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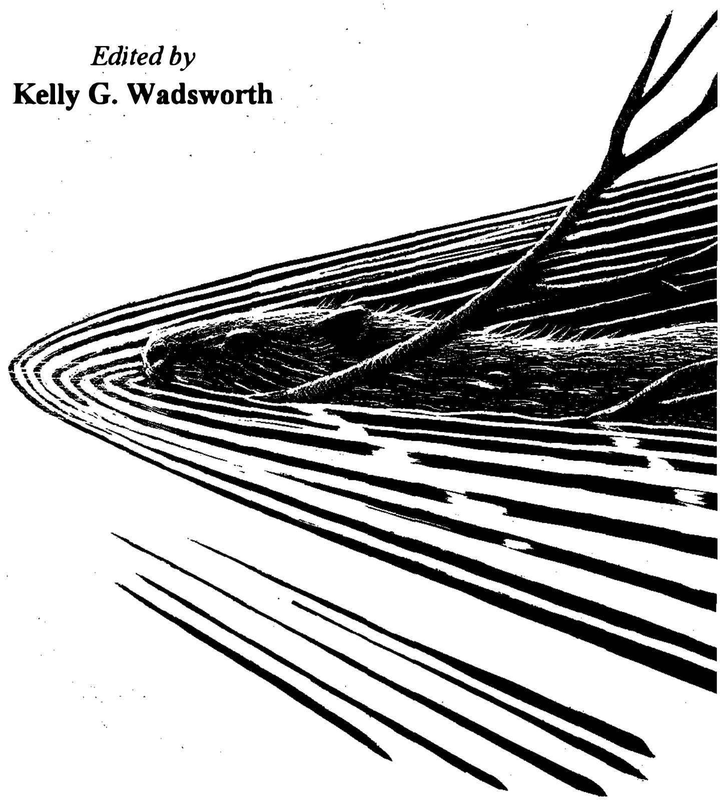

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Opening Statement

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Sixty years ago, the Second North American Wildlife Conference was held in St. Louis, Missouri. Plenary sessions focused on topics strikingly similar to those we consider here today. Wildlife conservation leaders from Canada and Mexico addressed the Conference on the status of resources and administrative structures to deal with those resources in their respective countries. Administration of both national and local wildlife programs was explored by United States leaders. The meeting lasted four days, with one full day devoted to negotiating the focus and activities of the new General Wildlife Federation, the organization formed in 1936 that became the National Wildlife Federation.

Presentations highlighted the value of extension work in delivering the message about wildlife conservation to the private landowner; the need for soil conservation in order to have wildlife; and formation of Missouri's Conservation Commission, the first nonpolitical state wildlife administration. Familiar topics such as national forest management, grazing and the status of waterfowl were prominent at the start of the program. Aldo Leopold spoke about the need for research, and others described formation of the first 10 cooperative wildlife research units to provide trained wildlife managers.

Most striking was an impassioned plea by conservationist William Finley of Portland, Oregon, to save the salmon runs from disastrous dam proposals for the Columbia

River. Finley asked, "Why should the government furnish public funds to promote schemes that wreck our salmon runs?" He went on to point out that these salmon runs are the basis for one of the most important industries of the West and one of its greatest recreational attractions. S. B. Locke, Conservation Director of the Izaak Walton League of America, spoke out for public expenditures to curb widespread water pollution.

How familiar the focus of conservation efforts appear 60 years later.

More than half the day at the first meeting of the General Wildlife Federation was spent in deciding organizational matters and how the new group would function. Later that day, the 1,500 delegates from all over North America considered a proposal to direct the proceeds from an excise tax on sporting arms and ammunition to the states as a revenue source to enhance their ability to work in cooperation with the federal government in wildlife restoration. This proposal came to the Federation from conservationist Ding Darling, their newly elected president. His primary argument noted that the Bureau of Biological Survey and Bureau of Fisheries had limited budgets and capabilities, and absolutely no responsibility to see that various valuable species of fish and wildlife did not become extinct. In fact, he said, "There is no official responsibility in any agency of government, federal, state or local, to prevent the extinction of any existing species on the North American continent." The ensuing discussion led to endorsement of Resolution No. 1 of the General Wildlife Federation, March 3, 1937, which advocated the redirection of the excise tax.

Near the end of the congressional session in 1937, President Franklin Roosevelt signed the Pittman-Robertson Federal Aid to Wildlife Restoration Bill. This came after fierce grassroots lobbying of Congress by members of the General Wildlife Federation and what was then called the American Wildlife Institute, now the Wildlife Management Institute. During this period, Congress became "wildlife conscious," as unprecedented attention and popular support were given a wildlife restoration bill before the U.S. Congress. The most impressive part of the support given this bill was the variety of interests. Sportsmen, bird watchers, naturalists, women's clubs, farm groups and many other conservation-minded citizens combined their influence working for the common aim of wildlife restoration.

In celebrating this year of the 60th anniversary of the Pittman-Robertson Program, the accomplishments are familiar. We have built agencies to conserve wildlife in the 50 states; designed research programs that support science-based management; trained professionals to do the management; and restored wildlife that, by any measure, would then have been listed as endangered. Through the most enduring partnership on behalf of conservation that exists in the world today, sportsmen and women, the shooting industry, state wildlife agencies, and the U.S. Fish and Wildlife Service celebrate the first stage of wildlife restoration.

In 1950, the Dingell-Johnson Sportfish Restoration Act continued development of state-level conservation by adding an excise tax on fishing equipment. More recently, amendment to that Act now called the Wallop-Breaux Sportfish Restoration Program expanded the strength of the state agency framework of science-based management of both wildlife and fish resources. Wallop-Breaux needs our active support now because reauthorization will be before Congress during the coming year.

Combined, these programs have returned more than $5 billion to the state agencies for fish and wildlife restoration. Another $5 billion have come from license revenues. An important recreation industry continues to grow, and recent reports indicate that hunting is a $14 billion per year industry, and angling a $34 billion per year industry in the United States alone.

In this time of questioning the role of government, and the realization that government can't do all that is needed, there are calls for more local participation, less regulation, and more "user-pay" approaches similar to Pittman-Robertson and Wallop-Breaux. There are many who have acted directly in their own way to preserve either wildlife or their habitats. Notable among these also celebrating key anniversaries are the Izaak Walton League of America, this year celebrating 75 years of conservation advocacy and grassroots action. And, Ducks Unlimited is celebrating 60 years of successful on-the-ground action in wetlands conservation.

The Wildlife Society, the organization of wildlife management professionals, adopted a constitution in February 1937. Maintaining the highest professional standards and development of wildlife management based on sound biology remains its primary objective. Its initial statement of policy said that wildlife management included game management, but "it embraces the practical ecology of all vertebrates and their plant and animal associates. While emphasis may often be placed on species of special economic importance, wildlife management along sound biological lines is also part of the greater movement for conservation of our entire native fauna and flora."

These days, newer organizations, such as the National Wild Turkey Federation, Quail Unlimited, The Nature Conservancy, Rocky Mountain Elk Foundation, Ruffed Grouse Society, Foundation for North American Wild Sheep, Pheasants Forever, Wildlife Forever and the National Fish and Wildlife Foundation, are putting money on the ground for wildlife and their habitats. The North American Waterfowl Management Plan and its extensive joint ventures have contributed widespread partnership-based activity to manage wetlands and associated habitats from Canada to Mexico. Over its first seven years, the North American Wetlands Conservation Act has brought in more than 600 partners from the United States, Canada and Mexico to share the cost with the federal government for innovative easements and acquisition projects. Partners in Flight, dedicated to songbird conservation, is now working to set identifiable goals for action that people can buy into for goal-oriented work. Similar activities are planned in Canada for songbirds, to match the long partnership with the United States and Mexico under the Migratory Bird Treaty.

A common basis for these growing partnerships, modeled substantially after the long-term success of Pittman-Robertson and Wallop-Breaux, has been a concern for the future of wildlife and fish through protection and management of their habitats. Their accomplishments are great, and we owe them much.

What is the next logical step? Through 60 years of directed funding and private/state/federal partnership, we have science-based management agencies, research programs to supply those agencies with information, secure funding for a certain level of management, trained professionals to do the work and a well-established track record of partnerships. The state agencies, built with previous funding from Federal Aid Programs and hunting and fishing license revenues, have the on-the-ground authority for all wildlife. The need for new funding sources was documented in 1975 by a Wildlife Management Institute review of state funding. Missouri successfully broadened their program with significant new revenues starting in 1976. We are happy to congratulate Arkansas for their new funding program; passed last fall. A few other states have made progress, but overall, the need is even more acute than it was in 1975.

The next logical step is Teaming With Wildlife, which has been highlighted at this Conference for several years. Teaming With Wildlife proposes to build on the success pioneered by the Pittman-Robertson Act for a federal/state/private industry partnership on behalf of conservation of wildlife that are neither hunted nor fished. It proposes the same kind of user-pays concept successfully used since the inception of Pittman-Robertson—to use revenues from expenditures on outdoor-oriented products to fund management of all wildlife at the state level. As I reported at the Conference last year, the logic of this next step for wildlife in America is clear. While there continues to be dialogue about funding sources and administration of the program, no one denies that it is needed. The number of supporting organizations and companies has grown substantially since last year, from 700 to almost 1,700. During this past week, some participants at the Conference have been visiting their congressional delegation supporting Teaming With Wildlife.

There is strong parallel here with activity that occurred at the Second North American Wildlife Conference in 1937. A key piece of wildlife legislation at a difficult time in the history of the country is being advocated by a broad spectrum of grassroots supporters. Supporters include hunting and fishing organizations, environmental groups, professional organizations, outfitters, large and small businesses, and citizen groups of all kinds. This is a truly unifying cause.

The Wildlife Society has committed support through its chapters across the country and, in some states, is leading the charge in local committees. For example, in December, the Wyoming Chapter donated to the effort for the second year in a row. This comes from a state where hunting and big game are a central part of their management program, but where agency professionals recognize the need for a comprehensive wildlife management program.

It is time to sell Congress on this concept. Let them know that citizens are willing to pay for it and that we want it now. What are you personally doing for this effort? What is your organization doing? Back in 1937, the modern conservation movement began because people didn't sit by and watch—they got involved and made a difference.

The 1996 Farm Act has produced landmark conservation provisions of high value to wildlife and fish conservation in America. We are grateful for the cooperation of Congress, the U.S. Department of Agriculture, various forestry and agricultural organizations, and the many wildlife conservation and environmental groups that helped get those provisions enacted. Focus now has swung to the all-important task of implementation. History teaches us that the vast habitat opportunity of farm conservation programs can be lost quickly by inattention. Habitat gains are won or lost in the details. The wildlife community's persistence has been rewarded with a strong law and sound regulations. Let's avoid the mistakes of the past. Wildlife managers need to stay intimately involved in farm bill implementation through the state and county levels.

As usual, much of the public focus is on the Conservation Reserve Program (CRP) designed to affect more than 36 million acres of farmland. The first sign-up for CRP is underway now through March 28. In its first decade, CRP has played a role in the restoration of continental waterfowl populations from their 30-year low in 1985. Pheasant populations have doubled or tripled in five midwestern states, and upland gamebirds have benefitted in many other states. Declining populations of at least 10 species of native grassland songbirds have been reversed, and fishery habitat is improving in U.S. rivers and streams. All of this has been accomplished through a voluntary, incentive-based approach that encourages and rewards private property owners for being good stewards of their land.

There has been a recent flurry of criticism of CRP as too costly, targeted to the wrong resources or the wrong regions, and benefiting only a few. This criticism is misguided. New tools for ranking projects, assigning regional importance to blocks of habitat, and working with wildlife and fish on a coequal basis with soil and water conservation offer unprecedented opportunity to improve the program's environmental benefits. Eligibility for cropped wetlands, automatic enrollment of filter strips and other water quality improvements, and recent advances in approaches to timber management in the Southeast are major strides for fish and wildlife made during the dialogue of the implementation phase prior to this first sign-up.

Critics of CRP and other parts of the Farm Act seem to want to prescribe what can happen on the land in stereotype terms. I have heard organizations lament the lack of specific provisions for endangered species conservation, for example. There are no less than six or eight ways in the Farm Act that habitat work for endangered species can be done on the ground through direct involvement by private organizations working with landowners, the Natural Resources Conservation Service, state agencies and others. In the past few months, new ideas have been negotiated to improve timber management in the Southeast, restore rare native habitats permanently and restore floodplain functions. There is abundant opportunity through the new Wildlife Habitat Incentives Program, Environmental Quality Incentives Program, Wetland Reserve Program and others emerging under the farm bill to work on virtually any wildlife habitat issue anywhere on private lands in America.

At a recent meeting with Vice President Gore, 20 organizations dedicated to conservation of wildlife, fish, habitat and sustainable use of those resources had a very positive discussion about past conservation successes and needs for the future. One of the issues discussed was the apparent schism between those who call themselves conservationists and managers and those who claim the title environmentalist. The Vice President agreed that such a barrier appeared artificial, and that it would be to everyone's best interest to remove it. Participants generally agreed that there were many common needs—clean air, clean water, responsibly managed forests and ranges, and attention to the needs of people for access to these resources—that we would all benefit by renewed efforts to bring divergent views together. Conservation groups appreciate the beginning of this dialogue, and look forward to a more regular discussion with the White House, Secretaries Glickman and Babbitt, Council on Environmental Quality Chair McGinty, and others.

The matters we at this Conference deal with are clearly nonpartisan issues that deserve a dialogue even between those who may not agree on each and every issue. There is too much at stake and too much common ground to maintain this separation. As leaders knew in 1937, much can be accomplished by joining forces.

There are many areas where environmentalists and conservationists agree. And, of course, those terms stereotype many groups that work together. The Cooperative Alliance for Refuge Enhancement (CARE) has brought together 16 organizations of widely different missions to improve operation and management of the national wildlife refuges. Their efforts have elevated the dialogue within Interior and Congress, and have begun to make progress in appropriation increases even during these tough times. At an appropriations hearing last week, CARE recommended consideration of a phased increase to fund two-thirds of the more than $400 million backlog in operating and maintenance needs by 2003. This would stabilize the erosion of services and allow most refuges to function more effectively by the 100th anniversary of the Refuge System. A detailed analysis and proposal will be delivered to key members of Congress soon. The last help for refuges of this magnitude occurred in the late 1970s under what was called the Bicentennial Land Heritage Program. We need a unified focused effort of that same magnitude!

The concept that our country is not investing enough in natural resource management through the budget is another unifying concept. Each year we all scramble to reallocate the budgets for natural resource agencies that get to the appropriations subcommittees. In these years of the drive for a balanced budget, we are competing with each other for a piece of a shrinking pie. A current movement to build grassroots support and pressure the budget committees for a greater up-front investment in natural resources is one that crosses ideological lines about resource management. We should all support this initiative to increase by 5 percent the funding from the budget committees to the subcommittees.

There are multiple efforts emerging to focus Congress on the Land and Water Conservation Fund (LWCF) and make it carry out its original broad purposes to satisfy the outdoor recreational needs of Americans. Recreation is such a highly valued segment of the American economy, and that fact is becoming so well recognized that such arguments seem to carry more weight. Economic data on the national forests, for example, show recreation values to local communities to be many times that of timber production. Recognizing the difficulty of wresting LWCF funds from their use in deficit reduction, this must be a unified effort. Acquisition of wild lands, solution to urban recreation problems and an overall better shake for outdoor America could be the result—and should bring all outdoor interests to the table.

There are other areas that need more dialogue. Forest management is locked in appeal and litigation between organizations that have abandoned common sense to call for no cutting of trees on public lands, obscuring both the science and management involved in resource stewardship. There have been substantial delinquencies in past stewardship, but the current process is broken and is costing taxpayers too much money. There should be middle ground to allow responsible stewardship without excessive regulation. In the current climate, however, there has not been enough reasonable dialogue in that direction. Note the session on northeastern forest management at this Conference, designed to highlight key issues. A similar regional focus on forest management issues is likely as this Conference moves geographically in the next few years.

Likewise, the advent of conservation planning, habitat conservation plans, and easing of real or perceived pressures on private landowners, are clearly beneficial for the future of endangered species management in America. There are legitimate questions about details of these planning practices, such as the nature and duration of guarantees against future regulation. It will not be constructive in the current political climate if the self-appointed, self-styled "environmental" and "conservation" groups line up on sides of the issue without more discussion. Some risks must be taken to test this important opportunity, as the Administration and some proposed legislation suggest, and we should deal with them with our eyes open.

Way back in 1937, there were papers presented at the Conference that talked about the need to work with the private landowner who controlled the future of most wildlife in America. We cannot forget, even with our love of public lands and wild places, that 70 percent of the nation's landscape is privately owned. While the percentage is different in Canada and Mexico, private lands—farmed, grazed and managed for forestry—are vital to the future of wildlife all over North America. The voluntary, incentive-based approach that is working with the farm bill is a strong indication of where we need to focus. We must not lose this opportunity.

USDA's Land-management Role

Secretary Dan Glickman
U.S. Department of Agriculture
Washington, D.C.

I am delighted to be here and to see so many people from USDA, other federal agencies, the Interior Department, our sister agencies, as well as state, local and private partners. When they open a speech, you often hear people, politicians particularly, say, "It gives me great pleasure to be here." Well, it does give me great pleasure because of the fact that USDA does so many different things.

People think of us as the farm agency, which we are, and that's our bread and butter so-to-speak, or, certainly, our political bread and butter. It's producing a stable supply of food and fiber for the world, but we are also the largest food safety agency. We are also largely the only rural agency in government with housing, water, sewer, and economic development for small towns and communities. We are also the largest land-management and resource agency in government, and not only because of the Forest Service. But, because we are largely responsible for private land-management efforts from the federal perspective and working in partnership with states and local governments in the private sector, we are trying to do our best to expand that role.

