continue.
- The nonhunter and nontrapper client base will expand greatly, requiring communications products and services not traditionally provided.

They say massive efforts will have to be put into the I&E budgets of wildlife agencies, and programs of most agencies will have to shift considerably.

But more convincing, I think, than any of these examples is an examination of your personal experience. I would challenge each of you to think about the most difficult, most exasperating, most critical issue you are dealing with or have dealt with. Then think about why it was a difficult issue and what the ultimate solution was or will be. Having done this with many people, I'm confident that a significant component of the issue or problem *and* its solution will have to do with people and thus with communications.

How Well Are We Addressing the Communications Function?

How well are we addressing the communications function? Frankly, I find the answer to this question embarrassing and hope that you do too. Before starting on the formal preparation of this paper I was concerned I might not be able to find enough information to back-up my observations on how important communications are or how poorly we are handling the communications function in the wildlife management field. That wasn't the case on either count.

Budget and Personnel Allocation

The U.S. Fish and Wildlife Service (FWS) is the federal government's lead agency for conserving and managing the nation's fish and wildlife resources (Chandler 1985). In fiscal year 1988, the FWS had a budget of $743 million and 6,300 employees (Lenhart 1988). The budgets and personnel devoted to communications efforts are difficult to assess in the FWS because of the various terms used to define communications and budgeting between regions and between divisions.

However, in fiscal year 1988, the public affairs office in Washington, DC had 18 full-time equivalent positions and a budget of $587,000. Adding an estimated 70 people for regional public affairs, public use and information, and others gives a total of 88 people (1.4 percent of their workforce) devoted to communicating with the myriad of interests that affect the FWS mandate.

In spite of an apparent low ranking for communications personnel within FWS, 29 (29 percent) of 101 objectives listed for achieving priority activities within the agency during 1988 had a significant or total communications component. Even if the number of people devoted to communications were doubled, the FWS would still be woefully understaffed in terms of communications.

Adams et al. (1988) conducted a national examination of information and education (I&E) divisions of state natural resource agencies and found that I&E divisions received 2.7 percent of the total reported agency budgets and were staffed by 2.6 percent of the total personnel. More than 21 percent of all I&E personnel had duties related to the production of the agency magazine and other publications, and 53 percent of all I&E program dollars were dedicated to these functions. Although highly variable, the "average" agency reported 628 personnel of which 16 were in I&E. Adams et al. questioned the effectiveness of state I&E efforts based on their orientation to short-term objectives and heavy reliance on potentially outdated communications techniques.

Surveys conducted by the Wildlife Management Institute (1987) indicated that I&E staff in state fish and wildlife agencies made up 3.2 percent of the personnel in 1968, 2.7 percent in 1976, and 2.3 percent in 1985.

Gilbert and Dodds (1987) gave the following assessment of communications of in the wildlife management field:

> *When there is so much apparent interest, as we have noted several times in this text, why are governments cutting budgets or failing to fund wildlife agencies? The answer lies in the profession's*

failure to market its product! We have failed to translate wildlife research findings and wildlife management practices into social and economic benefits. Only an occasional management practice has been perceived by a portion of our clientele as having some value. Wildlife is losing out at political levels during budget crunches almost by default . . . . We have been too complacent and too comfortable in believing that what we were doing is of value to the resource and to the public we were supposed to serve. But we failed to let these publics, both internal (in government, within the system) and external, in on what we were doing and how our activities benefitted each. Our attention has been too heavy on the side of research and management and too light on information, education, and public relations. As managers we have tended to be unable to articulate adequately what we were doing and why.

Steel Shot: A Case History

The lead versus steel shot issue in North America was, and is, a complex, controversial and emotionally charged issue, which makes it a fairly typical issue in the wildlife business. Unfortunately, it is also typical of communications efforts within the wildlife business.

Bellrose (1959) first quantified the problem of lead poisoning in waterfowl in 1959. Subsequent studies and discussions within the wildlife profession confirmed that lead poisoning was a serious problem and something should be done about it. Finally it was decided that steel shot should be used for waterfowl hunting and the hunting public was dutifully notified of that fact. The rest, as they say, is history. Millions of dollars and thousands of manhours have been poured into the fight of lead versus steel shot for waterfowl hunting. The resultant disputes over a seemingly simple issue will affect the wildlife management field for years to come.

From a communications standpoint, two basic principles (among others) were violated early in the effort. First, no systematic program was developed for assessing what the hunting public knew about lead poisoning or steel shot, what the potential reaction of hunters and shot manufacturers would be or what were the best communications strategies for getting support for conversion from lead to steel. Second, with few exceptions, the affected interests—hunters, manufacturers, waterfowl organizations, state agencies—were not brought together in the process until decisions were made and stances taken.

As a positive footnote, a number of states (Iowa, Montana, Nebraska, North Dakota) have successfully initiated intensive, systematic communications and training programs for conversion from lead to steel through the 27-state Cooperative Lead Poisoning Control Information Program (M.A. Johnson, pers. comm., 1989)).

How Can We Do Better?

Considerable variability exists between the organizations and agencies and their communications effectiveness. There are stellar I&E divisions and stellar communications efforts such as Project Wild. But, if the overall level of professional communications needed to properly manage our wildlife resources today and in the future is to be achieved, four basic things need to occur:

1. A recognition within the wildlife field of communications as the "weak link" in the wildlife management process.
2. Communications managers must become part of the management team and decision-making process. And, be held accountable for their performance.

3. More communications managers must be trained or recruited.
4. Personnel and budgets for communications within wildlife agencies and organizations must be increased.

Stating these needs and making them happen are, of course, two different tasks. Making them happen will not be easy. Major obstacles—illusions or delusions, if you will—must be overcome.

Communications—The Weak Link in the Wildlife Management Process

Figure 1 illustrates the communications process. Information is generated. It is then encoded by a sender and disseminated through a medium or media. The message is received and decoded by the receiver and understanding or action takes place. Through feedback, the sender can tell if the desired action was taken, and if not, what adjustments must be made. Breakdowns in this communications process can occur at any point—the medium (TV for example) may change the message from what the sender desired or the receiver may not understand the message as it was sent. In either case, the desired understanding or action may not occur.

Figure 2 illustrates the management process as practiced by most wildlife agencies (Wildlife Management Institute 1987). A comparison of the two processes reveals the root of our communications problems in wildlife management. In Figure 2, the communications function is relegated to an administrative service. It does not serve the encoder function that it obviously must. As illustrated, communications (direct contact with "People") for "Resource Management" and "Technical Services" are left to the personnel in those areas—most of whom do not have the interest, time or expertise for managing systematic communications efforts.

This fundamental problem can be resolved by either having communications managers within each division of the agency—fisheries, wildlife, parks, etc. Or, having a communications division that serves a support function for all divisions. The system used should be based on the organizational structure of the agency or organization. The important point is that the encoders or communications managers should be involved in the entire communications process. Today in most agencies and organizations that is not case and thus communications forms the "weak link." The growing and sorely needed field of human dimensions in wildlife is a direct recognition of this "weak link" (Nielsen et al. 1989).

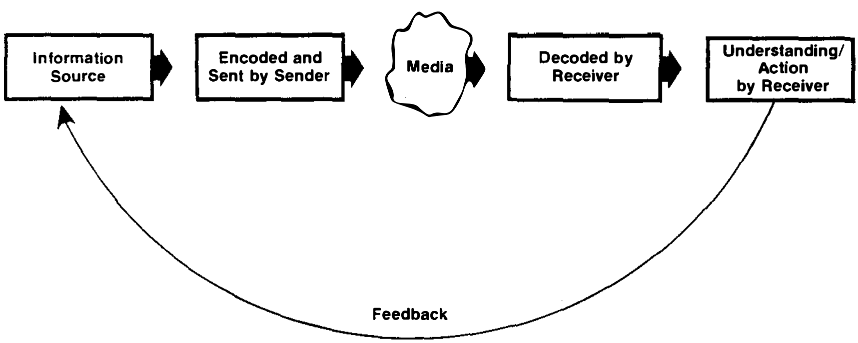

Figure 1. The communication process (Cutlip et al. 1985).

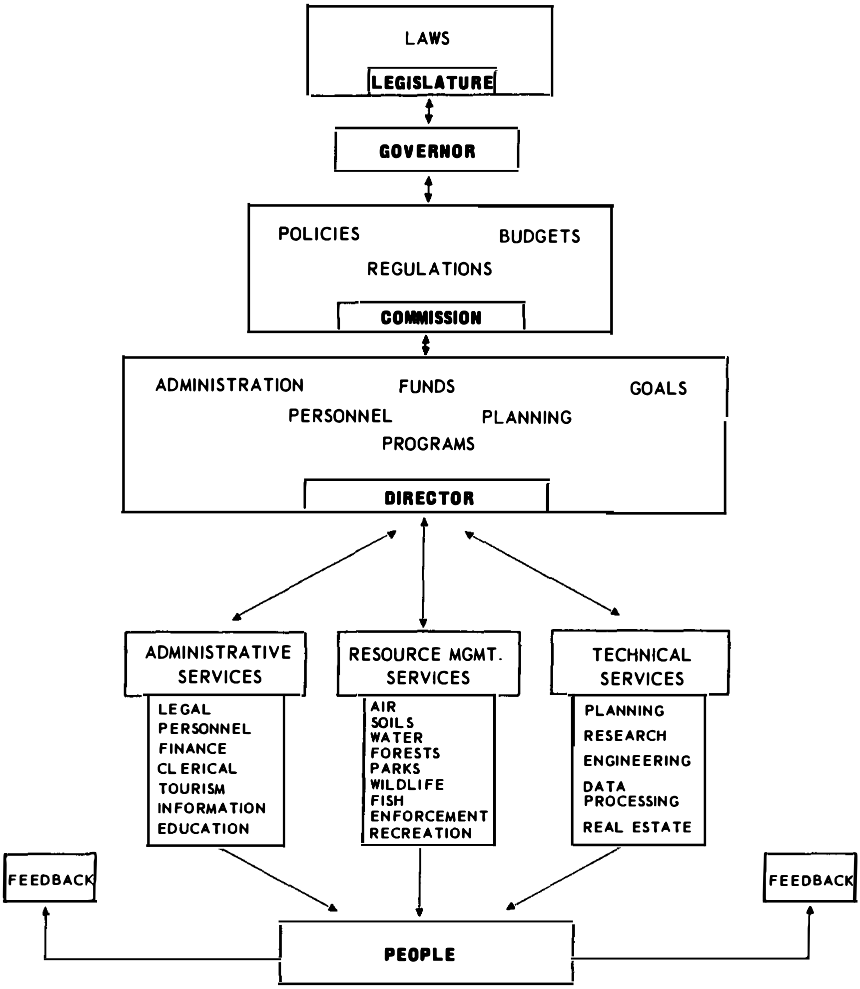

Figure 2. General pattern for resource management (Wildlife Management Institute 1987).

Communicators Managers: Part of the Management Team

Communications managers, as the term implies, are people in charge of planning, implementing and evaluating communications efforts within wildlife agencies and organizations. Their role is to identify how the communications function can be used to help achieve agency and organization objectives. Their counsel and expertise must be availed in all decisions that will involve the "public." And for the wildlife management agency, that means most decisions.

Larry Kruckenberg, Chief of the Communications Division for the Wyoming Game and Fish Department, one of the model I&E divisions in the U.S. (8.5 percent of Wyoming personnel are in I&E), says there are two main reasons the division and

I&E efforts in Wyoming have been successful (Kruckenberg 1985). First, the Communications Division is part of the management team. They are involved in the discussion and formulation of priorities, policies and strategies. Second, they are held accountable for their performance. It is the responsibility of the Communications Division to develop specific programs for helping achieve the identified objectives of the agency and then carry them out.