Going back to "It gives me great pleasure," I am reminded of Winston Churchill, whom everybody knows was a great English leader, Shakespearean advocate and other things, and everybody thought he was a great speaker, but he really didn't like to speak very much, and he used to say that many things in life gave him great pleasure, but speaking certainly was not one of them.

And so—a true story—Churchill was once asked to speak at a club in England called the Other Club. The Other Club basically was a club where intellectuals would get together and, in many cases, give extemporaneous speeches. When it was Churchill's turn to speak, they handed him a one-word topic. The word was "sex." Churchill looked at the card, stood up, looked at the crowd and said, "It gives me great pleasure," and then he sat down.

Well, I'll try to do my best to expand on that. But, I would have to say that it does give me great pleasure to be here. This is a very, very important group of colleagues of USDA—from Jim Lyons, our Undersecretary; to Paul Johnson, who is here; to Tom Hebert; and a lot of other folks. You all are the real implementers, the real action makers, in terms of conservation and wildlife management-related issues. And so, I am honored to be here and honored to talk about a more engaged role of the United States Department of Agriculture, which, as I say, and as we like to think, is the largest land-management agency in government.

I have to tell you I was a bit amused. I wrote on my schedule last week that I was speaking to the Wildlife Management Institute, and then I mistakenly assumed that I was appearing at one of those Congressional events they are having these days to try to get everybody to be nicer to one another. You know they all went up to Hershey, Pennsylvania, recently.

I must tell you. This is not just a categorical picture. I did serve in Congress for 18 years representing the great State of Kansas. I might add that we are in the sweet 16. We are number one. I won't say anything negative about any other schools, but I would say that basketball was invented at the University of Kansas—people are shaking their heads no, but the fact is it was first played competitively at the University of Kansas—although I think Dr. Naismith was from Massachusetts originally. But, anyway, we take pride in that.

I also spent 18 years in Congress as a member of the House Agriculture Committee. One of the accomplishments I was most proud of was that watershed year, back in 1985, when we wrote and cast the first conservation title to the Farm Bill.

Together with many people in this room, we made history. As a result, soil erosion has been reduced by one-third over the past decade and we are well on our way to no net loss of wetlands. That started approximately a decade ago, largely through your leadership. And we began recognizing that the interest of farmers and the interests of land management, generally, and wildlife protection were all together, not separate and apart.

Last year, we took the next step. We passed a Farm Bill that, in many respects, is at its heart a conservation bill. Certainly, that's a big part of it. Some say that it takes USDA away from its primary mission of supporting production agriculture, but I could not disagree more. It brings all of our interests closer together. After all, we need sustainable agriculture to sustain the world and to feed both our citizens and the hungry around the world.

I have here with me a book that I would like to call your attention to. You may all have seen it. In fact, I think there are copies of it out there. It is called a *Geography of Hope*. It was put together by USDA's Natural Resources Conservation Service. We are making it available at this conference.

It is an excellent document, a forward-thinking document, describing efforts to preserve the soil and the land, particularly, in terms of our efforts in cooperation with the private sector. It is a forward-thinking document that points us all to our next great challenge, which is private land stewardship. It is the great, largely untapped frontier of 21st-century conservation.

As Dr. Sparrowe said, 70 percent of America is in private hands; most of it held by farmers. They are less than 2 percent of the population, but they own close to a billion acres. Aldo Leopold knew this. That's why he said it is the American farmer who must weave the greater part of the rug on which America stands.

Farmers know that. They know the importance of healthy, productive land. If they don't have it, they are out of business. So, we should see farmers as a natural ally and a tremendous opportunity. We are forging this new alliance.

Last year, this Administration, farmers and many of you here today pushed for a strong new conservation role for USDA. It is unprecedented in its size and ambition, and it leaves USDA uniquely positioned to have a major, positive impact on conservation.

We manage a large chunk of America's public lands, our national forests, and we help private land owners, mostly farmers, care for private lands in nearly every single county in America. The centerpiece of our conservation effort, of course, is a dramatically reprioritized Conservation Reserve Program (CRP). Nowhere are the new priorities more apparent than in the central role wildlife habitat now plays.

For the first time, CRP will take only the most environmentally sensitive land. For the first time, protecting and improving wildlife habitat will be a major criteria for enrollment, as will improving air and water quality. Land in the prairie pothole region, critical habitat for migratory waterfowl, will be given priority.

Just to give you an idea of the sheer size of CRP, it can, and we hope will, enroll up to 35 million acres. What does that mean for wildlife? Just about twice as much grassland habitat as there is land in all state and federal wildlife refuges in the continental United States is the level we hope to get to in CRP enrollment.

Our FY '98 budget also asks for an additional 212,000 Wetland Reserve Program acres to create permanent easements and help farmers restore wetlands. We need this expanded acreage authority. Right now, there is a huge backlog of farmers who want to participate in the program. With it's expansion, there is tremendous potential to preserve critical nesting habitat for migratory birds.

We also have an intense effort underway to enroll 2 million miles of conservation buffers in CRP by the year 2000. Riparian buffers could remove up to 80 percent of the harmful runoff from cropland and give us unprecedented improvements in water quality, aquatic habitat and watershed health.

These new priorities also recognize that we need to look at the big picture of conservation and develop a strategy that protects all of the essential roles the working landscape plays in sustaining life. Beyond land-retirement programs, we are also expanding our work and providing technical assistance and cost-sharing incentives for conservation practices.

We have a new Environment Quality Incentives Program called EQIP, which provides financial help so smaller, family-size farms and ranches can adopt practices, such as grassed waterways, filter strips, manure management or habitat enhancement, that address natural resource and environmental concerns, and where, shortly, we will be issuing rules in that area.

We also have the Wildlife Habitat Incentives Program. I know many of you fought hard for this program. Now, we need to keep a close eye on the appropriations process. This program is USDA's first-ever conservation program targeted solely at protecting and improving wildlife on America's agricultural lands.

USDA has a new Wildlife Habitat Institute, to bring together practical knowledge and field expertise with the latest science and technology. This will keep us on the cutting edge of conservation, and fish and wildlife will be a key element in our forward progress.

What a difference 11 years can make. Back in 1985, many folks equated any mention of wildlife with two words that terrified private landowners—endangered species. Today, we have successfully shifted wildlife habitat to the center of our conservation efforts, and we have done it in a voluntary way that has brought everyone into the effort in a positive manner.

If I might just add parenthetically, through all of my years in Congress, especially the first 10 or 12 years, there always was tension between farmers and ranchers and the environment. That tension did not need to exist, because I always felt that 70 to 72 percent of the land was in private hands. By and large, farmers were outstanding stewards of the soil; there ought to have been efforts to bring people together, rather than separate them in an ideological war. This is the heart of the programs that have been adopted since the 1985 Farm Bill, to try to bring people together so that we don't look at each other as the enemy.

With these approaches, we have been able to prevent going back to endangered species. With the kinds of things that we have been doing, we have been able to prevent many species from hitting what I call "Def Con One" designation. We know, for example, that CRP has helped at least two species of birds stay off of the threatened and endangered lists—the Colombian sharp-tailed grouse and the greater prairie chicken.

CRP has helped hold onto or turn around population declines in 20 species of birds, half of them ducks. Ring-necked pheasant populations have more than doubled in several states due to added habitat created by CRP. Of course, you have to credit the groups who have been involved in making this happen, groups like Ducks Unlimited and Pheasants Forever. Everything we do right, we do as a team through the many partnerships we are pursuing. They will be critical to conservation's future.

So, while I will talk briefly today about our national forests and the important role they play, I urge all of you to look less to our public lands for conservation's future and more to each other and the tremendous potential in our own backyards.

We have a few facts to face up to. The federal government's ability to acquire and manage large, new tracks of land is severely restricted by fiscal reality. At the same time, rural demands on the working landscape are growing faster than ever.

Private land conservation asks all of us this simple question: "are we willing to do what has to be done to sustain life?" Whether you fly through the air, scamper around on all fours or walk upright, have opposable thumbs or wear nice suits, the answer is automatic. Why? Because it is based on instinct, the survival instinct. It is that gut feeling that what is best for nature is best for all of us.

We have a rapidly growing world today. Population and economic growth are increasing significantly. The pressures on the production side of agriculture will be strained continually as we see more and more hungry people, particularly in Africa.

As we see economic growth occur in places like Asia and Latin America, that will inevitably put more stress on private lands to produce more, increase yields, and deal with issues such as pesticides and water use that have long-term implications for the environment.

So, the kinds of things that we are doing at USDA with your help have tremendous practical implications on leaving this world with a resource base that can produce enough food to feed the hungry of the world, but do it in a sustainable, positive and helpful way that will leave the land and our resources for the next two or three generations better, certainly, than it got to us.

I know that all of us here have fought long and passionately over the care of our public lands, and I would like to talk about that for a moment. They are America's common ground, and they are a physical reflection of our values as a nation.

We are a country that appreciates the fact that when you look at a map of America, there still are vast stretches of land marked only by a few rivers and even fewer signs of the human race. That is rare around the developed world.

Some would argue that it is our ability to escape to these great open spaces that keeps us civilized. That is what Thoreau meant when he said, "In wildness is the preservation of the world."

Public lands will always be an important part of the conservation equation. As the Secretary of Agriculture, I am the proprietor of about 124,000 miles of trails, 4,300 miles of wild and scenic rivers, and about 137 prime ski resorts from Tahoe, to Vail, to Aspen, to Jackson Hole. Sorry, no lift tickets here, however.

I am proud of our national forests and what this Administration has done to protect them. I firmly believe, and I think most of America believes, that the most valuable commodity on our public lands can only be taken away in fond memories or on a roll of film.

We can no longer afford to equate conservation solely with public lands. In fact, one of our greatest opportunities lies on private forestland. More than two-thirds of America's forests are in private hands, mostly held as an investment for future development. I don't have to lay out for this crowd what that means for wildlife habitat.

In the next few weeks, the National Academy of Sciences will release what is expected to be a ground-breaking report on the future of private forestlands and what can be done to promote sound land stewardship there. We should all read it and find a way to come together cooperatively and make this a conservation priority with public and private sectors working together.

In many ways, private lands are USDA's roots. Most folks don't know this, although Jack Thomas probably does, because he's got an institutional memory. I wasn't going to talk about his age, but he's certainly got the institutional memory here. Ages ago, when the Forest Service was first created, its purpose was to address issues on private forestland. It took awhile and a bit of a battle before America's forest reserves were transferred to USDA from the Department of the Interior and transported to a national forest system for the greatest good for the greatest number in the long run, as the first chief of the Forest Service put it.

That now needs to be our philosophy throughout the landscape. Whether we are managing public lands or working with private land owners, our challenge today is to link all of the pieces together—public forests, private nonindustrial forests, farm and ranch lands, even urban areas. We must manage the entire landscape, fully recognizing the importance of each component. That is a complete vision for conservation and it is all natural.

Just take the journey, for example, of the coho salmon. That fish starts out in an icy stream in the glacier peak wilderness of Washington State. Come spring, her stream will swell with meltwater and she will leave the pristine area that is protected by the Forest Service. She will head into the great Skagit River and eventually head south. Along the way, she will pass through lands devoted to farming, timber, wildlife habitat, light manufacturing and outdoor recreation. For the purpose of this story, I wrote that she steers clear of the wriggling worms and nifty flies. In the lower reaches of the valley, USDA is helping landowners, from farmers to developers to homeowners, do their part to make the trip a little easier.

In the upper region, a Forest Service fisheries biologist is building ponds in a side channel of the river to rear future coho. He is working alongside Chris Dietrich, of the Washington State Department of Fish and Wildlife, and supported by sport fisheries groups and an Indian system's cooperative. With all of these unseen helping hands, that little coho will make it to the great Pacific. She will play around for a few years, then do the whole trip in reverse. She will never know whether she is in a national forest or swimming behind a farm. She simply knows whether she is in a hostile or habitable environment, focusing all of her energy on her quest, not just for life, but for the survival of her species.

The same story could be told and retold throughout the animal kingdom. From our perch at the top of the evolutionary ladder, we need to recognize our unique responsibility to protect and revere all life. That means giving private lands as sacred a place in the American spirit as our public lands occupy.

We must redefine common ground as land we all stand on, whether it is in a national forest or amid those amber waves of grain. We do that by seeking a new land ethic, one that crosses public and private boundaries, one that transcends state, local and federal jurisdictions, one that tears down the man-made boundaries that mean nothing to protecting her, still protecting private land ownership during all of this process, and one that takes us back to a simple truth—we are all part of a living community, and ultimately, we will fail or succeed together.

A land ethic was the clarion call to arms, that Aldo Leopold made a half century ago. He said, "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

It is time to build that community. It is time to thread all of our efforts together and sew one great geography of hope. Public lands, private lands, rural and urban land linked by a common concern, a singular commitment to being better stewards of this land of promise.

Together, we can spread hope across the American landscape and leave a legacy worthy of our children, a world in which people and the environment exist in harmony. I challenge you to join us in realizing that vision and building that legacy. Thank you all very much.

Canadian Perspectives on Wildlife Management—New Directions

Lynda Maltby
Canadian Wildlife Service
Ottawa, Ontario

What I intend to talk about briefly today are the factors that are influencing wildlife management in Canada, its historical context and also its future trends. Canada's wild spaces and species are actually the core of our way of being. They are the core of the image of Canada. They are important to our economy, providing the basis for more than 200,000 jobs, contributing $5 billion in tax revenues and adding more than $11 billion to our GDP. They form a large part of Canada's natural capital. Managing these resources has never been more difficult than it is today or will be in the future.

The constraints and influences faced by those responsible for wildlife management include both global and local challenges. While budgets are declining, public expectations are rising. One of the keys to facing these challenges is not to face them alone.

The history of wildlife management in Canada is a success story that has not been told often. It is a success story that includes cooperation, learning from experience, and engaging partners at the local, regional, continental and global levels to conserve our wildlife.

On November 1st, 1947, the government of Prime Minister William Lyon Mackenzie King issued an Order-in-Council establishing the Canadian Wildlife Service, and giving it responsibility for the management and protection of wildlife under federal jurisdiction.

This year, the Canadian Wildlife Service celebrates its 50th anniversary. It is an agency that has earned a global reputation for excellence in a wide range of conservation activities. Since the beginning, the key to the successes of our program has always been our partnerships with other countries, other federal departments, provinces and territories, nongovernment organizations, industry, the Aboriginal peoples of Canada, and communities.

These partnerships will be critical to the continued success of existing wildlife programs and to the implementation of new initiatives. The primary responsibility of the federal government in Canada is that of managing migratory birds, fish, marine mammals, nationally significant habitats and endangered species on federal land, as well as other wildlife initiatives of national and international importance, such as humane trapping. The provinces and territories are responsible for all other wildlife.

Sustainable development is a national goal, a policy of the government of Canada and a shaping assumption for wildlife and, in general, environmental management in Canada. Our science is the foundation of our policies, programs and regulations and is essential to achieving results.

The Wildlife Ministers Council of Canada, comprised of ministers responsible for wildlife, from the provinces, territories and the federal government, exemplifies the enduring intergovernmental cooperation that has assisted in the successful management of Canada's wildlife population.

More than a decade ago, this Council began the process of mapping a national vision for wildlife management in Canada. Six years ago, the publication of a Wildlife Policy for Canada recorded a major step forward, completing the evolution of a community from game managers to those interested in and responsible for the stewardship of all wildlife in Canada.

We are fortunate to have a strong legislative basis, as formulated in the 1916 Migratory Birds Convention with the United States, which was the pioneering instrument for international cooperation in the management of migratory bird species.

In addition, the Canada Wildlife Act, passed in 1973, has enabled the federal government to carry out wildlife research and, in cooperation with the provinces, to undertake a wider range of wildlife conservation activities, including the establishment of a network of National Wildlife Areas across Canada.

As mentioned before, wildlife management in Canada has not been without its challenges. Recently, the exercise of program review conducted by the federal government resulted in fairly substantial impacts within Environment Canada. Specifically, we are left trying to do more with less. At the same time, the federal government has been experiencing reorganizations and budget cuts, so, too, are the provincial and territorial governments.

In Alberta, for instance, fish and wildlife will be combined under one director in 1999. In the Northwest Territories, the Ministries of Economic Development, Minerals and Oil, and Renewable Resources will be amalgamated into the Department of Resources, Wildlife, and Economic Development over the next 24 months.

This trend of consolidating a variety of different interest groups into one is continuing throughout the country. Thus, the need for funding is becoming one of the main concerns in wildlife management. In light of these continuing challenges, our partnerships are more critical than ever in the successful delivery of existing and new wildlife-related programs.

There is a need to strengthen existing relationships and forge new ones, based not on jurisdiction, but on shared concerns and mutual responsibilities, harmonization in its broadest sense.

The recognition of the role of private landowners in the conservation of wildlife has led to such programs as the North American Waterfowl Management Plan. The North American Waterfowl Management Plan, as Rollie mentioned, is very close to our hearts in Canada and owes its success to the innovative partnership involving federal, state, provincial and territorial governments, nongovernment organizations, the private sector, and landowners; it brings together hundreds of partners from Canada to tropical Mexico.

A further example of an innovative program in Canada is that of the "Ecologically Sensitive Land Tax." That is a true partnership with landowners in conservation. This new measure is an important tool in providing environmental stewardship and biodiversity conservation on private lands in Canada.

The Canadian Land Bird Conservation Strategy and Partners in Flight represent a further evolution of the trend in wildlife management that has been happening for a number of years. With the Migratory Birds Convention Act, we were focused on management, harvest and hunting of game species of migratory birds.

We then broadened our management and research interest to address such issues as habitat through the Canada Wildlife Act and through programs such as the North America Waterfowl Management Plan.

Now, with the growing interest in nongame birds and bird watching being the highest recreational sport in Canada, and the broader biodiversity agenda in general, our programs will be expanded yet again. Particularly good examples are the Canada Land Bird Conservation Program and Partners in Flight, which work to ensure the long-term viability of populations of native Canadian land birds across their range of habitats.

It is our hope that all land managers and conservationists will work together to find land-use practices that accommodate viable land bird populations. A partnership of organizations working toward that goal was formed to help coordinate population and habitat conservation programs.

The Canada Land Bird Conservation Program is, in fact, the Canadian counterpart to Partners in Flight in the U.S. In addition, partnerships with Aboriginal peoples in the form of comanagement boards and regimes, such as the Porcupine Caribou Management Board, have proven to be an effective way to manage populations of wildlife.

The Porcupine Caribou Management Board was established in 1986 and has a membership which includes representation from the Yukon and Northwest Territories, the federal government and an equal number of representatives from Aboriginal communities.

I hope that we expand this as a model in trying to work out other partnerships in other parts of the country. We not only depend on these partnerships for the implementation of wildlife programs, but the conception and development of these initiatives, as well.

The proposed Canada Endangered Species Protection Act was conceived, developed and will be implemented in an open and transparent process based on partnerships with the provinces, territories, Aboriginal peoples, nongovernment organizations and private citizens. The development of recovery plans will be done with the participation of many affected parties in the broadest sense.

In order to facilitate the implementation of Canada's new wildlife legislation and programs, it has become necessary to propose new arrangements. One such arrangement is that of a National Accord for the Protection of Species at Risk, a commitment to a national approach made by the federal, provincial and territorial ministers responsible for wildlife. An Endangered Species Conservation Council, comprised of these ministers responsible for the management of wild species in Canada, is responsible for the implementation of this accord and federally consists of ministers of fisheries and oceans, heritage, and ourselves—a first in its own right.

This Coumcil will be assisted by a permanent secretariat provided by the federal government and the Canadian Directors Committee responsible for wildlife.

One of the certainties about the future of wildlife management in Canada is that our challenges will continue to be numerous and variable, as we work toward management strategies for biodiversity conservation. The concepts of multiple-resource use are being replaced by the more complex tests of ecological sustainable use.

The single focus of economic values is being challenged by the need to deal with ethical values—the rights of nature. We are equipped to meet these challenges if we learn from the expectations of the public, broaden our understanding of the world we are trying to live in and work cooperatively in achieving our common goals.

Recent examples of this cooperative effort include the signing of the Canadian Biodiversity Strategy by all 13 governments in 1996, extending our understanding to both the sustainable use of these resources, and the fair and equitable sharing of the benefits arising from those uses.

Again, in 1996, an agreement in principle was reached committing all government to develop legislation and programs complimentary to that of the proposed Canada Endangered Species Protection Act. This is to ensure that endangered species are protected throughout Canada.

It is only through such strong partnerships that the protection and recovery of species at risk will become reality. Public support for endangered species protection is staggering in Canada, in that, more than 92 percent of the people polled believe that there is a need for federal endangered species legislation.

In summary, if I could leave you with one message, it would be one that stresses the importance of partnerships and working within a broad policy context. Much of the wildlife we enjoy today in Canada is attributed to earlier wildlife policies, and we need to build on those.

Throughout the world, we are seeing shifts upward toward international institutions and downward toward communities in the setting of policy direction. And we, through experience, have recognized the usefulness of a wider policy context for wildlife management decisions.

Conservation of wildlife is everyone's responsibility and not left up to any one agency or government, and if we work together, it will happen. I hope you all have a very good conference, and I will say I am very pleased to be here. Thank you all.

Knowledge and Passion: The Keys to Resource Management

Mark Van Putten
National Wildlife Federation
Vienna, Virginia

The roots of the National Wildlife Federation (NWF) are intertwined with the North American Wildlife and Natural Resources Conference and its rich history. The relationship between NWF and this conference—including the wildlife professionals represented here—remains strong, and I am proud of these connections.

This year's theme, "Finding Common Ground in Uncommon Times," could just as well be the title of my remarks. Obviously, finding common ground and building diverse coalitions is the source of our collective strength. It is what NWF has been about for more than half a century. I refer to common ground among people of diverse background, diverse ethnicity, diverse lifestyle, diverse life experiences and diverse recreational pursuits. In this regard, NWF remains America's big-tent conservation organization. We are the home for those activists who believe in the protection of habitat; indeed we *are* the habitat people, and that is what NWF has been about for 60 years and what it will be about in the future.

But today, I want to talk about finding common ground in a different sense: a balance between passion and knowledge. These are two apparently conflicting human sentiments. Many of us in this room know them both well. We know the passion to protect natural resources that comes from the experience of specific places and the dedication to protect those places. After all, as Wendell Berry observed, you cannot love an entire planet—you can only love the special places that you have experienced. But protecting our natural resources is also about knowledge, the knowledge of those specific places that inform our wisdom of what is happening in environmental systems. This knowledge is intuitive. It's the knowledge familiar to the hunter who spends many hours in the field, the angler who spends many hours on the stream, the bird watcher and the gardener. In a sense more specific to our commitment, knowledge also means expertise. It means intellectual rigor and the dedication over a lifetime to an understanding of the natural world.

Finding the right marriage between passion and knowledge is the essence of any ethic. As Aldo Leopold said, the evolution of a land ethic is both an intellectual and an emotional process. For, as he also said, you cannot save what you do not know and what you do not love.

First, let me talk about passion. Our cause is born of passion; we should never forget this and never be ashamed to talk about it. Our passion comes from personal experiences of the natural world, not a devotion to an abstract cause of "environmental protection" or "natural resource conservation." The members of NWF are inspired in their passion by many different places. For me, it was the Great Lakes region, the shores of Lake Michigan, the Pierre Marquette River, the Baldwin River, the Coldwater River and the other rivers that I fished when I was young.

In my new role at the Federation over the last seven months, I've had the privilege of traveling America and meeting many different people. Their knowledge and commitment are as strong as mine, but derived from their personal experience of their special places. I spent one day with Bill Center, a river guide on the American River in California, who has spent years fighting the proposed Auburn Dam. I spent another day with Thea Lekovitz in Seattle, who has long worked to protect the rivers of the Pacific Northwest. I spent time with Jack Moller, a hunter who knows the Everglades as well as anyone and who is as committed to its protection as anyone. And I have drawn inspiration from Milton Pelletier, a burly, silver-haired dock worker from Duluth, Minnesota, whose dedication to protecting Lake Superior has been lifelong. These are the people and this is the passion that comprise our cause.

I've also observed that this passion for natural places is often tied up with the love of a special person with whom one has shared experiences in these places. Whether a grandparent with whom one hunted, fished or bird watched, a parent, special friend or child, our passion for the natural world is intertwined with our caring for each other and our belief in community. In this sense, our passion and our cause reflect core American values. It is main street and main stream America, and woe to the politician who forgets that—as some learned in the 104th Congress.

But passion alone is not enough. As one great philosopher said, passion without knowledge is ideology...at its worst, it becomes zealotry. Aldo Leopold understood that our movement is about combining the passion of commitment to special places with the knowledge that comes from the study of the natural world. Passion tempered with knowledge is what this conference represents, and it's also what NWF has been dedicated to for more than 60 years. Leopold was a scientist, and one of the founders of the field of wildlife management. He believed that professional, knowledgeable management of natural resources was the key to conservation and a way of living the land ethic. This is a core principle of NWF and its state affiliates. Today, we are still defending the concept of knowledgeable and professional management of natural resources as a way of living the land ethic.

What kind of knowledge are we talking about? I'm speaking of the knowledge that comes from understanding what is beneath the surface of what we see when we experience the natural world. It's the type of knowledge that Leopold had in mind when he wrote about Daniel Boone—the knowledge that disclosed the origins and functions of what to Boone were only facts, that disclosed the mechanisms for what to Boone were only attributes. It's the knowledge of the complexity and fragility of ecosystems that comes from a lifetime of attentiveness, intellectual rigor and just paying attention. But, this knowledge can and, if we are to succeed, *must* always connect back to passion.

Scientific knowledge disconnected from passion can obscure the seeing of the natural world and what must be done to save it. Aldo Leopold said that the Ph.D. "may become as callous as an undertaker of the mysteries at which he officiates." We must never take for granted or be callous about those mysteries. Leopold said that the role of knowledge and science was to reveal "the intrinsic beauty of the organism called America." Such knowledge leads to passion and, also, to a sense of obligation. After all, it is an ethic we are talking about, and an ethic calls for sacrifice. This is what

NWF stands for: marrying knowledge with passion, the passion that I am sure led many of you to begin your careers and has sustained your careers over the years.

The conference theme is "common ground," and also "uncommon times." In what way, then, are these times uncommon? Next year will be the 50th anniversary of Aldo Leopold's death and the posthumous publication of *A Sand County Almanac*. Let's look back 50 years and ask in what ways are these times uncommon. They are not uncommon times in the nature of the challenges we face. The challenge today remains the same as it did when Leopold wrote *A Sand County Almanac* 50 years ago: the ethical challenge of thinking and acting differently.

Speaking of his famous land ethic, Leopold pointed out that more education is not necessarily the answer; rather, it's the quality of the content that matters. And the content that really matters is that which transcends our self-interest. Leopold admonished that we must be careful in our attempts to make conservation "easy," lest we make it trivial.

Unfortunately, in most instances it's as true today as when Leopold wrote that the disposal of property is still a matter of expediency, not of right or wrong. Today, like in Leopold's time, debates about conservation are too often about economics and not about ethics. One form of knowledge—the economic value of a piece of property—has gained supremacy over other forms of knowledge, such as an understanding of ecological processes and a reverence for the fragility of the natural world. The evolution of an ethic that respects these things more than economic value appears to me not much further along than when Aldo Leopold wrote.

Leopold understood and admonished that a system of conservation based solely on economic self-interest will be "hopelessly lopsided." Now *there* is a phrase that seems to characterize our times: hopelessly lopsided. What phrase could better characterize some of the proposals to rewrite the Endangered Species Act to save only those species whose current value can be measured in dollars?

Hopelessly lopsided: what could better describe some of the disputes over wetlands conservation when the short-term economic value of a golf course counts for more than the invaluable ecological asset represented by a wetland?

Hopelessly lopsided: what could better describe the imbalance between the resources of those who live near superfund sites and the huge fees paid to legions of lawyers—dollars that could be used for cleanup—to argue over who is at fault?

Hopelessly lopsided: the arguments of those who attack EPA's new standard on ozone and particulates as benefitting only kids and old people. After all, they argue, you can keep the kids indoors on bad pollution days and old people will soon die anyway, so their lives should be valued less in the record of the EPA rule-making. It reminds me of a proposal we once heard for dealing with global warming: wear hats and sunglasses.

Hopelessly lopsided: what could better describe the narrow interests of agriculture and government pitted against the restoration of bison to the native prairie and to the Native Americans whose culture was built upon the bison?

Hopelessly lopsided: what could better describe the 104th Congress, where dollars purchased access to back rooms to write laws and undermine what we have stood for for more than half a century?

In truth, it is economic self-interest that has become the ruling ideology and the zealotry of today's America. It is knowledge *without* understanding of the natural world, it is knowledge *without* passion, it is knowledge *without* any ethical content at all—unless your mother taught you that selfishness has moral meaning. It is in the name of economic self-interest that the knowledge you represent is ignored. And it is in the name of economic self-interest that political expediency dictates natural resource policy.

So, what is the answer? Leopold's prescription was this: "[This is] the key log which must be moved to release the evolutionary process for an enlightened natural resource ethic: quit thinking about decent land use as solely an economic problem. Examine each question in terms of what is ethically and aesthetically *right*, as well as what is economically expedient."

But, if the times are not uncommon as to the challenges we face, there are some uncommon successes in which I think Leopold would take pride. What could better represent Leopold's legacy than the return of the wolves' howls to Yellowstone National Park, or the 1996 Farm Bill—an example of a land ethic in the making. And the U.S. Fish and Wildlife Service will soon propose a plan to bring grizzlies back to parts of their native habitats in Montana and Idaho...a plan developed cooperatively by NWF, Defenders of Wildlife, the Intermountain Forest Industry Association and the Resource Association on Timber Supply. Uncommon times indeed, when these unlikely allies find common cause in bringing back the bears.

These are also uncommon times in the many opportunities before us to marry passion with knowledge and to treat conservation as more than economic self-interest. There is the challenge of restoring the Everglades to health. And, to those opposing EPA's new clean air standards who would value old lives less, I direct their attention to Marjorie Stoneman Douglas. At more than 100 years old, she is still going strong in the cause of Everglades conservation. There is the challenge of rewriting the Clean Water Act to control runoff pollution from farmers' fields and city streets. There is the challenge of improving the Endangered Species Act while making reasonable changes that make it work better for private landowners. And there is the "Teaming with Wildlife" legislation, an opportunity for a broader coalition of people to do what ethics require—make a sacrifice—to help pay for the protection and conservation of the natural world, and their continued enjoyment of it.

I believe, and the National Wildlife Federation believes, that we *can* marry passion and knowledge in the defense of conservation. I believe that most of you chose your careers based on that belief. It is that melding of these two seemingly contradictory human sentiments that is the essence of our cause and will be the source of our success.

It was Aldo Leopold the scientist—who understood and described predator/prey relationships, and wrote passionately as well of the "fierce green fire" dying in wolves' eyes—who knew with certainty that progress comes when the heart and the head work together.

So, I urge you always to speak out with passion, but based on your knowledge, in defense of what's right and what's wrong in conserving our wild places and wildlife. Thank you.

Surveying the Road Ahead for Extension

Catherine E. Woteki
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Washington, D.C.

The overall conference theme—"Finding Common Ground in Uncommon Times"—resonates with my own experience in the U.S. Department of Agriculture, as I work with four USDA agencies brought together only two years ago under the mission area I head—Research, Education, and Economics.

One of my major tasks is to help the agencies within this mission area find common ground during continually changing times. I can report we are making steady progress in meeting this often difficult challenge.

Finding common ground seems to be the mood of Congress and the American people today, and I commend you for your willingness to embrace such a bold and timely theme and to address it here these several days.

You have asked me particularly to focus on "Surveying the Road Ahead for Extension," and, in the next several minutes, I will attempt to do just that.

Context of "Extension"

First, I will tell you that in these remarks today I place extension within the relatively new context of Research, Education, and Economics. Under the 1994-1995 USDA reorganization, extension became part of the new Cooperative State Research, Education, and Extension Service (CSREES), which, in turn, is one of the four agencies I just referred to.

Our mission involves us directly and indirectly with state and county partners, which include the research, education and extension missions of the land-grant colleges and universities.

When I speak today of the road ahead for extension, I also am speaking of extension at the federal, state and local levels, the Cooperative Extension System.

And, my references to extension are made in close connection with research and education at the land-grant universities nationwide.

Many CSREES staff cover both research and extension within their own individual positions. They echo this practice in the states, where many land-grant faculty and staff members hold joint extension and research appointments. In some cases, there may also be a third portion, the teaching dimension.

Some Background

The role of extension education programs is relatively simple in terms of the decades-old legislative authority and mission: it was part of a three-way partnership of the U.S. Department of Agriculture, the land-grant universities, and the county governments in each state and territory.

Purpose of the Cooperative Extension System was and is to aid in diffusing among the American people useful and practical information on agriculture and related subjects through research-based educational programs.

Wildlife and related natural resource programs have long been an interest and concern of extension.

Speaking at the first North American Wildlife Conference in 1936, Dr. C.B. Smith, Assistant Director of Extension, addressed ongoing extension efforts in wildlife fields. He vowed to conference attendees that the Extension Service was...and I quote..."squarely behind this great conservation movement" and would play an increasing role in stimulating wildlife restoration and conservation interest and knowledge.

And, sure enough, it was later that same year that the first extension wildlife specialist positions at the federal and state levels were established.

Today's extension wildlife and natural resource programs that evolved through legislation and policy over the years have served as the basis for a close relationship with the natural resource community and with this conference.

Current Situation

What are some of the trends within extension natural resources education today?

- One is that we see fewer states with as large an arsenal of extension natural resources programs, compared with 10 years ago. Some positions have been lost due to budget cuts and retirements, and some because of changing priorities within state extension programs. Within CSREES, our national program leaders for natural resource programs now devote their energies to both research and extension programs, as a result of the merger of CSRS and Extension.
- At the same time that extension and other agencies have been downsizing, we find increasing global interest in the environment. Therefore, a more intense and widespread environmental awareness is another player in today's research, education, economics and extension focus on wildlife and natural resources. As the 21st century nears, world attention is on the environment and on sustainability and use of natural resources.

U.S. consumers, state and community decision makers, corporate leaders and educators want to protect wildlife habitats and open space, understand global change, and address dozens of other environmental questions. I see the growing number of environmental issues as fitting priorities for us in the research and extension area, especially given our longtime investment and nationwide system of research-based educational programs.

While federal downsizing and a world more focused on the environment are two emerging realities affecting Extension natural resources research and education today, so are (1) the on-going revolution in biological science knowledge, and (2) the information explosion:

- Thanks to a rapidly increasing understanding of life processes through research, we are in a better position today to conserve natural resources and protect the environment.
  - For example, today we can genetically alter plants to defend crops against pests, avoiding prolonged and concentrated use of chemical pesticides that may affect water and soil quality and animal and human health.
  - We are poised to detect and control emerging infectious diseases in animals that not only threaten commercial livestock, but wildlife as well.
  - We better understand how to sustain and restore ecosystems.
  - Because we can foresee—through knowledge being developed as we speak—the precise effects of global climate change on natural resources and on animal, plant and human life, we can produce strategies for the 21st Century.

In short, breakthroughs and new approaches to problem solving in the biological sciences have equipped researchers with powerful new tools to solve continuing and emerging challenges.

I should mention here that we have proposed to Congress a FY 1998 $36 million increase in CSREES' National Research Initiative. Of that, we are asking for a $10 million increase in the area of natural resources and environment alone.

In addition, we propose another $1 million to develop methods to help mitigate environmental impacts from grazing land use.