One reason the communications function doesn't play the vital role that it should in many situations, is that its value has never been demonstrated by the communications people. The obstacle is often the attitude of I&E departments and public affairs people. They see their role as producing products for the public and the agency—a magazine, newsletter, videotapes or radio shows. If these products look good and receive awards then it's a job well done. Producing products is obviously important, but even more important is determining what needs to be communicated to whom, how they feel about it now, and then, and only then, producing the communications products. If the communications managers do not do this strategic thinking it will probably not get done. How many state and federal agency or organizations I&E departments can show you their detailed communications plan for the next one to five years for addressing the identified priorities of the organization? The answer, unfortunately, is very few.

More Communications Managers Used in the Wildlife Management Process

The solution is to have more communications managers managing communications efforts. Communications managers can be produced:

1. Through continuing education of current I&E and other staff.
2. By training wildlife students at the undergraduate and graduate level as communications managers.
3. By recruiting or hiring communications professionals.

Continuing education. Intense continuing education in the areas of strategic communications planning, conflict resolution, human dimensions research and citizen participation for current I&E and other staff involved in communications would be a first step. It is widely known that communications skills, in addition to policy, administration and other "non-traditional" wildlife disciplines need to be part of the wildlife managers training. (Gilbert and Dodds 1987, Hein and Bates 1983, Cookingham et al. 1980). The need for continuing education of wildlife professionals in general is a separate, but no less important issue.

Training students. The need for communications as part of the training for wildlife students has been well documented (Cross 1987, Knuth 1987, Nielsen 1987, Adams and Thomas, 1986, Brynildson 1984) and a number of universities offer communications courses. The need still exists, however, for specific curricula designed for communications managers in natural resource management.

Recruit or hire communications professionals. Professionals practicing in all of the communications areas needed in the wildlife management field exist. They need to be recruited or hired to lend their expertise.

The use of qualified communications managers will help wildlife management agencies and organizations deal with two serious delusions—"activities equal results" and "if its on the radio or TV you have communicated." The reality is that activity does not always equal results. The fact that an article has been published in the state magazine, a radio show has been aired or a news release sent out does not mean it was heard by the target audience, understood or acted upon. Only through careful planning and continual evaluation can you ensure activities will equal results.

To many in the conservation field, communications means working with the mass media—radio, TV and newspapers. Although the media is often a key channel for communicating with the diverse publics that wildlife agencies and organizations deal with, it is not appropriate for all situations. Jim Grunig, professor of public relations at the University of Maryland, recently said "the better the public relations program the less the need for mass media" (Public Relations Journal 1989). The success of intensive one-on-one extensions type programs in North Dakota and other places are evidence (Stromstad and Donovan 1989).

Increase Communications Personnel and Budgets

In spite of the austere budgets most agencies and organizations are now dealing with, it is clear communications budgets and personnel must be increased if we are to achieve our wildlife conservation mandate.

Does this mean money and manpower allocated to other fisheries and wildlife management programs should be reduced? With few exceptions, natural resource management agencies in the U.S. are severely under-budgeted considering their mission. However, given the economic and political realities, it's not likely that budgets will be increased to accommodate expanded communications efforts. In that case, then, it is not only appropriate but absolutely necessary that money and personnel be allocated from other programs to communications.

The attitude of some state and federal legislators is a major obstacle to increased communications budgets for state and federal resource agencies. Some legislators are subject to the illusion that communications budgets should be kept to a minimum because, they say, agencies don't need to toot their own horns. Is there a legitimate concern for communications efforts getting out of hand? Sometimes. Is line item reduction of communications budgets the most effective way to manage that concern? Emphatically, no. That reasoning is analogous to solving the military procurement corruption problem by eliminating the military.

Responsible communications efforts in the best interest of the public will be achieved by hiring competent, professional communications managers and holding them accountable for carrying out their programs; not by keeping their budgets so low they can hardly sustain a program.

Conclusion

Wildlife management is people management, and thus communications. Whether our objective is the selective harvest of species through hunting, trapping or fishing regulations, enhancement of habitat on private lands through incentives or persuasion, or the protection of critical habitats through acquisition or legislative action, communications plays a critical role.

Are we barking up the wrong tree? No, I don't think so. We're just not barking loud enough yet. Encouraging progress in the recognition and implementation of planned management systems and the developing field of human dimensions bodes well for our ability to address the communications function. The theme for the annual meeting of the Organization of Wildlife Planners last June was "Politics, Public

Relations and the Press." And yesterday afternoon an entire session of this conference was devoted to human dimensions.

In summary, if we as wildlife professionals:

1. Recognize the role of communications in the wildlife management process.
2. Make sure trained managers are in charge of our communications efforts and
3. Provide the level of funding and personnel commensurate with the task at hand, we *will* be barking up the *right* tree.

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Consumptive and Nonconsumptive Values of a Game Animal: The Case of California Deer

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Introduction

The presence of deer in California provides many different type of benefits to Californians. The general public enjoys viewing deer on outdoor recreation trips taken throughout he year. Hunters derive a substantial economic benefit from deer during the fall hunting season. However, deer hunters also receive enjoyment from viewing deer on outdoor recreation trips taken when deer hunting is out-of-season. In addition, rural towns and counties in California obtain a significant injection of business activity from deer hunters during the fall hunting season.

This study quantifies in dollar terms the economic benefits to the public and hunters as well as the business activity generated in California from deer. We display how hunting and viewing benefits change with increases in deer populations. Lastly, the use of this economic information in habitat protection, land use planning and deer management is presented.

Defining the Benefits of Deer

Wild deer are the property of the State, and in California, hunting rights on public lands are not sold through a competitive market. Because viewing or hunting deer provides enjoyment (i.e., utility) to people and deer are a scarce resource, deer do have an economic value to society. In many cases this economic value substantially exceeds any of the financial indicators associated with deer. For example, the price of a deer tag reveals little about the *economic value* of deer hunting. In the case of viewing deer, no fee is currently charged. Does this imply there is no economic benefits from viewing deer? Certainly not.