We seek an additional $4 million plus for pest management research, $2 million more for pesticide applicator training and $13 million for improved pest control management, including $8 million for Integrated Pest Management and biological control.

We are now in a world in which we have more and better options for communicating. More today than ever before, we are positioned to deliver the knowledge our research produces to those who need it for promoting wildlife and natural resources conservation. That is because we have a greater variety of tools to communicate with larger audiences in more ways than ever before.

The information environment has exploded, led by the computer and telecommunications industries. The Internet and World Wide Web were virtually nonexistent 10 years ago.

- Today, we can pull down and transmit a wealth of information on everything from methods for recycling agricultural wastes to understanding how agricultural practices affect our air, water and soil.
- We can electronically develop models for managing water quality.
- We can create global databases for animal, as well as human disease surveillance.
- And, given limited federal resources, we can conserve funds by electronically coordinating the nation's and world's information in this area.

Incidentally, toward this end, CSREES has set its priorities in a tight budget year so that we are able to request $600,000 for implementing, operating and maintaining a comprehensive, integrated, user-friendly electronic information system that connects our four agencies' data. We are receiving $400,000 this fiscal year in design and other startup funds.

To continue to meet our responsibilities to the public, despite governmentwide downsizing, we recognize the necessity of adjusting our priorities to stay abreast of 21st century information technology.

This is the climate in which extension is operating today. We don't have all the personnel resources we need because the federal government is becoming smaller. So we must set our priorities and change our communication techniques to accommodate the nation's greatest needs, including wildlife and natural resources conservation research, education and extension.

Sustaining Productive Capability of Private Land Resources

Let me speak a moment about one of the major tasks facing USDA's Research, Education, and Economics agencies in the decades to come: sustaining the productive capability of private land resources.

Our country's natural resources provide the foundation for our communities, our economy and our heritage. Continued prosperity depends on the country's ability to protect this natural resource base and learn to use it in ways that do not diminish it.

The President's Council on Sustainable Development in 1996 made the following two points, with which I concur. Sustaining the productivity of land resources means that we must apply what we have learned from science to our management, and we must generate new science to learn how to manage even better.

About two-thirds of the contiguous U.S. land base is privately owned. The quality, vitality and fate of these natural resources will continue to depend on private choices, and the role of research and extension will remain that of making the best science available to private decision makers.

Making intelligent decisions about environmental issues is critical, but not easy. The amount of information currently available is astounding, and it contains both fact and fiction. The most accessible information, however, may not be the most factual or useful. Searching for particular knowledge may be overwhelming.

Teaching people how to sift fact from fiction will help them to make intelligent decisions about the use and management of natural resources. It is the best way to sustain production of goods and services while protecting the natural resources on which we depend. This is the goal of extension programs in Natural Resources and Environmental Management (NREM).

By including this kind of education with other extension programs, millions of people can learn about the relationships between natural resources, environmental sustainability and human well-being. Such knowledge, along with appropriate action, is essential to maintain not only our natural resources, but also our way of life.

Among the highest priority educational needs, identified from the grassroots up, are programs directed at helping private landowners and managers sustain and manage a productive and viable natural resource base.

This holistic concept, to integrate our best knowledge about management of natural resources with our understanding of human needs, is necessary to ensure sustained productivity of our natural resources—in urban as well as rural communities. It meshes appropriately with federal land managing agencies' conceptual approach toward ecosystem level management and sustainable development.

Extension faculty around the nation recognize the importance of natural resources and agricultural sustainability, and feel a sense of urgency to respond where developmental pressures are greatest.

While most of our natural resource rich lands are rural, increasingly, decisions are made because of urban influences. These can be made by absentee landowners or through the public policy process.

About two-thirds of the total value of U.S. agricultural production takes place in or adjacent to metropolitan counties. Natural resource education and outreach programs must continue to be strengthened in our urban and suburban population centers, as well as being maintained with an interdisciplinary focus to assist rural community needs and private landowners and managers.

It is no simple challenge to retain our rural communities and their economies while protecting the natural base on which those communities are built. Education to protect our water, soil, air, forest, rangelands, fisheries and wildlife must complement our efforts to enhance our natural resource based industries and productive capacities on private lands.

Cooperative Partnerships

Nationally, extension provides more than 600 annual staff service years to natural resource and environmental programming. Critical to achieving these results are the cooperative partnerships at the federal, state and local levels.

An example of one of these long-term and effective partnerships was facilitated by a federal-level Memorandum of Understanding. Since 1978, more than 300 cooperative educational projects, programs and products have been made possible through this cooperation.

Similar partnerships with numerous other federal and state agencies and with the private sector exist in the forestry, range, water quality, environmental education and sustainability programs, as well as with other wildlife and fisheries cooperators.

As you can see, there are different approaches—and for people from all ages and backgrounds—for the kind of comprehensive yet targeted education in which extension excels.

Challenges

What are some major, broad challenges facing agriculture and the environment and USDA's Research, Education, and Economics agencies, particularly CSREES with its extension, education and research components?

One is using the information we collect and analyze to paint and continually repaint "the big picture," if you will, that reflects the status of our natural resources and their relationship to agricultural productivity.

This changing "state of the land" picture needs to show how water, soil, air and wildlife conditions relate to one another over large areas and how they relate to agriculture. And, this measurement also needs to afford us a comparison with the past—so that we know when those conditions are getting better or worse.

To develop this "big picture," we constantly need to analyze the use and shifting uses of America's private land, including the greatest use: agriculture. And, we constantly need to assess our natural resources inventory.

At the same time, we need to be able to track and protect agricultural productivity. Our agriculture and food system contributes more than 15 percent to the Gross Domestic Product and accounts for at least 18 percent of the nation's civilian jobs.

Agriculture is important to the national economy, and one of the five goals in USDA that drives Research, Education, and Economics is identifying and promoting the needed balance and harmony between agriculture and the environment. Our USDA agencies can help provide and communicate this overall picture of natural resources conditions and agriculture's role.

More specific challenges include:

(1) Continuing the research, education and extension that help stem soil erosion and loss of important soil organic content.

Obviously, soil conservation is central to both a healthy ecosystem and agricultural production. We must continue to provide research and education in such areas as crop residue management, crop rotation and tillage systems.

(2) Our nation's water resources must be guarded carefully. Certainly, agricultural research, education, and extension must play a role here.

One has to look no further than the Gulf Hypoxic Zone to understand how agricultural practices may affect water quality. There remains uncertainty about precisely how to assign hypoxia responsibility to likely contributors to the problem.

However, the nutrient overload entering the Mississippi Upper River Basin and emptying in the Gulf, adversely affecting marine life and the fishing industry, can be traced not only to municipal and domestic waste and atmospheric contaminants, but also to fertilizers and animal manure.

We must work to reduce agriculture's potential for impairing water resources through intensified research and education in furthering integrated pest management, biotechnology, improved pesticide and nutrient management planning, irrigation and other agricultural practices, and livestock manure management systems.

(3) Expand and share the knowledge developed in pursuit of increasing agriculture's contribution to clean air.

As I mentioned earlier, my USDA agencies are participants in and contributors to developing national and international strategies to counter future, predictable adverse global climate changes on a wide variety of earthly conditions, including natural resources and wildlife.

Beyond that and beyond our developing knowledge on agricultural practices that promote clean air, a good example of what we are doing in this area is a little-known program called "biomass for energy."

Along with the U.S. Department of Energy, we have launched several of these pilots around the country, hoping to demonstrate their value to utilities, agricultural producers, conservation organizations and economic developers so that the private sector will follow our example...profitably.

The environmental advantages are multiple. Under this pilot, farmers are encouraged to grow nontraditional crops such as alfalfa and switchgrass for harvesting and use as power plant fuel.

The producer benefits by having an alternative cash crop. Consumers benefit with local, cheaper electrical power. And, community economies benefit because the process attracts supporting commercial development.

But, the environment benefits the most. The naturally renewable crops help stabilize the soil and provide small animal and bird habitat cover. Less fertilizer and pesticide are needed than with traditional row crops. And, perhaps best of all, using wood rather than fossil material for fuel is an atmospheric plus. What's more, ash residue from the gasification process using alfalfa or switchgrass as fuel can be used to replenish the soil, completing the cycle of putting back in the earth what it has given.

The Future

What's ahead, and what do we need to do?

First, we must sustain a strong and viable natural resource and agricultural base in the face of a progressively expanding human population.

Second, we need to conserve biological diversity for future generations, helping people to understand its importance and continue to use and appreciate it in a sustainable way.

Third, we need to link national policy mandates for ecosystem management on public lands with private landowners' objectives for ownership and management of their lands. And, we need do this without losing our capacity to meet the public's need for food, fiber, and natural resources products and amenities.

We have the tough task of addressing natural resources and agricultural sustainability along with biodiversity and ecosystem management. If we fail to sustain a viable natural resource base, we cannot sustain viable agricultural systems. Nor can we sustain biodiversity or effectively manage ecosystems.

Certainly, when we realize that the world human population of 5.4 billion is expected to increase rapidly into the next century, we see that many ecosystems are unlikely to be sustained as they exist today. People and communities will have to manage ecosystems and allow for biodiversity to sustain agriculture and natural resources for present and future generations.

Linking national policy mandates for ecosystem management on public lands with private landowners' objectives may be the most difficult and complex task of all. Ecosystem management, an evolving concept, extends the holistic concept beyond the individual property owners to the whole ecosystem. Implied is the concept that to continue to sustain biological diversity and ecosystem integrity over generations, management must sustain several key components. These include soil productivity, gene conservation, biodiversity, landscape pattern and the array of ecological processes that sustain the ecosystem. Landowners, managers and resource users must be involved in the process or it is likely to fail.

Federal government should provide leadership in and cooperate with activities that foster the ecosystem approach to natural resource management, protection and assistance. In administering our programs, we must be sensitive to the needs and rights of landowners, local communities and the public, and we should work with them to achieve common goals.

In the past, most rural private landowners have seen their role as being stewards of their property with some consideration for neighbors and the community but primarily with their own family objectives as uppermost. Today and in the future, as they learn about ecosystem management and biodiversity, they will find themselves part of the global environment, at least as part of a regional or unit ecosystem puzzle.

The challenge to extension is to reach the diverse multitude of owners, managers and users with science-based information that helps them make informed decisions and implement new technologies compatible with their own objectives.

Devolution of the Public's Lands—Trading a Birthright for Pottage

Jack Ward Thomas
Boone and Crockett Professor of Wildlife Conservation
School of Forestry
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Missoula

Just What is Devolution?

When political figures speak of "devolution" of the public's lands, what are they really saying—what do they really mean? Webster's Collegiate Dictionary defines the word as "to pass on (as rights or powers) to another" or "...to degenerate through a gradual change or evolution." Folks, don't be misled by fancy words. This is a fuzzy and fancy way of saying "we aim to give away, sell, trade or transfer the people's lands, those lands owned in common with all citizens, to other entities to own or manage."

A Message from the Heart

Now, right up front, I want to be clear that this presentation comes right from my gut—and from my heart. These lands are so precious to me and, I hope, to the American people that the issue of their ownership transcends arguments over "efficiency" of management, purposes of management or the agency of management. Those matters can and will be debated over and over. But such debates will persist only so long as the lands in questions remain the public's lands.

Right up front, I clearly state, without equivocation, that these are *our* lands today—the lands of all the people. These are *our* lands—they belong to us lock, stock and barrel. And they will be *our* lands and *our* children's and *our* children's children's lands far into the future unless we, as a people, through carelessness or apathy or conscious choice, allow that precious heritage to be sold or traded away for pottage.

Such lands, owned by all the people, are rare in the world and destined to become ever more rare and infinitely more valuable as human populations, gross national products and land values soar. Some believe that nothing so valuable should be owned by a whole people but should instead be "devolved" into other ownership or control to be managed for "higher and better uses" as, perhaps, tree farms, subdivisions, shopping malls, resorts, golf courses, military training grounds, ranchettes, estates or other corporate uses such as industrial forests.

I have no bone to pick with private landowners—corporate or otherwise. This is a discussion about the public's lands and no other.

Some believe that the people as a whole can no longer afford to retain ownership of a birthright of such rapidly increasing value while recognizing that the nation must at last come to grips with the problem of national debt. They deem that selling, trading or transferring the ownership of this birthright to be a rational and desirable act to benefit the American people. The price of past political prolificacy, then, is to be exacted in the trade or sale of the most valuable parts of our land heritage for that mess of pottage.

The Roots of Public Land Ownership

In our nation's youth, there was much land in the public domain and little capital. The nation was built largely by using land in place of standard sources of capital to be mixed with the sweat equity of the pioneers to build the foundation for the nation-building journey that has made the United States the foremost economic and military power in the world—with all that entails.

But as the nation matured, visionaries such as John Muir, Gifford Pinchot, Theodore Roosevelt and others saw the wisdom and need for retention of a significant portion of the rapidly diminishing public domain in the common ownership of the American people. Later, that idea was expanded to the acquisition of additional national parks and national forests in the eastern United States and continuing efforts to "block up" public land holdings through purchase and value-for-value land trades.

From such visionaries and the thousands of conservationists that acted on their insights came the public's lands that exist today. Most of these lands were, upon initial reserve, of little perceived value. And so they remained for many decades—except to those who dedicated their lives to guarding, protecting, nurturing and building those lands into the national treasure in the form that exists today.

Reaction to Proposals of Devolution

I have esteemed colleagues who caution me to calm my admittedly visceral reaction to threats of devolution. They say that there is nothing to these proposals beyond political posturing. Or they say that the American people will never stand for such devolution.

These valued colleagues may be correct. I hope so. But I see too many ongoing actions related to devolution, in one form or another, to remain sanguine. To take these increasingly frequent threats lightly is to take lightly that treasure of public lands that was so carefully created and nurtured for more than a century by our predecessors—and by many in this room. Sadly, it demeans and devalues the careers and dedicated service of the professionals who fought for, cared for and protected those lands for more than a century—and do so today.

I sometimes find myself awake at night wondering what the first Forest Service Chief, Gifford Pinchot, would do in my place. I try to visualize what President Theodore

Roosevelt would have thought of devolution of the public's lands that he so daringly put aside for the American people. I cannot twist away from the answer that comes strong in the darkness: No! By God, No!

Remain calm and silent in the face of these threats? No! By God, No! These various grabs, in all their various forms, for the people's lands should be recognized for what they are—pure and simple—and beaten back. These threats should be so soundly defeated that those who reach out for those lands draw back hands so blistered by the heat of opposition that any further attempts at devolution, in any form, will be deterred for at least a political generation.

The generations of Americans that follow ours undoubtedly will face these same challenges. But if these repeated attempts at devolution are turned back, we will have afforded those generations the option to choose. Such would not be a shabby legacy—that incredibly precious opportunity to choose. Our predecessors left such options to us. They did not fail. We should do no less.

Devolution Can Come in Many Forms

Let me discuss five current and very different ongoing attempts at devolution of the public's lands. These efforts differ in form but not in their effect of transferring something of incredible and increasing value from the public as a whole to other entities. The first two are emerging in Congress and take different forms. Yet, both involve not transfer of ownership but the transfer of the rights to control one or more of the varying sticks in the bundle of rights associated with property ownership. But that too is devolvement—pure and simple.

Activities Originating in Congress

Regulation of public land grazing. The Public Rangeland Management Act that emerged in the Senate in 1996 addressed the enhancement of power of interests that hold grazing permits on national forests and lands managed by the Bureau of Land Management. In the course of various iterations, this bill made grazing a predominant use, transferred water rights, made grazing permits a property right (as opposed to a privilege), imposed standards for altering conditions of grazing permits so stringent as to preclude most such changes, and imposed a grazing fee structure with no obvious detailed assessment or rationale.

That legislation came close to passing the Congress. It will likely be back in one form or another. If such legislation became law, it would not be necessary to hold title to the public's land in order to exert significant control over that land. Such is devolution—pure and simple.

Revamping the National Forest Management Act. Another bill aimed at reform of the National Forest Management Act has emerged from the Senate Committee on Energy and Natural Resources. While this effort has, in my opinion, some good aspects, one Title allows the states, through a convoluted process, to assume management of national forests under state rules. Such is devolution—pure and simple.

That Title begins with the statement that hearings revealed that the states did a "more efficient" job of forest land management than that carried out by the federal land management agencies. The states studied did put more timber on the market faster and cleared more money in the process,. That statement emerged from carefully orchestrated hearings and, in my opinion, a review by the General Accounting Office that was either incompetent or conducted with preordained results in mind The process that was used was grossly flawed and could serve as a textbook example of "comparing apples and oranges."

The states managed forest lands under state laws and rules under trust responsibility to maximize revenue. The federal land management agencies, on the other hand, managed under federal laws and regulations with a multiple-use mandate that specifically required the achievement of a mix of objectives, and not necessarily in a combination that maximized financial return. The appropriate process would have been the comparison of results accruing from management under different sets of rules and mandated objectives—not who was doing the management. However, that gross but carefully constructed distortion would matter little if the bill were to pass. Such are the standards of "gamesmanship" that are applied in the devolution game.

There are recurring arguments over the relative "efficiency" of federal land management. To the extent that efficiency is an issue at all, it should be noted that such could be enhanced quickly and dramatically by establishment of a clear mission for federal land management agencies. It should be recognized that the more simple and straightforward the mission, the more likely that the objectives can be efficiently achieved. That is why the states fared well in the "apples and oranges" comparison.

Through the cumulative effects of a series of poorly related laws, lawmakers have decreed that extensive public involvement, detailed land-use planning, elaborate appeals processes, emphasis on threatened or endangered species, periodic adjustments in plans when "new information" comes to fore, overlapping agency responsibilities, maintenance of water and air quality, consideration of aesthetic values, and maintenance and broad distribution of viable populations of all native vertebrates are all to be achieved while paying attention to utilization of resources such as timber, recreation, grazing, fish and wildlife, and water. In addition, high and increasing levels of micromanagement and oversight by both the Administration and Congress must be dealt with. All of these requirements and activities are considered desirable—or at least acceptable—in the management of federal lands. Such could be altered through Congressional action if efficiency were an overriding concern.

Obvious in the maintenance of the status quo is that the associated loss of efficiency is acceptable, or that some other definition of efficiency is appropriate in this situation. The question of efficiency is not one of who can get timber on the market fastest and make the most money in the process. The more appropriate measure is how well and efficiently the entire job prescribed by law and regulation is achieved—*the whole job*.

The Department of Defense takes a slice. In 1996, the Army announced that maintaining Fort Polk in Louisiana as a viable training facility would require that the Department of Defense take over ownership of the Kisatchie National Forest solely for military use. This threat to close or curtail operations at Fort Polk naturally stirred interests in Louisiana to petition one of their senators to act to transfer control via legislation. This was attempted through a "rider" to another bill—a technique that precluded committee hearings and any public hearings, and might have succeeded with minimal public attention as a *fait accompli*.

As Chief of the Forest Service at the time, I was stunned by the arrogance and power behind that attempted land grab. The Army merely stated that they needed that land to achieve their mission and they simply intended to take it. A senator was willing to take a legislative shortcut to get the job done.

My insistence that the people of the United States had purchased every single acre of that land over years and years of determined effort to fulfill the multiple-use mission of the Forest Service was brushed aside. This attempt at land transfer to the Department of Defense was devolution—pure and simple. This attempt was thwarted, for the moment at least, by negotiating "special-use" arrangements for the military to use the land while leaving stewardship with the Forest Service. This was, in my opinion, a sorry state of affairs—but it was the best that could be achieved under the circumstances. This was not the first raid on national forestland by the military. It likely will not be the last. And when it occurs, such is devolution—pure and simple.

Actions of the Administration

Two efforts by the Administration are underway that potentially involve the sale or exchange of the public's lands or other capital assets of the American people (i.e., the people's property) to achieve immediate political objectives in addressing what are discerned as environmental problems of overriding concern.

The Deal for the New World Mine

The first of these involves a swap of some as yet undefined mix of federal assets—perhaps including national forestland—to "buy out" a Canadian company that proposed opening the New World Mine on the Gallatin National Forest near the boundary of Yellowstone National Park.

In quick response, the State of Montana proposed to the federal government that it sell and exchange selected tracts of high-value timber lands from the national forests to Plum Creek Timber Corporation for adequate cash to help finance the buy out of New World Mine. It was suggested that this action would allow Montana to realize the economic benefits that would accrue if mining proceeded.

Opposition was immediate and strong from Forest Service retirees (who still struggle to protect those lands to which they dedicated their working lives), hunters and fishermen, individuals, and environmental activists that helped cut the deal to make a deal that had brought the proposed mine to a halt. Seeing this opposition and the building controversy, Plum Creek withdrew its proposed participation in a final deal. Are national forests now off the trading block in this situation? That is not yet clear.

The overpowering need for such an unprecedented deal has been difficult for many people to discern, because the ongoing, multiyear preparation of an Environmental Impact Statement was terminated just short of completion when the deal (or a deal to make a deal) was consummated between the Administration, environmental activists and the Canadian company without full public disclosure or public involvement. Cancellation of the assessment process, for whatever reason, precluded full evaluation and understanding of the consequences of any proposed action.

Confusion reigns concerning the circumstances surrounding this deal. There was widespread belief, resulting from extremely sloppy press coverage, that the proposed mining operation was in or immediately adjacent to Yellowstone Park, that the area to be mined was pristine backcounty with potential as wilderness, and that the water drained into Yellowstone Park. Further, only the method of dealing with the mine tailings proposed by New World Mine seemed to be discussed.

In fact, the proposed mine was several miles from Yellowstone Park on the Gallatin National Forest, in a drainage that had been mined since before the turn of the century and now produces significant acid mine drainage. The water from that drainage does not run into Yellowstone Park. And a number of other alternatives for disposal of the mine tailings were being examined in the truncated environmental assessment process.

This is not to say that the proposal to activate the New World Mine under the 1872 Mining Law was without problems. There were serious problems to be confronted. But it is to say that the facts never emerged in a fashion that could be evaluated carefully and openly to allow the public to judge the efficacy of the deal to buy out the mine. Well, so be it.

The larger question concerns the wisdom of setting two extremely dangerous precedents. Buying out a mine on public lands made possible by the 1872 Mining Law and considered unacceptable from an environmental or political standpoint might well set off a chain of events that could reverberate with mine after mine being proposed, with the possibility of "mining the treasury" as a viable alternative to actual mining. And if dollars are not available to make the deal, there are always national forests or other public assets to consider tossing on the bargaining table as trading stock.

Since when are national forestlands considered an expendable commodity? I love the national parks and consider them inviolate. However, for the reasons that suit me as I relate to our public land heritage, I cherish the national forests even more. The national forests should be considered equally inviolate.

Just maybe, it might be more to the point to take on the 1872 Mining Law. Now, that would take some real political courage.

The Headwaters Old-growth Redwood Deal

In Northern California, the Administration is involved in working out a deal to acquire a tract of old-growth redwood forest from MAXXAM Corporation in order to preserve that tract from logging. In a complex deal involving MAXXAM Corporation, other timber companies, the State of California and the federal government, it has been proposed that select tracts of national forest in California be sold or traded to large timber companies to provide some of the purchase price for the old-growth tract.

Pressing Concerns and Viable Alternatives

Of particular interest are the potential consequences of the precedents set by using national forestland as trading stock in such deals and the as yet unrevealed consequences—ecological, economic and social—of such actions. Some folks, including me, have serious reservations as to the legal authorities that would allow such a purchase or exchange, particularly as the area to be acquired lies outside of any established national forest boundary.

Why use such convoluted, tortuous and legally questionable approaches? Why not simply use the money and authorities in the Land and Water Conservation Fund? In theory, some $11 billion reside in that fund which have not been appropriated. Well, forget those dollars. They have long since been absorbed into debt service.

Still, Congress can appropriate up to $900 million each year for land acquisition from this fund. However, in 1997, only $150 million were so appropriated. If the Headwaters redwood tract is so critical to bring into federal ownership, why not simply propose the purchase of these lands using the Land and Water Conservation Fund and let Congress act on the merits of the proposal?

I cannot believe that piecemeal sale or exchange of national forests or other public lands is an appropriate or, perhaps, even legal means of achieving such ends. And this approach seems contrary to the clear expression of the national policy of retention of the public's lands in public ownership as set forward in the Federal Land Policy and Management Act of 1976.

These deals are so complex and convoluted (to the extent that all the details are known) as to boggle the imagination, at least my imagination, and leave myriad unanswered questions as to legal ramifications, assessments of values, appropriate processes, environmental assessment, precedents established, legal authorities and other ramifications. Before such deals become established through precedent as an acceptable way of doing business, perhaps all concerned should subject themselves to the equivalent of a cold shower and then seek the explicit approval of and assurance from Congress that such approaches are appropriate, legal and ethical means of federal land acquisition and, more significantly, land disposal.

Obviously, there is an increasing temptation for political operatives to trade off public assets to achieve political objectives of the moment. Is such wheeling and dealing simply a first step in using the public's lands as an expendable medium of exchange in other such deals—i.e., are these deals merely harbingers of things to come? This is a very new political game. But, stripping away the hype, such is devolution—pure and simple.

You can bank on one thing if devolution of the public's lands proceeds, particularly those lands in your national forests. Individual citizens of modest means will never own an acre of that land. That land, *our land*, will go to large corporations or other entities who can afford the price and have the connections to attend the "auction."

No! to Devolution

Our land is all the land that most Americans of modest or lesser means will ever own outside of our house lots. As such, that land is simply too precious to be a bargaining chip in one expeditious deal after another. That may be solely my opinion, but I don't think so. I really don't think so.

When I was Chief of the Forest Service, I had occasion to appear before a Congressional Committee. The Chairman, whom I respect, asked me what I thought of the debate over the devolution of the public's lands. I asked permission to answer in two veins—as Chief and as ordinary citizen. He nodded assent. The Chief's reply was as you would expect and likely much in the manner that any of my predecessors would have used.

My personal reply was different and went something like the following (though this version may be a bit more polished). "Mr. Chairman, I was born and raised in Texas—a state with but little of the public's lands. Hunting and fishing and roaming the woods were my passions then and remain so today. But as my family had little land and little money, the exercise of my passions depended on begging permission or sneaking (I certainly could not afford to pay for the privilege). I became adept at both, but relished neither. I grew up to become a wildlife biologist and duly gave up sneaking when I attained gainful employment with the Texas Game and Fish Commission. Begging was still in order, as there was no way for me to afford to purchase hunting privileges.

"After working in Texas for 10 years, I was employed by the U.S. Forest Service to work in West Virginia. There, at age 32, 1 set foot on a national forest for the first time. This land was my land, land owned in common with all my fellow citizens. For the first time in my life I did not have to beg, I did not have to buy and I did not have to sneak in order to roam the woods. This land was my land. I could go as the spirit moved me. The feelings of pride, ownership and gratitude to my forefathers that came over me that day are with me still. It seemed to me then, as it still does, a wonderment.

"Mr. Chairman, speaking for myself as part owner of the public's lands, I do not consider any of my heritage available for devolution. I believe that I can speak for my grown sons. I will take the liberty of speaking for my grandchildren who are not too articulate just yet and even for their children that will not be born for 20 to 30 years.

We will oppose any loss, any diminution, any giveaway and any sale of our birthright in the public's lands."

The Chairman smiled and asked, "Chief, how do I get the impression that your answers are, in order, No and Hell, No!?"

The Chairman was dead on target. My answer then, now and tomorrow is not only "No" but "Hell, No!" That's it—pure and simple—Hell, No!

National 4-H Wildlife and Fisheries Volunteer Leader Recognition Awards, 1996

Sandra Clemence, ***Snohomish, Washington***

Sandy is a homemaker and has been a 4-H volunteer leader for the past nine years, providing leadership for youth involved in a variety of projects. For the past two years, She has coordinated Washington's most popular natural resource event—the River Salmon Tours—reaching approximately 2,000 K through 12th graders and 700 adults annually. She has been the statewide coordinator of training for the Wildlife Habitat Evaluation Program for the past three years, and the program is improving in quality and number of participants under her care. Sandy's family of two teenage daughters, a younger son and a supportive husband are a high priority, and she extends her family values to the youth she reaches through 4-H. A talented giver, teacher, leader and mentor, Sandy plans to continue serving as a volunteer leader for many more years.

Joel Glover, ***Rockford, Alabama***

A biologist with the Alabama Department of Conservation, Joel has been a 4-H volunteer leader for the past six years. He assists the county extension agent in coaching the Wildlife Habitat Evaluation Program team, helps with county 4-H forestry events, serves as an instructor for the Shooting Sports program and as a judge for the 4-H photography contest. Joel states, "One of the most rewarding aspects of the program is to witness the progress our students make....It is gratifying to watch as the students grasp the concepts and grow in their knowledge of wildlife species, wildlife habitat management, etc. It delights me to see the progress from year to year that our kids make in their writing and studying abilities." The Alabama Wildlife Federation selected Joel as their Wildlife Conservationist of the Year in 1995.

Debby Martin, ***Steens, Mississippi***

A 4-H volunteer leader for 18+ years and a Soil Conservationist for the Natural Resources Conservation Service, Debby states, "What I like to do best is to get kids outdoors to do hands-on, experiential learning activities." Debby has been deeply involved with the county horse project club, land judging, shooting sports and training other adults as project leaders, but the 4-H wildlife project has brought her the greatest reward. Her first team competing in that project won first in their state and sixth at the National Invitational Wildlife Habitat Evaluation Contest in Alabama. Debby has since trained three more teams of winners and national competitors, and she plans to continue teaching kids about natural resources.

Glen Terry, ***Gillette, Wyoming***

Glen is a rancher who has served as a 4-H volunteer leader for the past 11 years. He is a Shooting Sports leader certified in rifle, pistol, shotgun, archery, muzzle loading and hunting. Attending the statewide training held in Laramie and incorporating what he learned in his county, Glen was instrumental in getting the Wildlife Habitat Evaluation Program started in Wyoming. In 1994, he was chosen to attend the NRA Whittington Center in Raton, New Mexico, for 4-H Shooting Sports Leader Training, and he has been the state leader trainer in the hunting discipline for the last five years. Glen is also a Wyoming Hunter Safety Instructor, a volunteer fire fighter, and serves on the Board of County Commissioners.

Joe Walters, Jr., ***Franklin Parish, Louisiana***

Joe is the Parish Sales and Use Tax Director for Franklin Parish and has been a 4-H volunteer leader for 13 years. His individual experiences and accomplishments as a 4-H Wildlife and Fisheries leader cover several pages. Some of the highlights are assisting with area hunter safety training, conducting cast iron outdoor cooking clinics, coordinating Wildlife Habitat Training, participating in Project Wild Training programs, and presenting programs on bird banding and purple martin research. About six years ago, he began a program known as "Wild Woods Wandering" that includes units on forestry, soil conservation, wildlife management, agricultural environments, water quality, soil sampling and pesticide usage. Joe's admirable long-range goal is to make it possible for every 4-Her in Louisiana to have the opportunity to participate in "Wild Woods Wandering" or related hands-on wildlife and fisheries projects.

Jack Weiland, ***Holyoke, Colorado***

Jack is a District Wildlife Manager for the Colorado Division of Wildlife and has been a 4-H volunteer leader for the past six years. Jack has assisted 4-H members in raising pheasant chicks, archery education, shooting sports, and beginning studies in fishing, fish environments and exploring wildlife and small game. Also a Hunter Safety instructor involved in waterfowl and fishing projects, his future plans include work with the Wildlife Habitat Evaluation Program. Jack is involved in many organizations that target youth groups because he feels that wildlife and environmental education presented to our youth today will help them make better, well-educated decisions in the future with regard to environmental issues such as the human population explosion, loss of habitat for threatened and endangered species, loss of rain forests, pollution, etc.

THE 1997 GUY BRADLEY AWARD

Whitney Tilt
National Fish and Wildlife Foundation
Washington, D.C.

Crimes against wildlife occur 365 days a year. The poacher doesn't keep a 9 to 5 schedule and likely will work at night or on holidays. Foul weather that grounds aircraft is likely to lure the outlaw gunner out. These are the hours and the weather conditions under which the Wildlife Conservation Officer works. Together with biologists, habitat managers, and host of other state and federal land management professionals, wildlife conservation officers are the "thin green line" dedicated to conserving this nation's fish, wildlife and plant resources for future generations. In recognition of law enforcement's role, the National Fish and Wildlife Foundation presents the Guy Bradley Award.

The Guy Bradley Award was established by the Foundation in 1988 to recognize the contribution of the law enforcement community to conservation. The award is given annually to the 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.

Over the years, the Guy Bradley Award has recognized state and federal law conservation officers, forensic scientists, the Department of Justice, and corporations, all of whom have received a commemorative plaque, together with a check for $1,000. These recipients are representative of the many dedicated individuals and corporations who deserve recognition.

This year, the Foundation is pleased to recognize Vernon Ricker.

Vernon G. Ricker, U.S. Fish and Wildlife Service

Vernon Ricker serves as a Special Agent with the U.S. Fish and Wildlife Service in Salisbury, Maryland. He has worked as a wildlife conservation officer for the past 27 years and has given his all in the protection of wetlands, waterfowl, migratory birds and other wildlife.

Vernon began his wildlife career as a seasonal employee at Assateague Island National Seashore before being hired as a wildlife enforcement officer with the Maryland Department of Natural Resources. Officer Ricker was honored as Game Warden of the Year in 1974 for the State of Maryland. Beginning in 1976, Ricker was hired away from Maryland DNR by the U.S. Fish and Wildlife Service where he has served as a Special Agent throughout the United States with work ranging from the protection of peregrine falcons in Alaska to waterfowl enforcement in the Lower Mississippi Valley and Chesapeake Bay.

Special Agent Ricker is uniformly praised by his colleagues for his fairness, intelligence, hard work and perseverance in the face of adversity. He has repeatedly risked his own life in the line of duty, often pursuing armed poachers alone and on foot in order to make an arrest. Agent Ricker is equally adept and accomplished in the courtroom, where he is known for meticulous case preparation and presentation and a conviction percentage that reflects this personal dedication. For a career of dedicated service to conservation law enforcement, the Foundation is proud to present the 1997 Guy Bradley Award to Vernon Ricker.

The Guy Bradley Award:
A Decade of Conservation Law Enforcement Excellence

1988	Granville Ross, Virginia Game and Inland Fish Department
1989	Terry Grosz, U.S. Fish and Wildlife Service
1990	Rex Corsi, Wyoming Game and Fish Department
	Ben Moise, South Carolina Wildlife and Marine Resources
1991	Bob Brantly, Florida Game and Fresh Water Fish Commission
	Dave Hall, U.S. Fish and Wildlife Service
1992	Ronald Lahners, U.S. Attorney's Office, Department of Justice
1993	Tom Moore, Wyoming Game and Fish Department
	Richard Moulton, U.S. Fish and Wildlife Service
1994	Ken Goddard, National Forensics Laboratory, U.S. Fish and Wildlife Service
1995	John Cooper, U.S. Fish and Wildlife Service
	PacifiCorps, Portland, Oregon
1996	David Klabak, Wisconsin Department of Natural Resources
1997	Vernon Ricker, U.S. Fish and Wildlife Service

Special Session 1. *Extension Outreach: A Link to Resource Sustainability on Private Lands*

Chair
ROBERT L. RUFF
University of Wisconsin
Madison

Cochair
JAMES E. MILLER
USDA Cooperative State Research, Education, and Extension Service
Washington, D.C.