The economic value of any resource, whether marketed or non-marketed is defined as the users' willingness to pay. (U.S. Department of Interior 1986, U.S. Water Resources Council 1979, 1983, Sassone and Schaffer 1978, Just et al. 1982). Willingness to pay (WTP) is an expression for the users' willingness and ability to forego either income or other goods to a gain resource of interest. Thus, WTP is a measure of the economic sacrifice a person would make to obtain or maintain use of a good or service. Whether this WTP is actually collected as cash is largely irrelevant from the standpoint of economic efficiency. While it may be important for political reasons to transfer a portion of the users willingness to pay to actual cash flow, any financial returns are just that; a transfer of benefits from users to the recipient. The total economic value received by society does not change, only the distribution of the economic value between members of society.

The actual expenditures by deer hunters or viewers for gasoline, film, lodging, etc., is a cost of participation but is a gain to the local economy where the spending occurs. The spending by hunters or viewers stimulates the local economy, creating personal and business income as well as employment. Income and employment is also supported in business sectors that supply goods or raw materials to the businesses that directly receive hunter spending.

Different policy decisions require different types of economic information. From the point of view of counties in California and the state government, actual expenditures by deer hunters and viewers may be relevant indicators of the economic importance of deer in California. Certainly at the county level, injection of hunter spending creates a gain in local income and employment. Thus, for land-use planning issues where cities and counties are the decision-making entities, information on income and employment generated by people viewing and hunting deer would be appropriate.

However, from a national economic efficiency stand point, the expenditures by hunters are a cost of participation, not a benefit. More importantly, the gain in employment from hunter spending in California, may be offset by less business activity in other sectors of the economy that would have received the consumer spending if hunting was not available. Hence from the viewpoint of a federal agency, or when dealing with federal funds, income and employment generated by hunters, a local logging contractor, ranchers, etc., are *not economic efficiency benefits*. Here information on the hunters or viewers net willingness to pay, i.e., willingness to pay over and above their current expenditures is the relevant measure of value of deer to the nation. This value is sometimes referred to as a gain in National Economic Development or (NED) by the Bureau of Reclamation, U.S. Army Corps of Engineers, or U.S. Soil Conservation Service. All of these agencies follow the principles of benefit-cost analysis, which defines net benefits as the gain in value of output over and above the costs (or expenditures) necessary to produce it.

This viewpoint is similar to that of the hunter or viewer themselves. Again, expenditures are costs of hunting, but the gain is a form of net willingness to pay called consumer surplus. The relevance of these different economic concepts will be made clearer later in the habitat protection example.

Techniques for Measuring Benefits and Business Activity

Measurement of deer hunters and viewers net willingness to pay can be performed using either a demand estimating technique called the Travel Cost Method (TCM) or a market simulation approach called the Contingent Valuation Method (CVM). Both methods are recommended for use by Federal agencies when performing benefit cost analysis (U.S. Water Resources Council 1979, 1983) and when valuing natural resource damages (U.S. Department of Interior 1986).

Both methods are applicable to valuing deer hunting and viewing deer. The choice between methods depends upon the nature of the data, sample size and the objectives of the study. Since one of the key objectives of this study is to quantify how the benefits of deer hunting change with many hypothetical changes in deer management, the Contingent Valuation Method has the broadest applicability. However, the Travel

Cost method was also applied to this data with results similar (but not identical to) that from the Contingent Valuation Method. To provide a brief summary of the different facets of the study and to maintain comparability between hunting and viewing values, the remainder of the discussion will focus on CVM. The results of the TCM are available in Loomis et al. (1989).

Dichotomous Choice Contingent Valuation Method (CVM)

CVM utilizes a simulated market to allow the hunter or viewer to reveal their net willingness to pay for deer. Specifically, the respondent is asked whether they would pay some additional dollar amount. The specific increase in dollar amount varies across the sample of respondents. A logit regression is then statistically estimated relating the probability a respondent will answer yes they would pay or no they would not pay, to a set of explanatory variables including the dollar amount they were asked to pay. From the estimated logit curve, the expected value of the samples maximum net willingness to pay can be calculated. More detail on this method is provided in Loomis (1988) or Loomis et al. (1989). Willingness to pay was calculated for the value of deer hunting under current conditions as well as five possible improvements in deer hunting quality.

Translation of hunter and viewer expenditures into personal and business income and employment in the state requires having information on the gross retain margin or "value added" in each sector of the economy and each sector's multipliers. For example, a hunter's expenditure of $10 on ammunition might result in an initial direct gain in the California economy of only $3, since the sporting goods store may have purchased the shells from the manufacturer or distributor located in another state. However, the $3 gain is only the first round effect on the California economy. This $3 gain becomes wage income to sales clerks, business income to the store owner and rental income to the store's landlord. A large portion of this additional income to these people is spent in the economy, becoming income to others. This process of spending and respending continues for several rounds.

The multipliers quantify the total change in income and employment in all sectors of the economy from the initial change in income. The particular multipliers used in this study are the U.S. Department of Commerce's RIMS multipliers for California (U.S. Department of Commerce 1986).

Data Sources

Two mail surveys were performed to collect the data for this study. The first mail survey dealt with the value California households place on viewing deer during 1987. The sample was 3,000 randomly selected households in California. Deleting the undeliverable surveys, we obtained a response rate of 44 percent or 1,056 returned surveys. The deer hunter survey involved mailing 15,300 surveys to persons who had purchased a deer tag for the 1987 deer hunting season. The surveys were sent out immediately after the end of the season in each hunting zone. Deleting undeliverable surveys, we obtained a response rate of 60 percent.

Both surveys asked questions about trip expenses and dichotomous choice CVM questions regarding willingness to pay. Copies of the survey are available in Loomis et al. (1989).

The results of the survey and analysis will be summarized at the state level and for the four major types of hunting zones in the state. In general, the A zone extends along the coast of California from Mendocino to Ventura counties. The B zones are the north coast of California to the Oregon border. The D zones generally follow the central valley, the west slope of the Sierra Nevada Mountains and southern California. The X zones cover the northeast corner of the state and the east side of the Sierra Nevada Mountains.

Willingness to Pay Results

Deer Hunters

Deer hunters net willingness to pay for current hunting conditions averaged \$191.45 per trip. The average hunter takes 4 trips per season. Hence, hunters seasonal net willingness to pay was \$765. The typical deer hunter would pay or bid \$191.45 over and above their current expenditures of \$169 per trip to continue to go deer hunting at their current hunt zone. The relationship between net willingness to pay, demand and seasonal expenditures of \$678 (i.e., \$169.62 × 4 trips) is illustrated in Figure 1.

While the average trip value is a good summary statistic, the net willingness to pay ranged from about \$170 per trip in the B and D zones to \$234 in the X zones.

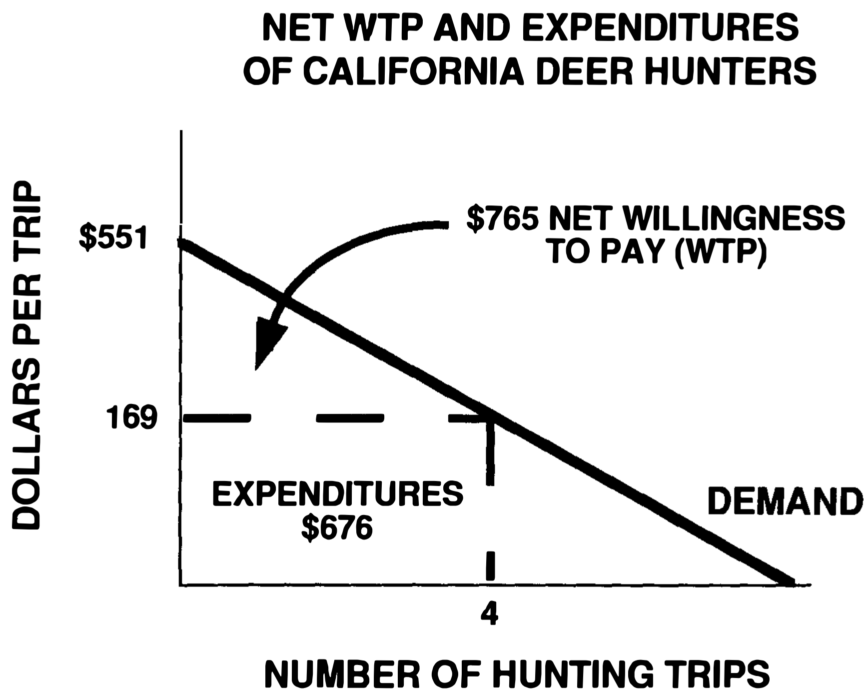


Figure 1. Net WTP and expenditures of California deer hunters.

The net willingness to pay per trip translates into a per hunter day average of $69 and $115 per 12-hour Recreation Visitor Day (RVD) or Wildlife Fish User Day (WFUD). The $115 per WFUD contrasts with the current U.S. Forest Service value per WFUD of $30.

In 1987 there were approximately 1.2 million deer hunting trips. Using the state average value of $191.45 per trip translates into roughly $230 million dollars in net economic value. This is an annual economic value to the hunters and the nation attributable to deer hunting in California.

Deer Hunters Viewing Deer

The deer hunter survey also asked deer hunter about the value of viewing deer at times when the hunting season was closed. Specifically, hunters were asked CVM willingness to pay questions about outdoor recreation trips taken out of season where deer were seen. The data were analyzed using logistic regression. For the state as a whole, the typical hunter would pay $10.65 per trip where they saw deer. Since the number of deer seen was a statistically significant variable in the logit equation, we are able to calculate how non-hunting outdoor trip benefits change when twice as many deer would be seen on these trips. The benefits per trip rise from $10.65 to $11.59 when the number of deer seen increases from 6 to 12.

General Public Viewing Deer

Members of the general public were also asked their net willingness to pay for recreation trips where they saw deer. Using the same type of CVM willingness to pay questions, the general public has a value of $11 per trip for outdoor recreation trips where they saw deer. This value also increases with the number of deer seen. Specifically, if twice as many deer are seen on outdoor recreation trips, the value of a typical trip rises fro $11 to $11.40. However, the value increases much more than this in the X zones, where value per trip rises from $19 per trip to $26 per trip when twice as many deer are seen. The state average gain of 40 cents per trip more when twice as many deer are seen is a lower bound estimate of the contribution deer provide too the enjoyment of outdoor recreation trips taken for purposes other than viewing deer. The lower bound gain in enjoyment on the 21 million outdoor recreation trips taken in California in 1987 where deer were seen was valued at $8.4 million dollars annually.

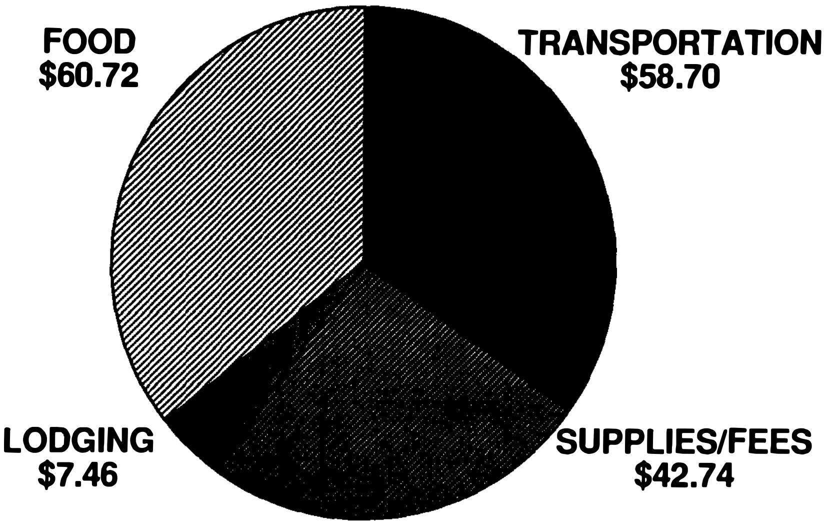
We also asked households their net willingness to pay for trips taken specifically to view deer. Only about 10 percent of all outdoor recreation trips in our sample where deer were seen, were taken for the primary purpose of viewing deer. However, these trips have a higher value to the general public. This value was $15 per trip. With an estimated 2.3 million of these primary purpose deer viewing trips taken in California during 1987, the annual value was $34.5 million dollars.