Opening Remarks

Robert L. Ruff
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Good afternoon and welcome to this special session entitled, "Extension Outreach: A Link to Resource Sustainability on Private Land." My name is Bob Ruff. For the past 27 years, I have served as Extension Wildlife Specialist in the Department of Wildlife Ecology at the University of Wisconsin-Madison, with a three-way split appointment in research, instruction and extension; and for the past 10 years, I have also served as Chair of that same Department.

It has been 20 years since Extension Specialists were last accorded a special session dedicated to their programs at this conference. Several individuals and groups are responsible for making this happen, most notably the Extension Specialists themselves for building the credibility and stature into their programs that enabled leaders of the Cooperative State Research, Education, and Extension Service (CSREES) and the National Association of Fish and Wildlife Programs (NAUFWP) to support such a session with the program committee of this Conference. I thank them for their efforts. For those of you who specifically elected to participate in this session, thank you for coming; your attendance is appreciated. For those who wandered in by accident, please stick around; I am positive you will find it interesting and applicable to your particular programs and locales. The authors of the eight papers included in this session come from around the country, the themes of their papers cut across a variety of issues, their programs utilize an array of methodologies and culminate in real contributions toward resource sustainability on private lands.

The theme of this year's North American Wildlife and Natural Resources Conference, "Finding Common Ground in Uncommon Times" is an entirely familiar one for anyone involved in natural resources conservation today. Indeed, for those of us in Extension, this could well be our theme song. We are seemingly on an endless quest to find common ground in nearly every situation we encounter. In fact, the soft drink commercials that feature the line, "been there, done that," probably borrowed it from an Extension Specialist long ago. But today, signs of uncommon times ahead are becoming more numerous and ominous. Our clients, the citizens and taxpayers of this county, are asking for more and improved services coupled with diversity of choices. They demand greater accountability, and they expect the delivery of services to come with a measure of enthusiasm, integrity and sensitivity to client age, gender, ethnicity, culture, and tenure on the land. At the same time, budgets are shrinking, downsizing is a reality for nearly all of us, and plans for restructuring and reorganization are everywhere as bureaucrats and academicians alike attempt to deal with the rough, if not uncommon, times ahead.

And did I mention the growth, composition and distribution of human populations? Two nights ago, I logged onto the World Wide Web and checked the World POPClock one last time before coming to this gathering. There on the screen was the number 5,828,111,000 for the globe and 266,868,000 for the United States, and counting. Most of us would have extreme difficulty envisioning what a million people may look like, much less a billion. So, to imagine the addition of 90 to 100 million to the planet each year, or a billion per decade, is nearly beyond our comprehension. Yet, with these numerical bases, even with projected declines in growth rates, we will add another United States (270 million) to the global population in just two and a half to three years; and another Wisconsin (5.3 million) or six Montanas (890,000) to the U.S. population in the same time frame! This means that when we again convene this conference in Washington, D.C. four years hence, we will have added the population equivalents of another U.S. and three Canadas to our global society. These days, when we speak in ecosystem and landscape scale constructs, we often acknowledge that the addition of so many organisms to a finite land base could have dire consequences. Do we yet appreciate the enormity of the problem or its consequences as it relates to people? Many feel we do not (Meffe et al. 1993, Meffe 1994, Gehrt 1996). One of our speakers will discuss these demographics and what they will mean to our management and educational programs in the future, so I will not belabor the point. Uncommon times truly are ahead; I encourage you to listen attentively.

The issue of private lands and resource sustainability on them will become increasingly prominent with a finite land base and escalating human numbers. Private holdings comprise about 70 percent of the land area in this country, so it is patently clear that the scale of ownership and the mindsets of the owners are and will continue to be critical in the context of resource sustainability. This, of course, is not new ground; more than 65 years ago at this very conference, Leopold (1930: 286) implicated the private landowner as key to management (i.e., sustainability) "...because he is the only person who resides on the land and has complete authority over it." Although the promulgation of contemporary laws and policies now question whether anyone has complete authority over the land, the owner still does retain substantial control over management of the land and access to it. Consequently, as biologists acting in concert with agency programs, we embarked on a course of providing landowners with a myriad of monetary and technical incentives to practice land management. Some of these programs succeeded, while others failed, some rather badly. Why? What was missing? Leopold (1949: 204) suggested it may have something to do with a land ethic, or lack thereof:

> "The land ethic...enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land....A land ethic of course cannot prevent the alteration, management, and use of these 'resources,' but it does affirm their right to continued existence, and, at least in spots, their continued existence in a natural state. In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land community to plain member and citizen of it."

Leopold (1949: 209-210) further asserted: "No important change in ethics was ever accomplished without an internal change in our intellectual emphasis, loyalties, affections, and convictions." Clearly, a change in attitude and temporal perspective of private landowners toward the land was being summoned.

Four decades later, Orr (1992) expressed similar views in the context of sustainability as he compared two meanings of the term, technological and ecological. He noted that proponents of ecological sustainability "...aim to restore civic virtue, a high degree of ecological literacy, and ecological competence throughout the population" (Orr 1992: 31). In essence, Extension personnel have been attempting to do this since our inception. We have always provided research-based knowledge to private landowners to help them in decision making; this has been our central mission and hallmark. Sometimes, however, we did this piecemeal by emphasizing our preferred disciplinary options over some others, and many of the government-sponsored programs we supported were short term in both vision and application. I am, therefore, pleased to report that the Cooperative Extension Service has more recently adopted sustainability as a central theme in its vision and educational programs for the future. Specifically, the mission of the Natural Resources and Environmental Management (NREM 1994: 2) program is to educate "...a diverse people to make decisions and take actions to improve the quality, productivity and sustainability of natural resources." Uncommon times prompted this development, and I believe it will help us immensely as we seek common ground in the environmental education arena and push toward sound land stewardship over the long term.

Precisely how we partner and cooperate with one another to achieve this goal, whether at the individual or agency level, remains to be seen. Nonetheless, I admonish each of you to accept the direct and sometimes visceral challenges put forth by nearly all speakers at this morning's session that we truly engage in serious partnering and collaborative efforts toward achieving sustainability of natural resources on both private and public lands. It is, after all, the right thing to do. For the balance of this special session, we will showcase selected Extension programs that have worked well to influence private landowner attitudes and the practice of land stewardship in positive ways. In this respect, they provide the requisite links to resource sustainability on private lands.

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Extension's Role in Achieving Hunter, Landowner and Wildlife Agency Objectives Through Utah's Big Game Posted Hunting Unit Program

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In the United States, private landowners control more than 60 percent of the land base (Langner 1987, Wigley and Melchiors 1987, Gerard 1995). As such, publicly owned wildlife inhabits and is dependent on the habitat resources found on private land. Although national policies may influence regional land-use decisions (Gerard 1995), landowners retain the right to manipulate their land (McDivitt 1987, Morrill 1989). Transferable property rights give landowners influence over the quality and quantity of the existing habitat base (Horvath 1976, Conover 1994, Gerard 1995).

Most landowners have little economic incentive to manage their land for wildlife (Noonan and Zagata 1982, McDivitt 1987, Morrill 1987). Although public and private wildlife management agencies and conservation organizations have implemented programs to encourage wildlife management public access on private lands (Wigley and Melchiors 1987), lack of collaboration between management agencies (Gerard 1995) and landowner concerns about damage caused by wildlife have reduced overall program effectiveness (Wade 1987).

In 1994, Utah farmers and ranchers may have lost in excess of $5 million because of wildlife damage in their alfalfa fields (Messmer and Schroeder 1996). In many states, wildlife damage to agricultural crops may have reached levels that discourage many private landowners from managing for wildlife on their property (Conover 1994, Conover et al. 1995). Further complicating this issue is the landowner's perception that wildlife managers are unaware of the extent of agricultural losses and thus insensitive to their needs (Decker et al. 1984, Conover and Decker 1991).

As the number of outdoor recreationists using public lands increase, the value of private lands as recreational areas will continue to grow as will the associated trespass problems (Driver et al. 1986, Langner 1987, Morrill 1987, Wiggers and Rootes 1987). In the U.S., the increased demands for hunting areas and the decreasing supply of wildlife habitat (Doig 1986) have nurtured the growth of fee hunting (Wallace et al. 1989).

Fee hunting was recommended by the American Game Policy Committee as a logical way to compensate landowners for wildlife production and public hunting on private lands (Leopold 1930). However, many state agencies have not promoted fee hunting because of the belief that it will decrease hunter recruitment, direct people away from land-based outdoor recreation (Swenson 1983, Wiggers and Rootes 1987, Benson 1989) and thus, erode the public's interest in wildlife conservation (Geist 1985, 1988). Proponents argue that fee hunting will increase net public benefits by creating an economic incentive for landowners to conserve wildlife habitat and result in a reapportionment of hunters and enhanced hunter access (Porter 1982, Wallace et al. 1989).

Traditional fee hunting programs are more prevalent in eastern areas of the U.S. where little public land exists (Wallace et al. 1989). To address wildlife depredation, hunter demand, hunter access, habitat degradation and urbanization issues, wildlife agencies in the West have implemented alternative hunting access programs that are designed to provide direct benefits to hunters, landowners and the resources (Gonzales 1989, Larson and Bunnell 1989, Loomis and Fitzhugh 1989, Messmer and Shields 1994, Lloyd et al. 1995).

Utah's Alternative Hunting Access Program

In 1939, the Utah Game and Fish Department (now the Utah Division of Wildlife Resources) initiated one of North America's first agency-sponsored alternative hunting access programs called "posted hunting units" (PHUs). The PHU program was developed to address landowner concerns and hunter access issues involving the ring-necked pheasant (*Phasianus colchicus*). Although 72 percent of Utah is public land, pheasants and pheasant hunting are dependent on privately owned irrigated land (Larson and Bunnell 1989). This dependence on private property and the associated recreation demands caused conflicts between wildlife, landowners and sportsmen. The pheasant PHU program was implemented to enhance wildlife habitat and populations on private land, control hunter access, decrease landowner property damage and increase landowner revenue from recreation provided on their property. Only hunters who purchased permits from a landowner association were allowed to hunt PHUs. Interest in the program peaked in 1963 when more than 51,000 permits were sold to hunt on 682,500 acres (273,000 ha) (Larson and Bunnell 1989).

In 1988, a Utah public wildlife/private lands task force was formed to resolve similar concerns regarding big game populations. The task force recommended expanding the pheasant PHU concept to include big game species. In 1990, the Utah Division of Wildlife Resources (UDWR) implemented a three-year experiment to evaluate big game PHUs (BGPHUs). This program was subsequently codified by the Utah Legislature (Laws of Utah 1993).

BGPHUs are authorized for the specific purpose of managing moose (*Alces alces*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*) and pronghorn (*Antilocapra americana*) on private rangeland in Utah. In addition to meeting certain size and composition requirements, BGPHUs must have written management plans and provide limited public access to private lands for hunting big game. In return, BGPHU operators and landowners are given flexibility in hunting dates and a choice of permit allocation options designed to achieve UDWR big game herd population objectives.

Utah residents can obtain BGPHU bucks/bulls and antlerless permits through a public drawing. Nonresidents may only apply for antlerless permits. Successful applicants are provided free access to private lands enrolled in the program for which the permit was drawn. Additional amenities (e.g., guide services, meals, lodging) may be provided by the BGPHU for an additional fee. Permits also may be obtained through BGPHU. Under program rules, participating landowners or operators may charge clients fees for access and/or amenities above the cost of the permit. These permits are available to both residents and nonresidents and include bucks/bulls and antlerless hunts.

We present a case study of how university-based wildlife extension programs continue to work with Utah partners to address wildlife resource management issues involving crop depredation, recreational access, trespass, property damage and habitat management on private lands. In particular, we will discuss the role wildlife extension specialists play in conducting research and extension education programs to achieve landowner, hunter and wildlife agency objectives through a state-regulated alternative hunting access program.

Extension: A Front-line Partner in Wildlife Conservation

Extension is an informal education system that endeavors to empower people to apply scientific information, new technologies and alternative practices to solve immediate problems and identify and achieve long-term goals (Boone 1989). Unlike state or provincial wildlife management agencies, extension is nonregulatory. The success and effectiveness of extension education programs is directly related to the nonregulatory nature and origin of the extension system. When charged with enforcing government rules and regulations, extension educators run the risk of losing the client's trust; a trust that is essential to the creation of a dynamic and collaborative learning environment.

Aldo Leopold first recognized the vast potential of the Extension system in achieving wildlife conservation and landowner stewardship goals (Meine 1987). In addition to providing an important measure of trust, the Extension system touches every phase of agriculture and ultimately the individual farmers and ranchers who have the greatest potential to affect wildlife resources on a daily basis (Leopold 1929).

Extension's Role in BGPHUs

Utah State University (USU) Cooperative Extension Service wildlife and range extension specialists served on the Utah public wildlife/private lands task force that developed the experimental BGPHU program. In 1994, after the program was codified, the USU Extension Service published a BGPHU directory that was prepared by wildlife extension specialists in cooperation with the UDWR biologists. The directory contained information about the type of hunts and services available through the BGPHU program. Directories were distributed to the public through county extension and UDWR regional offices.

To determine if BGPHUs were achieving desired hunter, landowner and wildlife management agency objectives, we subsequently surveyed hunters and landowners/operators who participated in the program during 1994 to determine their level of satisfaction. This information assisted the UDWR and the USU Extension Service to identify program strengths and weaknesses. The survey results were used to guide the development of BGPHU educational and regulatory programs so the benefits to the wildlife resource, recreational interests, the wildlife agency and the landowner would be preserved (Morrill 1989).

Survey Methods

In December 1994, we mailed a self-administered questionnaire to all public and private hunters who received a permit to hunt a BGPHU during that year (n = 2,700) and to all participating BGPHUs (n = 45). Private hunters were defined as those individuals who received their hunting permits from a BGPHU operator, landowner, guide or outfitter, or through a conservation permit auction. Public hunters received hunting permits through the public drawing. Each mailing contained a cover letter, the questionnaire and a business reply envelope. A second mailing was sent to all nonrespondents six weeks later.

To determine if BGPHU public and private hunters differed in their hunt expectations and perceptions, we asked them why they chose to hunt a BGPHU. In addition, to determine if both groups of hunters were treated similarly by the BGPHUs, we asked them to identify what amenities were provided for them either free or for a fee, the number of days they were allowed to hunt and if advice on areas to hunt was given. Hunters also were asked to rate their hunting experience in terms of overall quality, the amount of time allowed to hunt, the time of the year the hunt was conducted, the information provided about the hunt, the number of other hunters encountered and overall satisfaction.

To assist us in planning and conducting educational programs for BGPHUs, we asked landowner respondents to rank a series of management issues from 5 to 1 (5 = highly important and 1 = not important) regarding the importance to their operation. Finally, landowner respondents were asked if they would be interested in joining an association that would work to enhance wildlife-based economic opportunities and increase associated recreational opportunities on private lands.

BGPHU Survey Responses

Hunter Response and Perceptions about BGPHU Hunts

Fifty-two percent of the hunter questionnaires (n =1,404) were returned, of which 91 percent (n = 1273) were usable for analysis. Although there was general agreement that BGPHUs provide higher quality hunts, private hunters were more interested in trophy hunts (47 percent) than were public hunters (20 percent). The desire to avoid hunter crowding (> 56 percent) also influenced respondent decisions to apply for a BGPHU hunt. More public (31 percent) than private (15 percent) hunters were aware of the BGPHU directory.

Services Provided Hunters by BGPHUs and Hunter Satisfaction

BGPHU landowners/operators are required to provide public hunters with equal access to recreational opportunities, not equitable services. Although guided hunts, meals, lodging, animal retrieval and camping are amenities that private hunters were more likely to pay for, these services also were provided free to both public and private hunters by some BGPHUs. There was no difference in the number of weekend days hunted (mean days = 2.3) or total days allowed to hunt (mean days = 10.0) between private and public hunters. BGPHU operators offered advice to 67 and 73 percent of the private and public hunters, respectively. Most of the private (58.0 percent) and public (62.0 percent) hunters found this advice useful.

In general, public hunters were more satisfied than private hunters regarding overall hunt quality and their hunting experience. Public and private hunters were equally satisfied regarding the timing of the hunt, information received about the hunt and the number of other hunters encountered (Messmer unpublished data).

BGPHU Operator Responses

In 1994, 60 percent of the responding BGPHUs were operated by more than one landowner. Respondents indicated that increased flexibility in hunting dates (54 percent), improved hunter access management (46 percent), increased input in wildlife harvest management (40 percent), better enforcement of trespass and increased economic income (36 percent), habitat improvement (32 percent), compensation for wildlife damage (21 percent) and guaranteed permits (14 percent) were the primary reasons for participating in the program. Most BGPHUs (80 percent) monitored wildlife populations and habitat conditions as part of their management plan. BGPHU landowners indicated that information (5 = highly important to 1 = not important) on monitoring wildlife habitat (3.9), developing management plans (3.8), monitoring wildlife populations (3.7), habitat management (3.7), public relations (3.7), creating an association (3.6) and risk management (3.5) were priority needs. Information on marketing (3.0) and hunter management (2.9) were considered less useful. Most respondents (93 percent) expressed an interest in forming an association.

Developing a Proactive Approach to Achieve Management Objectives

Recognizing that private lands have become more important in maintaining hunting recreational opportunities (U.S. Department of Interior 1991, Lloyd et al. 1995) and that decreased access resulting in increased crowding contributes to declining hunter participation (Wright and Kaiser 1986, Austin et al. 1992), most states have implemented programs that encourage landowners to cooperate in developing, maintaining or improving fish and wildlife habitat (Musgrave and Stein 1993). Although many public wildlife management agencies have stopped short of promoting fee hunting and landowner compensation programs (Wigley and Melchiors 1987), some western states have implemented alternative hunting access programs (Gonzales 1989, Larson and Bunnell 1989, Loomis and Fitzhugh 1989, Messmer and Shields 1994, Lloyd et al. 1995).

Alternative hunting access programs that enhance hunting opportunities for public and private hunters may be an important incentive to link hunters with wildlife and recreation on private land and landowners with habitat improvement programs (Benson 1989). One of the expected benefits from traditional fee access hunting programs is that landowners will be provided an incentive to implement land-management practices beneficial to wildlife (Leopold 1930). Previous to the BGPHU program, few Utah landowners operating fee hunting access enterprises had ever consulted with the UDWR when planning their wildlife or habitat management activities (Jordan and Workman 1990). Although BGPHU landowners may still view their livestock enterprises as their central focus, our study suggests their interest in managing wildlife habitat on their property has increased considerably.

During 1994, participating BGPHU public hunters had the opportunity to hunt 30 percent (1.1 million acres) of Utah's privately owned rangelands (Messmer and Shields 1994). Public hunters who hunted BGPHUs in 1994 experienced less hunter crowding, increased chances of harvesting an animal and the opportunity for a better quality hunt (Messmer unpublished data). Previous studies of resident Utah deer hunters suggest that crowding negatively affects hunt quality regardless of whether hunters were on public or private land (Krannich and Cundy 1989, Austin et al. 1992).

Although a directory containing information about the types of BGPHU hunts available was published in 1994 to assist hunters in applying for hunts, our study indicated that few hunters knew about the directory. This may have been partially the result of hunter unfamiliarity with a new program and a distribution system that only included county extension (n = 26) and UDWR regional offices (n = 5). To address this problem, the BGPHU directory is now published as part the UDWR's annual big game proclamation. The proclamation is distributed through UDWR regional offices, hunting license vendors and sporting goods retail outlets statewide.

Utah's BGPHU Association

To address BGPHU landowner/operator management information needs, USU extension wildlife specialists worked with interested landowners to organize an association. In 1996, the Utah BGPHU Association (Association) was incorporated under the laws of the State of Utah and obtained 501c(6) status under IRS tax codes as a nonprofit business association. The primary purposes of the Association are to facilitate sustainable management of wildlife populations and the privately owned lands they inhabit, and to foster a spirit of cooperation between private and public agency land managers to the benefit of both wildlife and the public (Messmer 1996).

The Association currently represents 72 percent (45) of Utah's BGPHUs. It operates under membership-approved bylaws and is governed by a duly elected Board of Trustees. The trustees meet quarterly with USU wildlife extension specialists to conduct Association business and plan two annual meetings/workshops for members, interested landowners, UDWR personnel and sportsmen. A USU wildlife extension specialist currently serves the Association's executive secretary/treasurer. In this capacity, the specialist assists the trustees in conducting daily business, scheduling annual meetings and planning educational workshops.

Association annual regular membership dues are $100 per BGPHU. These dues are used to support Association educational and public relation programs. In addition to regular memberships, the Association offers affiliate memberships to county extension agents, UDWR biologists, and other groups or individuals that are interested in working to achieve the organization's stated purpose.

Association summer workshops are conducted on participating BGPHU farms and ranches. These workshops consist of a tour of the host farm or ranch to review management goals and habitat enhancement practices that have been or will be implemented. Workshop participants also discuss management plan preparation and learn population and habitat monitoring techniques. The winter workshop is the Association's annual business meeting. During this meeting, members review and discuss proposed program changes, elect new trustees and vote on proposed Association policies and/or actions.

The Association, in cooperation with USU wildlife extension specialists and the UDWR, conducts a statewide BGPHU public awareness program. In 1995, USU wildlife extension specialists produced a BGPHU slide-set presentation and a brochure to inform Utah hunters and nonhunters about the program and its benefits. During 1996, the slide-set reporting the results of the 1994 survey was presented at all regional wildlife advisory meetings held throughout Utah. In addition, more than 5,000 copies of the extension brochure published to answer questions about the BGPHU program were distributed statewide.

Principles for Developing Alternative Hunting Access Programs

The Utah BGPHU experience suggests that alternative hunting access programs can benefit hunters, landowners and the resources. We recommend that wildlife agencies consider five basic principles when developing policies to implement similar programs: (1) ownership of wildlife must remain public; (2) distribution of harvest opportunities must be equitable, therefore control of the harvest must remain with the legally responsible state wildlife management agency; (3) responsibility for wildlife management must remain with wildlife professionals; (4) participating landowners must be given the opportunity to provide input into management decisions that affect their property; and (5) university-based cooperative extension programs should be included in the development, evaluation and educational aspects of program implementation. We believe that wildlife agencies working in close concert with the extension educators could better position themselves to provide landowners with the information, guidance and leadership necessary to develop alternative hunting access programs that will balance the concerns of the landowner with the public's interest in wildlife, while meeting the biological needs of wildlife populations (Leopold 1929).

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Wildlife in the Classroom: An Overview of Texas 4-H Wildlife School Enrichment Programs

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Environmental education programs first appeared in the 1960s as a result of an increasing awareness of environmental deterioration (Klein et al. 1994). These efforts were further intensified because educators recognized the lack of knowledge that school children possessed in the environmental arena (Studebaker 1973). The central goal of these programs has been to give young people a clear appreciation of socioenvironmental problems (Pearson 1971).

Formal school programs focusing on wildlife and other natural resources became a major theme of more recent environmental education efforts. However, the wildlife views held by most Americans appear to be based on limited factual understanding and awareness (Kellert 1980). One must be informed in order to respond intelligently to today's environmental problems (Alaimo et al. 1980).

The lack of knowledge about natural resources and the environment is not limited to school children or the public in general, but teachers as well. Teachers are with students daily and are in an ideal position to mold their thinking relative to wildlife and fisheries resources (Taylor et al. 1975, Burts 1977). Unfortunately, most teachers lack training in the concepts of wildlife and fisheries conservation and management, resulting in a low comfort level with the subject matter (Hooper 1988). Teachers have identified these inadequacies as a primary reason environmental education has not been taught on a more frequent basis (Lane et al. 1994).

Lewis (1981) and Adams et al. (1990) recommended in-service training as a mechanism to educate teachers concerning natural resources subject matter. However, these programs must compete for limited time with state- and district-mandated curriculum workshops. Otherwise, teachers must attend on their own time (e.g., weekends, summer recess) which may limit participation. An alternative to these trainings is to create modules that (1) are useful to teachers with minimal science background, (2) are user-friendly, and (3) require minimal teacher orientation, yet contain sufficient background information for integration into existing science curricula.

From 1993 to 1996, the Texas Agricultural Extension Service (TAEX) developed three multimedia modules designed to deliver factual, research-based information to elementary students (grades three and four). "The White-tailed Deer," "Wildlife Success Stories and Endangered Species" and "Something's Fishy" school enrichment modules were developed and evaluated in Texas elementary schools in 1992, 1993 and 1996, respectively.

Methodology

School enrichment program protocol consisted of module development that met Texas Education Agency (TEA) mandates for grade-level specific essential elements for science and Texas Assessment of Academic Skills (TAAS) objectives. All materials were reviewed by teacher grade-level committees to ensure that TEA mandates were satisfied and subject matter was grade-level appropriate (Higginbotham in press).

The multimedia modules were developed by TAEX wildlife and fisheries specialists and agricultural communications specialists. Module components include hands-on (i.e., free-standing) displays, videos, teacher resource packets and test instruments.

The "Wildlife Success Stories and Endangered Species" and "Something's Fishy" modules also included four personal computers featuring an interactive computer program that reinforced information provided by other module components. All materials necessary to teach the module were provided to minimize teacher preparation time, including student handouts and test copies.

Evaluation of program impact was assessed by employing pre-test/post-test methodology as described by Jaus (1984). The tests consisted of 10 questions in true/false and multiple-choice formats. Identical pre-tests, immediate post-tests and 60-day post-tests were administered for each module to measure base knowledge/attitudes, immediate response and information retention, respectively. However, "Something's Fishy" participants were unable to participate in the delayed post-test due to the module's April debut.

The null hypothesis of no significant difference ($p \leq 0.05$) in test scores was tested before and after exposure to the respective module. Data from the pilot phase of each module were compiled and forwarded to the TAEX Data Center-Texas A&M University for statistical analyses. Levels of statistical significance ($p \leq 0.05$) were determined using analysis of variance (anova), t-tests and Duncan's multiple range test.

Modules were made available to elementary schools as part of TAEX's 4-H program. County Extension agents (CEAs) were primary contacts for interested elementary schools. Module availability was advertised through 4-H newsletters, personal contact by CEAs and media coverage of the module's use on participating campuses.

County Extension agents were responsible for module scheduling and setup. One to two weeks prior to each module's scheduled arrival date, the CEA delivered teacher packets and provided a brief teacher orientation. Teachers were instructed to administer the pre-test prior to module arrival. Demographic data (i.e., student gender and ethnicity), pre-tests and immediate post-tests were collected when the module was removed from each campus. Teachers were asked to keep their resource packets to encourage future use.

"The White-tailed Deer" and "Wildlife Success Stories and Endangered Species" modules targeted third graders and remained on each campus for one week. The "Something's Fishy" module targeted fourth graders and was scheduled for two weeks per campus. The display component of each module was set up in a highly visible area (e.g., a foyer, stage or library) to maximize contact with students. The computers, videos and lesson activities were used in conventional classroom settings.

Although program sequence varied among campuses, teachers typically led discussions of the display and video components, taught lesson activities and scheduled sufficient computer time for students. One to four students could participate simultaneously in the interactive computer programs using headphones without disturbing other ongoing classroom instruction.

During the summer recess, modules were made available to youth camps, interpretive centers, and TAEX adult and youth field days and programs.

Results and Discussion

"The White-tailed Deer"

The display was the focal point of the deer module and featured a jawbone aging board to familiarize students with aging deer via the tooth wear and replacement method. Also included were (1) a shoulder mount of a buck white-tailed deer (*Odocoileus virgianus*) with text descriptions of management and the role of hunting, (2) a pictorial sequence of the annual antler cycle, (3) a color poster depicting important food plants for deer, and (4) an antler board containing six sets of whitetail buck antlers to illustrate antler growth and genetic influences. Videos and lesson activities concentrated on white-tailed deer life history, conservation and management.

A total of 1,964 third graders from 21 elementary campuses in 4 counties participated in the pilot program conducted during the 1992-93 school year. The student sample was equally comprised of males and females. Ethnically, 60 percent of the student sample was white, 25 percent was African-American, 14 percent was Hispanic-American and 1 percent was Asian-American. Students from Smith and Gregg counties in eastern Texas were considered to be urban (100,000+ residents) and made up 93 percent of the sample. The remaining 7 percent of the student sample came from Kimble and Llano counties in the "rural" ranch country of the Edward's Plateau. This central Texas region was selected for participation because it has the densest deer population in North America with deer densities sometimes in excess of 60 animals per square kilometer (B. Young, Texas Parks and Wildlife Department, personal communication: 1996).

The mean score on the pre-test was 46 percent (Table 1). As expected, the immediate post-test scores (mean = 78 percent) were higher than the scores on the pre-test and the 60-day post-test (mean = 73 percent). The basic lack of knowledge about wildlife among third graders reported by Corral-Verdugo (1993) was evident on the deer module pre-test, where 60 percent of all students believed that the white-tailed deer was an endangered species. This was particularly interesting since Texas has the largest deer population (3 to 4 million head) in the nation.

There were no significant differences in test scores by student gender on any of the three tests (Table 1). Similarly, no significant differences were noted in pre-test scores between ethnic groups. However, Asian-American students scored significantly higher than Hispanic-American and African-American students and white students scored significantly higher than African-American students on the immediate post-test. On the 60- day post-test, Asian-American and white students scored significantly higher than African-American and Hispanic-American students.

Students from the rural communities within Kimble and Llano counties scored significantly higher than their urban counterparts from Smith and Gregg counties. An additional analysis further partitioned the Kimble and Llano county students between those living on ranches ("rural-rural," n = 31) and those living in town ("rural-urban," n = 52). This comparison revealed no significant differences in scores on the pre- and 60-day post-tests. However, students living on ranches did score significantly higher on the immediate post-test. This difference may have been because students living on ranches were more readily able to apply what they learned because of their frequent contact with deer.

Table 1. Comparisons of mean test scores (percentage) for the three testing periods by student gender, ethnicity and residency for "The White-tailed Deer" module.

	Pre-test	Immediate post-test	60-day post-test
Mean score	46a[a]	78b	73c
Gender	Male-46a	Male-78a	Male-73a
	Female-46a	Female-78a	Female-73a
Ethnicity	Asian American-48a	Asian American-83a	Asian American-81a
	White-48a	White-82a,b	White-79a
	African American-43a	Hispanic American-76b,c	African American-70b
	Hispanic American-43a	African American-74c	Hispanic American-69b
Residency[b]	Rural-54a	Rural-86a	Rural-83a
	Urban-45b	Urban-78b	Urban-74b
Residency[c]	Rural-rural-57a	Rural-rural-91a	Rural-rural-86a
	Rural-urban-53a	Rural-urban-82b	Rural-urban-79a

[a]Values in categories followed by the same letter are not significantly different at the $p \leq 0.05$ level.

[b]Location of residence: urban (Smith and Gregg Counties) versus rural (Llano and Kimble counties).

[c]Location of residence: rural-rural (Kimble/Llano county students living on ranches) versus rural-urban (Kimble/Llano county students living in town).

"Wildlife Success Stories and Endangered Species"

This module's theme featured four species (white-tailed deer, eastern wild turkey [*Meleagris gallopavo silvestris*], American alligator [*Alligator mississippiensis*] and wood duck [*Aix sponsa*]) that had been restored successfully to viable populations, and four species (bald eagle [*Haliaeetus leucocephalus*], red-cockaded woodpecker [*Picoides borealis*], black bear [*Urus americanus*] and paddlefish [*Polyodon spathula*]) that were on the state endangered species list. Management efforts employed to restore endangered species and help make them future success stories were also addressed.

The hands-on display included pictures and descriptions of the eight featured species, a pair of wood ducks mounted on a nesting box, a picture sequence of a rocket net capturing wild turkeys for relocation, a fiberglass replica of a paddlefish and a red-cockaded woodpecker nesting cavity insert.

The interactive computer program was divided into wildlife success stories and endangered species main menus. A submenu for each species contained information on species decline, recovery efforts, distribution and life history. Students could also access menus that provided glossaries of technical terms, audio and tracks of featured species.

Lesson plans and videos addressed wildlife management success stories and endangered species issues. The focal point of these module components was the critical loss of wildlife habitat and its impact on restoring and maintaining viable wildlife populations.

A total of 1,650 third graders from 18 school districts in 8 counties participated in the pilot program during the 1993-94 school year. The student sample was equally comprised of males and females; 65 percent was white, 25 percent African American, 9 percent Hispanic American and 1 percent Asian American.

The mean score on the pre-test (mean = 52 percent) was significantly lower than scores on either the immediate (mean = 77 percent) or 60-day post-tests (mean = 73 percent) (Table 2). These changes in student knowledge were similar to results obtained from the deer module.

Table 2. Comparisons of mean test scores (percentage) for the three testing periods by student gender, ethnicity and residency for the "Wildlife Success Stories and Endangered Species" module.

	Pre-test	Immediate post-test	60-day post-test
Mean score	52a[a]	77b	73c
Gender	Female-52a	Female-77a	Female-75a
	Male-52a	Male-78a	Male-76a
Ethnicity	African American-47a	African American-74a	Asian American-88a
	Asian American-58a	Asian American-82a	White-77a,b
	Hispanic American-47a	Hispanic American-75a	Hispanic American[b]-71b
	White-55a	White-80a	African American-68b
Urban vs. rural[b]	Urban-51a	Urban-75a	Urban-72a
	Rural-54b	Rural-83b	Rural-79b
Urban vs. rural[c]	Urban-51a	Urban-76a	Urban-73a
	Rural-55b	Rural-83b	Rural-79b

[a]Means followed by the same letter are not significantly different at the $p \leq 0.05$ level.
[b]Urban schools located in cities with more than 30,000 population (Longview, Nacogdoches, Texarkana and Tyler) versus rural schools located in cities with less than 15,000 population (Arp, Henderson, Jefferson, Junction and Llano).
[c]Urban schools located in cities with more than 15,000 population (Henderson, Longview, Nacogdoches, Texarkana and Tyler) versus rural schools located in cities with less than 3,000 population (Arp, Jefferson, Junction and Llano).

There were no significant differences in test scores by gender. Furthermore, the pre-test and immediate post-test scores indicated that knowledge of wildlife in general and endangered species specifically was not significantly different among ethnic groups.

However, Asian-American students scored significantly higher than Hispanic-Americans and African-Americans on the 60- day post-test.

Analyses of test scores were also made by community size to facilitate rural-urban comparisons (Table 2). Initially, scores of students attending schools in communities with more than 30,000 residents were compared with scores of students living in communities with fewer than 15,000 residents. Students from the smaller, more rural communities scored significantly higher on all three tests.

A similar comparison was made between scores of students living in communities with fewer than 3,000 residents as opposed to communities with more than 15,000 residents. Again, students living in smaller, more "rural" communities scored significantly higher on all tests. These results suggest that rural students may better comprehend wildlife issues, perhaps because of increased opportunities to view or interact with wildlife than their urban counterparts.

Teacher survey. Following the debut of the "Wildlife Success Stories and Endangered Species" module, all teachers (n = 83) were mailed a survey to determine their attitudes and opinions regarding the curriculum. A total of 62 teachers (76 percent) responded to the survey.

Teachers were asked to rate opinion statements about the module using a scale of one (not useful) to five (very useful) (Table 3). Teachers especially liked the module's multimedia approach and having test copies provided, followed by availability of lesson plan materials. Teachers appreciated the fact that the module design minimized their preparation time and expense. However, many teachers indicated that one week was insufficient time to teach the module.