Economic Activity Associated with Deer

Deer Hunting

Deer hunters spend an average of $169 per trip when taking trips in California in 1987. As Figure 2 demonstrates, about 70 percent of hunter expenditures are spent on transportation and food. The other 30 percent is largely miscellaneous retail such

DISTRIBUTION OF DEER HUNTER EXPENDITURES



TOTAL EXPENDITURES PER TRIP = $169.00

Figure 2. Distribution of deer hunter expenditures.

as ammo, film and other non-durable hunting supplies, as very few hunters have expenditures for lodging.

Applying the Department of Commerce multipliers to these expenditures on the 1.2 million deer hunting trips indicates that $134 million in personal and business income was generated in California in 1987. Viewed from the employment side, the 1.2 million deer hunting trips supported 7,700 full time equivalent jobs in California in 1987.

Primary Purpose Deer Viewing Expenditures

California residents who make primary purpose deer viewing trips spend approximately $30 per trip. Applying the $30 per trip to the 2.3 million primary purpose deer viewing trips yields $69 million in deer viewer spending. Applying the Department of Commerce multipliers to these expenditures, indicates $46 million in personal and business income was generated from outdoor recreation trips taken for the specific purpose of viewing deer. Viewed from the employment side, 2,787 full time equivalent jobs were supported in California from these deer viewing trips.

Total Recreational Value of Deer in California

Taken together, hunting and viewing deer support nearly 10,500 jobs and provide $180 million·in personal and business income to California's economy. In terms of benefits to the hunters and viewers themselves, these recreational activities provide $264 million in direct benefits each year. Including the additional enjoyment on other outdoor recreation trips where people saw deer brings the direct user benefits to $272 million annually. In terms of economic importance to all citizens of the State of California, whether employees in related industries, hunters or deer viewers, deer contributes $445 million annually to California's economy and citizens.

Valuation of Different Management Actions

While knowing the total recreation value is useful for setting broad state and federal level policy direction, oftentimes land-use planning and season-to-season management of deer herds requires hunt zone specific economic values. In addition, many management decisions or habitat modifications normally do not result in a complete loss of existing deer hunting but rather change the nature of the deer hunting experience. For example, shortening of hunting season or reductions in number of deer a hunter is legally allowed to harvest. Alternatively, the deer hunting experience can be enhanced by increasing chances to harvest a trophy deer.

To address these management issues a series of CVM willingness to pay questions were asked regarding the benefits from (1) double chances of harvesting a four-point buck; (2) bag an additional deer; (3) double the length of the hunting season; (4) reduce crowding and (5) see twice as many deer while hunting. While these are increases in the quality of deer hunting, they also serve as useful indicators of how the benefits of deer hunting would be reduced if crowding were increased, chances of harvesting a four-point buck were cut in half, etc. For each of the five conditions, separate CVM questions were asked and separate logistic regressions were estimated. Details are provided in Loomis, et al. (1989).

The first three of these issues were asked in the context of net WTP for the hunting season. For example, net WTP for a hunting season in which the hunter is allowed to bag an additional deer, but everything else is the same as the current season. Adding this feature to the hunting season is worth an additional $164 to a typical hunter in California. However, adding the opportunity to double chances of harvesting a four-point buck has a seasonal value of $267. That is, a typical hunter in California would pay $267 more per hunting season to increase the chances of harvesting a four point buck from 18 percent (about one in five years) to 36 percent (about one ion three years.

Doubling the legal hunting season would increase the value of the hunting season by an average of $234. As would be expected from economic theory, the additional days of hunting are valued less highly (about $21) for each additional day as compared to the current days in the season ($69 per day). Also consistent with demand theory, there is a statistically significant inverse relationship between the net willingness to pay for an additional day of the season and the season length. In general hunters were willing to pay more per day for an additional day of deer hunting in hunt zones which currently have short seasons. In fact the hunt zone with one of the highest willingness to pay is X7, a zone with the shortest season.

The value of reducing crowding and seeing twice as many deer were asked for the most recent trip. Essentially hunters were asked their willingness to pay for a trip that was similar to their most recent trip, except that in the reduced crowds scenario, they saw half as many other hunting parties on their trip. The same is true for the saw twice as many deer scenario. In general, seeing twice as many legal deer was worth a small amount ($9.86) more per trip to the typical deer hunter. However, the average masks a great deal of variability. For example, hunters in zones B1–B3 were willing to pay $33 more per trip. In 13 of the 34 hunt zones or groups of hunt zones analyzed, hunters would pay $54 more per trip to see twice as many legal deer. However, in about a dozen hunting zones, an average deer hunter would not pay anything additional to see twice as many deer. Few California deer hunters would pay to reduce the number of other hunting parties seen. Only in five of the 34 hunting zones were hunters willing to pay a significantly higher dollar amount (averaging $56.20) to reduce crowding. All but one of these five hunting zones where hunters would pay to reduce crowding were located near California's major metropolitan areas.

Application to Deer and Land Management and Planning Issues

The values from this study are applicable to numerous resource conflicts. The first example relates to performing an economic analysis of a subdivision on a deer migration corridor and prime fawning habitat. The decision-making authority is the Plumas County Board of Supervisors. The land is currently in private ownership. The issues are whether to approve a subdivision in a deer migration and fawning area and if so: (1) how large should the deer migration corridor be (125 acres versus 98 acres) and (2) what should be the minimum size lots. Before an accurate economic comparison between deer and the subdivision values can be performed it is important to insure both resources are being valued in the same terms and the time frame of the housing and deer values are the same.

To make the deer hunting and land values conceptually comparable we must recognize that land prices represent a present value over a long future time period, that is, over a 50–100 year period. Hence, the value of deer hunting must be put in equivalent time frames. The appropriate value comparisons involve two features: First the differences in land values and deer values must be compared in terms of economic efficiency; then the returns to the county from alternative land uses can be compared in terms of jobs and taxes.

Biologists feel the subdivision would negatively affect about 10 percent of the 8,000 animals in the deer herd or 800 deer. Since the area affected is in hunt zone X6, there are several alternative deer hunter management actions which California Department of Fish and Game might take. One action would be simply to reduce the number of permits offered. If for example, the deer population dropped by the entire 800 deer, this might mean a reduction in 200 legally harvestable bucks. Using the zone success rate, a loss of 200 bucks would mean 600 fewer deer tags offered for X6. Since the average hunter to X6 takes 2.6 trips, this is a loss of 1,560 deer hunting trips. This can be translated into a net economic value of the lost trips to the hunter and the nation as a whole by multiplying the net willingness to pay per trip times the 1,560 trips. With hunting in X6 worth $203 per trip, the annual loss is $316,680. The present value of this loss over a 100 year period at 8 percent discount rate is $3.958 million dollars. This value is directly comparable to the value of the house lots within the subdivision.

From the county's viewpoint, they may be interested in the change in hunter expenditures, income, employment and taxes from the loss of 1,560 deer hunting trips to the county. Deer hunters visiting Plumas County spend an average of $199 per trip with about half of this actually being spent within the County. With 1,560 fewer trips, spending in Plumas County would go down $155,220 annually. This translates into $112,534 less in personal and business income in Plumas County each year. The loss in tax revenue to the County from less hunter spending can be computed by the county tax specialists.

Even if California Department of Fish and Game (CDFG) does not directly change the number of permits it offers for X6, the fact that there are fewer deer in X6 will reduce the net economic value of hunting in at least one other way. In response to fewer deer, CDFG might have to reduce the length of the hunting season. Reducing the season by three days would reduce the number of hunter days per hunter by about two. With 3,000 hunters, this would reduce the total number of days of hunting by 6,000. The "marginal or incremental" net economic value (not the average) of changes in the days of hunting in X6 is $16.74. Thus the total value of the change would be $100,440 annually. This translates into a present value of $1.25 million dollars. An incremental analysis could easily be performed by computing the different losses in the deer herd with alternative sizes of the deer migration corridors and different minimum lot sizes. These losses in the deer herd would be translated into losses in hunter permits, trips and economic value.

Several examples of how the net willingness to pay numbers can be applied relate to wildlife versus livestock trade-offs on public lands. Research has shown that high stocking levels of cattle have several negative effects on deer (Loft et al. 1986, 1987, Pearce 1988).

To perform a trade-off analysis between cattle and wildlife, the appropriate comparison is the net willingness to pay of ranchers versus hunters for the forage. Ranchers net willingness to pay for the forage has been calculated by USDA Economic Research Service. In the northern Sierra Nevada mountains this value is $10.20 per Annual Unit Month (AUM) of forage. This amount exceeds the subsidized price the rancher actually pays for the forage, just as the net WTP of deer hunters exceeds the price of the deer tag. To develop comparable values of forage to deer, we need to know how the number of deer available for harvest is related to forage availability, hiding cover and deer energetics. Ideally, a habitat-population model would be used. In the meantime, we can develop a simplistic relationship using the following three factors: (1) the change in the total deer herd required to change the number of deer available for harvest; (2) the amount of forage consumed by a deer; (3) herd age and sex structure. In the interim, we can use 0.2 AUMs per deer and a ratio of 20 percent of the deer being bucks, 55 percent being does and 25 percent being fawns (Loomis, Donnelly and Sorg 1989). Using these relationships, a simple production function relating AUMs consumed by adult deer (AD) and fawns (FD) to potential deer harvested (DH) is give below:

$$DH = 1/[5.54AD \times 0.2AUM \times 12\text{months}) + (2.05FD \times 0.1AUM \times 12\text{months})] = 0.063AUMs$$

This equation translates changes in AUM of forage into Deer Harvested (DH). To calculate the dollar value of forage to deer, we need a value per deer harvested. Based on responses to our CVM questions on the value of deer hunting when hunters would be allowed to bag an additional deer, the value of harvesting an additional deer can be inferred. In the northern Sierra Nevada mountains (for example hunt zone X6) this value is $175. Multiplying the $175 by the 0.063 yields a value of forage of $11. This value means that deer hunters would be willing to pay or "bid" $11 to provide an additional AUM of forage to deer. Since this value is competitive with the value to ranchers, the forage allocations in this hunt zone should be reviewed with this in mind. If, for example, the value of forage to deer was substantially higher than it was to livestock, it would imply shifting more forage to deer.

Conclusion

This study clearly demonstrates the substantial economic value of deer in California. Both deer hunters and the general public derive substantial benefits from the presence of deer in California. Our study showed the deer hunting season is valued at $230 million per year by the hunters themselves. Members of the general public who take outdoor recreation trips to view deer value such opportunities at $34.5 million each year. The values presented in this study illustrate the many values provided by a game animal to society. While the hunting value certainly dominates, the nonconsumptive viewing values reflect 16 percent of the recreation benefits provided by deer in California.

The business activity generated by hunter and viewer expenditures generates $180 million in personal and business income in California each year. Approached from the employment side, these hunter and viewer expenditures support 10,500 jobs in California.

The study demonstrated that the value to hunters and viewers increased when more deer were seen. The value of the deer hunting season increased when hunters had increased chances of harvesting a trophy deer and were allowed to harvest an additional deer. Increasing opportunities to harvest a four-point (e.g., trophy) buck add more to the hunting season than being able to harvest an additional deer. Extending the hunting season is also highly valued by hunters, almost as much as doubling the chances of harvesting a trophy deer.

When these values are expressed on a hunter day basis, the values are much higher than those used by the U.S. Forest Service and Bureau of Land Management. The expenditure and net willingness to pay figures collected in this study should be quite useful to both these agencies for their own land management planning and benefit-cost analyses.

In general, we feel the study has been successful at identifying the relative worth of hunting and viewing deer in California. The relative value hunters derive for alternative improvements in deer hunting conditions have been identified in such a way that trade-offs can be made objectively. The empirical results are robust enough to serve as the foundation for the deer management model to be developed for California Department of Fish and Game.

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Planning in the Twenty-first Century

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My charge is to summarize this Session and offer an opinion on where natural resource planning is headed in the next decade. I have been allocated 15 minutes in which to accomplish this task. I will strive to do it in less time than that. The nice thing about being the last speaker on the last day of the Conference is that most everyone has already departed and those who have not will be grateful for your brevity.

Let me address the initial portion of my charge, that of summarizing this Session, by pointing out that natural resource planning appears to be in good hands. We have traveled far over the past ten years and the lessons learned have been well-presented here today. Among the many things we have learned is that planning (if it is to be effective) is a process, not a product. We have learned that good planning is really nothing more than good management. We have learned that good planning is an agency-wide function, not an isolated exercise carried out by planners. We have learned that good planning is formulated from the bottom up, then implemented from the top down. We have learned that wildlife conservation involves not only biology, but sociology, psychology, economics and a host of other humanities skills. We have learned that politics is inescapable in any human endeavor, including, unfortunately, wildlife management. We have learned that the public increasingly demands a say in our decision-making process. And we have learned that it doesn't take the future as long to get here as it used to. These are all true and valid observations. They are true today and they will be true in the year 2000, which, incredible as it may seem, is now separated from us only by the decade of the 1990s.

Having said all that, let me offer my view of where we are headed as we approach the Twenty-first Century milestone. I'll begin by stealing a perspective from Tom Wolfe. You will recall ol' Tom as the author who labeled the 1970s the "ME" generation. In a recent *Time Magazine* interview, he declined to categorize the decade of the '80s, but speculated the '90s will witness a rebirth of traditional values. I'll venture where Wolfe declined to go by suggesting the '80s be labeled the "MINE" generation. It's been an era in which the vision of Aldo Leopold dimmed somewhat in the light from the rising star of a new guru, Alex P. Keaton. Economics tended to overshadow many decisions, and I think we may have lost our way a little in the wildlife business. Conservation and husbandry became somewhat confused as we reacted to the clamor for game ranches, license set-asides, trophy production, single species emphasis and many other "fish and wildlife to the highest bidder" schemes. In so doing, we may not only have lost our way but perhaps also a portion of our constituency. We sort of forgot about the common man out there—the "rank and file" sportsman who has been the backbone of the conservation movement in this country for over half a century. We also didn't do as much as we might have to endear ourselves to the growing legion of wildlife lovers who never harvest anything and really don't see us as champions of their cause. I must therefore disagree with a statement made earlier this morning that planning should "directly translate into furs, feathers and scales." I believe that, now and in the future, planning should translate into viable, self-supporting, free-ranging fish and wildlife populations and the habitat necessary to support them. The bounty that accrues from that should then be available to all and sundry lovers of wild things and wild places, be they non-consumptive users or those who enjoy the fair-chase taking of the harvestable surpluses.

Having offered this perspective, I will further speculate that if Wolfe's observation is true and the decade if the '90s will see a rebirth of traditional values, then perhaps we could christen it the "OURS" generation. That would be an encouraging progression wouldn't it—from the "ME" generation of the 1970s to the "MINE" generation of the 1980s to the "OURS" generation of the 1990s?

If this hopeful prognostication is indeed the trend, then perhaps I can bring it to focus on what I was supposed to talk about in the first place—planning. Since it has been established that good planning is merely good management, and I assume you will grant me that good management is merely good decision making, I will conclude by expanding on an observation made earlier by Spencer Amend. He pointed out a trend to increasingly rapid turnover of fish and wildlife agency heads. The question is why? The answer, of course, is that somebody doesn't like the decisions that are being made. Psychosocial research has demonstrated that people will accept decisions with which they disagree, so long as they feel these decisions were reached in a fair and equitable manner. Put another way, folks may not like our decisions, but if they agree with the process by which they were reached, they will accept them. So, the problems with our public, which is manifesting itself as an ever-quickening pace of deposed agency heads, is that something must be wrong with the decisions being made. This could stem from two possibilities. One is that the decisions are actually unfair, in which chase the parade of ex-agency heads is an inevitable symptom of the evolution from the "MINE" era of decisions favoring special interest to the "OURS" era exemplified by a demand for decisions favoring equitable access to and allocation of the wildlife resource. The other possibility is that the decision-making process actually is fair and equitable, but is not recognized as such.

If the former possibility is the case, then what we are observing is a natural and justifiable process and democracy really does work. If, on the other hand, the latter possibility is actually the case, then some form of management system incorporating public values in the establishment of objectives and then documenting the decision-making criteria used is in order. In other words, we must actively seek broad-spectrum public input, not just lay back and react to special interest demands. Furthermore, we must develop high visibility, objective-driven, participatory decision-making systems that demonstrate and quantitate equitable consideration of all user desires.

In short, we will need a planned approach to management decision making in the future much more than we ever have in the past. Either that or we will need a hellava' lot more special interest organizations so that ex-agency directors will have a job to go to.

REGISTERED ATTENDANCE

ALABAMA
Richard A. Fischer, Keith D. Guyse, Rodrigo Migoya, H. Lee Stribling, Leigh Ann Stribling Mark Wallace

ALASKA
Craig Altop, Michael A. Barton, Chip Dennerlein, David C. Douglas, Bruce M. Durtsche, William A. Gossweiler, Calvin J. Lensink, Thomas R. McCabe, Nicki McCabe, Rosa Meehan, Robert M. Muth, Allen P. Richmond, Fred B. Samson, Roland Shanks, Walt Stieglitz, Bob Weeden

ARIZONA
Bud Bristow, Wade L. Eakle, Richard Etchberger, Carol Krausman, Paul R. Krausman, Rosemary Mazaika, Cal McCluskey, Michele Monroe, Valerie Morrill, Gordon Edward Nez, Jerome J. Pratt, Sherry Ruther, Duane L. Shroufe, Bruce D. Taubert, Mark C. Wallace

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Charles Amlaner, Jr., Steven H. Cole, Clyde Gates, Sharon Rushton, Steve N. Wilson

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