Using the same one to five scale, teachers were asked to rate the efficacy of the various module components. Not surprisingly, the interactive computer program rated highest (mean = 4.9), followed by the display (mean = 4.7) and both the videos (mean = 4.1) and lesson activities (mean = 4.1). As one teacher stated, "the interactive computer program was effective as a teaching tool because it put the students in charge of their own learning."

Table 3. Teacher survey results for the "Wildlife Success Stories and Endangered Species" module.

	Strongly disagree				Strongly agree	Mean
The lesson plan materials were helpful	1	2	3	4	5	4.1
I like having all test copies provided	1	2	3	4	5	4.9
The multimedia approach of lesson plans, videos, displays and computer enhanced the learning process	1	2	3	4	5	4.9
One week is enough time for the module to be on campus	1	2	3	4	5	3.6

More than 97 percent of respondents believed the module effectively taught their students about wildlife; 96 percent wanted to use the module again and 100 percent perceived the module to be extremely user-friendly.

"Something's Fishy"

This module's theme addressed water quality, water conservation and aquatic ecology. Unlike the previous two modules, "Something's Fishy" targeted fourth graders and remained on participating campuses for two weeks.

The display consisted of fiberglass replicas of 10 fish species with descriptions of their role in predator/prey relationships and an interactive aquatic food chain. Pictures and descriptions were used to stimulate discussions on water quality and conservation. The interactive computer program consisted of eight submenus including "Let's Go Fishing," "Why Does That Fish Look Like That," "Aquaculture" and "Water, Water Everywhere," among others.

Additional module components included three videos on water conservation, water quality and aquatic ecology. Water testing kits were provided to give students experiential learning opportunities via water sample analyses for pH and oxygen. Teacher resource guides included 11 lesson activities addressing TAAS objectives and additional activities (i.e., "brain teasers" and crossword puzzles).

A total of 499 fourth graders from three elementary schools in one county participated in the module debut during April and May 1996. The student sample was 52 percent male and 48 percent female. White students comprised 68 percent of the sample, 24 percent was African American, 7 percent Hispanic American and 1 percent Asian American.

The mean scores on the pre-test (mean = 52 percent) and immediate post-test (mean = 78 percent) were significantly different (Table 4). There were no significant differences in test scores by gender or ethnicity. Since all student participants were from the same community, no urban-rural comparisons were applicable.

Table 4. Comparisons of mean test scores (percentage) for the two testing periods by student gender and ethnicity for "Something's Fishy."

Comparison	Pre-test	Immediate post-test
Mean scores	52a[a]	78b
Gender	Female-54a	Female-78a
	Male-53a	Male-78a
Ethnicity	African American-51a	African American-77a
	Hispanic American-57a	Hispanic American-76a
	White-54a	White-79a
	Asian American-65a	Asian American-85a

[a] Means within the same row followed by the same letter are not significantly different at the $p \leq 0.05$ level.

Pleasant Surprises

A number of unforeseen, yet pleasant surprises resulted from school utilization of these 4-H modules. These activities were initiated primarily by teachers, but sometimes were the ideas of the students. One of the most interesting experiences occurred in 1993 at Orr Elementary School in Tyler, Texas. A class of students with learning disabilities initiated a self study of "The White-tailed Deer" module, then "team taught" the module to all other students on campus. They became the resident experts on white-tailed deer and teachers reported a discernable increase in leadership skills and self esteem among these extraordinary students. Other activities included the development of classroom bulletin boards including "The White-tailed Deer: Then and Now," which featured the white-tailed deer's role in American history. Numerous classrooms also prepared individual written and oral book reports and posters.

Students received a certificate of completion following their participation in the modules. There was no question that these individual certificates were highly prized and appreciated.

Another pleasant surprise was the extensive media coverage associated with the 4-H modules' presence on elementary campuses. Contacts with newspapers and television stations by CEAs and school personnel resulted in considerable publicity. Media coverage served as effective advertisement of module availability and has positively influenced the sponsorship of five additional "Wildlife Success Stories and Endangered Species" modules and two additional "Something's Fishy" modules since their debut.

Additional Module Uses

Most Texas school systems operate on a nine-month school year which decreased module demand by schools during the summer recess. However, requests for module use at youth camps, interpretive centers, museums, and adult and youth field days minimized module downtime during the summer.

Recommendations and Conclusions

The Texas 4-H wildlife and fisheries school enrichment modules positively impacted third and fourth graders' knowledge of environmental issues in general, and wildlife and fisheries resources in particular. The links established between resource professionals and elementary schools provided valuable experiential learning opportunities.

Recommendations for program expansion through the creation of new module scenarios include (1) identification and networking between potential partners and sponsors, (2) establishment of grade-level specific teacher committees for the development and review of curricula, (3) targeting specific grade levels while meeting state-mandated curricula requirements, (4) employment of a multimedia approach, (5) inclusion of all materials and copies necessary in teacher resource guides, (6) program evaluation through pre-/post-test methodology, (7) encouragement of publicity through local media, (8) development of annual reports to provide the public and sponsors with program results, and (9) exploration of alternative module use outside of traditional school environments. Program expansion through the duplication of existing modules can be accomplished by actively seeking additional sponsors.

Increased availability of these and other school enrichment modules can equip elementary students with necessary factual information about our renewable natural resources and help prepare them to become tomorrow's enviromental policy makers.

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The Impact of Changing Demographics on Wildlife and Fisheries Extension and Outreach

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Demography is the study of the size, distribution and aggregate characteristics of human populations (Murdoc et al. 1996). The population of the United States is changing faster than most of us realize, and that change will have a tremendous impact on the future of our country (Murdoc 1995). Population shifts include changes in growth, ethnicity, age structure, rural versus urban distribution, family structure and economic stratification. These changes will impact future participation in recreation and the interest of population groups in natural resource issues. A few have attempted to analyze these demographic changes in terms of their impact on the future of natural resources and natural resource professions (Murdoc et al. 1992, Dyer 1994, Ditton 1995, Brown 1996, Connor and James 1996, Murdoc et al. 1996). Clearly, these changes will impact wildlife and fisheries extension and outreach efforts. Our clientele base is changing because we will have new clientele, our traditional clientele will have new informational needs, and the resource itself will require different extension approaches if we are to protect and conserve the resource. Some knowledge about our changing society will help us understand who our clientele are and what their needs might be.

Changing Demographics of the United States

Population Growth

From a population standpoint, the United States is the third largest nation in the world. The U.S. population was estimated to be 262.8 million in 1995 (Murdoc 1995). Growth of the population is affected by migration, fertility and mortality. Although the U.S. population continues to increase, the rate of population growth is slowing. From an annual growth rate of 1.4 percent from 1900 to 1980, the rate of population growth slowed to less than 1 percent from 1980 to 1990 and is expected to grow at about 0.5 percent from now on. This is despite the "baby boom" period of rapid growth from 1946 to 1964. The population is expected to peak around 393.9 million by 2050, and decrease somewhat after that (Murdoc et al. 1996). Although the rate of growth is slowing, the change in absolute numbers of people in the United States is still substantial, increasing nearly 50 percent between now and 2050.

This slowing of the population growth rate is not universal regionally. In Texas, California and Florida the growth rate is increasing, largely due to migration from other states, immigrants and the high birth rate of the latter population. These states accounted for 54 percent of the entire U.S. population growth from 1980 to 1990

(Murdoc 1995). This trend is expected to continue. In fact, the population of Texas is expected to nearly double in the next 30 years (Connor and James 1996).

Ethnic Diversity

Although the overall rate of population growth is slowing, the ethnic diversity of our population is changing rapidly. Immigration and the offspring of immigrants will make up the largest proportion of our future growth. In 1990, 75.6 percent of the U.S. population was Anglo, 11.8 percent was African American, 9.0 percent was Hispanic and 3.6 percent was classified as "other" (largely Asian). But from 1980 to 1990, the Anglo population increased by only 4.2 percent, the African American population by 12.0 percent, the Hispanic population by 53.1 percent and the population of others by 71.7 percent. Of the net population increase from 1980 to 1990, 66.1 percent was due to growth of minority populations, and the projection from 1990 to 2050 is that 86.4 percent of the net population change will be due to increases in minorities. An important component of this shift in ethnic diversity has been and will be immigration. A full 55 percent of the population growth from 1990 to 2050 will be due to immigrants and their descendants. The overall proportion of the U.S. population comprised of minorities will increase from 24.4 percent in 1990 to 47.2 percent in 2050 (Murdoc 1995). Again, there will be regional differences; the states of California, Texas and Florida account for nearly 40 percent of the entire minority population of the United States (Murdoc et al. 1992). By the year 2030, non-Anglos will be the majority of the Texas population (Connor and James 1996).

Aging

There is an interesting dichotomy in the changing age structure of the United States' population. The overall population is aging, and more rapidly in recent years. In 1900 the median age in the U.S. was 22.9 years. By 1950 it had reached 30.1 and was still at 30.0 in 1980. But in the next 10 years, by 1990, the median age had increased to 32.9 years. A full one-third of the U.S. population is now comprised of the baby boomers, born from 1946 to 1964. They are now middle-aged, and will begin becoming elderly (over 65) in the year 2011. By 2029, the entire group will be over 65. In fact, by that time, 20 percent of the U.S. population will be over 65 as compared with 12.5 percent in 1990 (Murdoc 1995). An additional impact on this process is the fact that life expectancy is improving, from 75.9 years in 1995 to an expected 82.0 in 2050 (Murdoc et al. 1996). Because women currently live an average of seven years longer than men, the older population will be numerically dominated by women.

On the other hand, the rapidly growing segments of our population, the minorities, are relatively young. Nationally, one-third of Americans under 35 belong to minority groups, whereas only one-fifth of those over 35 do (Edmonson 1994). In 1990, 14.4 percent of the Anglo population was over 65, but only 8.5 percent of the African American, 5.2 percent of the Hispanic and 6.2 percent of the other populations were over 65. This trend will continue toward 2050, with minorities making up proportionately small parts of the elderly population. Thus, the fastest growing segments of our population are age groups 25 to 44 and 65 and over (Murdoc 1996). We are becoming a population of younger minorities and older Anglos.

Urbanization

More than three-fourths of our population lives in the nations' 837 metropolitan counties (O'Malley 1994). In Texas, a state most of us think of as rural, 82 percent of the population lives in urban areas, and about 60 percent of those people live in just four cities (Connor and James 1996, Murdoc 1996). Cities are growing faster than other locations, and the largest cities are growing the fastest. Surprisingly, however, in some areas of the U.S. where retirement and recreation offer opportunities, small communities are growing as well (Edmonson 1994). During the 1980s, most of America's 2,304 nonmetropolitan counties lost population, and overall, those counties experienced only a 0.3 percent annual growth rate (as compared with 1.1 percent in metropolitan counties) (Johnson and Beale 1995). In the 1990s, however, only about one-fourth of the nonmetropolitan counties have lost population, and their overall average annual growth rate tripled to 0.9 percent. This trend has been caused not by births, but by fewer residents leaving and migration or "urban flight" from cities. The greatest gains have been in those counties adjacent to metropolitan areas and in those whose economies are based on recreation and retirement (Johnson and Beale 1995). Thus, the "rural rebound," at least where that can be found, seems to be caused by commuters, retirees and the occasional "lone eagle" who seeks pleasant surroundings while operating a business from the home (Edmonson 1994).

Family Structure and Poverty

The changing composition of the American household portends to be a major influence on the future of our culture. The average size of American households declined from 3.67 in 1940 to 2.63 in 1990, largely due to lower marriage rates, higher divorce rates, lower fertility and more diverse living arrangements (Murdoc 1995). From 1970 to 1980, the total number of households in the U.S. increased by 27 percent, but family households increased by only 17 percent and non-family households increased by 70 percent. This trend continued through 1987 (Murdoc 1995).

In Texas, 28 percent of households are non-family units, and 15 percent are single-parent units, of which 77 percent are headed by women. In fact, nationally, 61 percent of children will spend part of their lives in a single-parent household before age 18. Nationally, about 25 percent of children are born out of wedlock, although that rate is as high as 40 percent in some southern states. These figures are important in the context that the person least likely to hunt, fish or visit a park is a single female parent (Murdoc 1996).

Nearly half of the children of single-parent households headed by women live in poverty (Edmonson 1994). Income in female-headed households in 1987 was only 44 percent of that of married-couple households. Economic stratification follows ethnic and age lines as well. In 1987, median household incomes of African Americans were 60 percent and Hispanics were 70 percent of that of Anglos. Also, median household incomes of households with a head under 25 years of age or with a head over 65 were less than 50 percent of households with a head who was 45 to 54 years old (Murdoc et al. 1992).

Recreational Interests

Unfortunately, this shift to a more urbanized, aging, increasingly diverse ethnic population saddled with limited economic resources and fragmented families may not portend well for those interested in natural resources. All of these changing demographic factors will impact use of and interest in natural resources in the future, and thereby extension needs and approaches. Dyer (1994) made an excellent effort at attempting to predict the impact of these changes on recreation. He reported the impact of age, economic background, rural versus urban background and current residence, and ethic background on participation in outdoor recreation. He found, for instance, that African Americans have significantly lower participation rates in such outdoor activities as non-pool swimming, motorboating and canoeing. African Americans participated in hiking and backpacking at only one-tenth the rate as Anglos, but Hispanics and other (largely Asian) groups had higher participation in these activities than did Anglos.

Age was also a factor, with, as one might expect, a decrease in nearly all outdoor recreational activities with increasing age. Only birdwatching increased with age, and only in the 55- to 64-year-old age group, with a decline thereafter. Since this age group is currently growing faster than the rest of the population, this activity will likely increase at least until 2011. Dyer noted a general shift in consumptive to nonconsumptive recreation as people age, and a tendency to take recreational trips closer to home. Murdoc et al. (1996), however, found that African Americans were the only ethnic group that maintained their interests in fishing as they aged. He also found that while Anglos participated in freshwater fishing at rates from 2 to 4 times that of African American, Hispanic and other ethnic groups, they participated in saltwater fishing at rates lower than all other ethnic groups except younger Hispanics.

Other Influences on Recreation Participation Rates

Other influences on participation rates in outdoor recreation have been noted but are not always well documented. Participation in hunting has been decreasing by age class since 1955, whereas fishing participation leveled off about 1980 (Dyer 1994). People in rural areas participate more in hunting and fishing than do those in urban areas (Dyer 1994). Those in urban areas who do participate often come from rural backgrounds. Anglos tend to spend more money on fishing and other recreational pursuits than do minorities. And, as mentioned earlier, single parents tend to have low outdoor recreational participation rates. In Texas, although fishing license sales have been stable, hunting license sales have been declining 3 percent per year since 1987. Less than 11 percent of anglers and 6 percent of hunters in Texas are minorities. Twenty-seven percent of Hispanic and 58 percent of African American Texans have never visited a state park (Texas Parks and Wildlife Department 1992).

Dyer (1994) found that across seven outdoor activities (backpacking, birdwatching, camping, hiking, hunting, picnicking and walking), the predicted changes in participation from 1990 to 2025 could be statistically accounted for as 65 to 95 percent due to age, 2 to 25 percent due to population growth and 1 to 11 percent due to ethnicity.

Opportunities and Implications

Nonetheless, this climate offers both a challenge and an opportunity. It is important that as we look at demographics and their impact on our future, we not group people too loosely. For instance, as pointed out here, all ethnic groups should not be grouped together. Likewise, there may be great differences in interests and attitudes among inner city people, especially youths, urban people, and those who live in the suburbs. Dyer (1994) suggests not grouping all people over 65 as "elderly," as some may be far more active than others. He also points out that demographic studies often differ in results and their consequent predictions. The fact that our population is becoming older, more urban and more ethnically diverse means that their activities may be more difficult to predict in the future. The point is that we must at least try.

In 1996, Brown defined our extension clientele in four categories, based on the where they used to live, work and recreate, and where they do these things now.

Rural People Living In Rural Areas

Farming and ranching landowners are our traditional clientele—they brought us to the dance. Two dramatic trends affect how we now approach this group. We know that this group has been declined to about 1.2 percent of the U.S. population. In Texas and some other states, most of these people are small producers; half of all Texas farms have sales of less than $ 5,000 per year (Albrecht 1990). Only 1.5 percent of farms have total gross incomes of more than $100,000, and they produce 32.7 percent of total agricultural sales. However, both small and large landowners need a new type of information than we have provided in the past. The golden cheeked warbler episode in Texas, the spotted owl conflict in the Pacific Northwest, and similar issues remind us that these clientele need help to deal with the Endangered Species Act, the Clean Water Act and other regulations. They specifically need help with community-based approaches to dealing with these regulations, such as conservation easements, local Habitat Conservation Plans and Safe Harbor agreements. In addition, as commodity supports dwindle over the next seven years due to the 1996 Farm Bill, these clientele will need to be advised on alternative income opportunities to help them keep their land. Income from hunting and fishing, birding, nature-tourism, bed-and-breakfasts, and conservation easements will not save all of rural America from economic decline, but we must provide assistance for these clientele to avail themselves of these opportunities if they are able. As a sidebar, demographers speak of a "widow belt" stretching through Texas north through the plains states—a high population of widows of farmers and ranchers who still live on their family land. I doubt if any of our agencies have addressed the specialized needs of this clientele group of rural people who still live on the land.

Rural People Living in Urban Areas

Demographers also tell us that two-thirds of farmers and ranchers do not actually live on their land. They live in towns where they or their spouses have full- or part-time jobs and they commute to their farms or ranches. They, too, need information about coping with a regulatory environment and means of diversifying their options for utilization of natural resources. The trick, of course, is to provide that information at a time and place convenient for these clientele. Some of these clientele hold two or three jobs so that they can continue this lifestyle, and sociological help is no doubt needed as well.

Urban People Living in Rural Areas

This group is probably the fastest growing and makes up the "rural rebound" I mentioned earlier. It accounts for the statement that most people living on farms and ranches do not farm or ranch (Edmonson 1994). It includes commuters who live on ranchettes but work in larger communities or cities, retirees attracted to "country living" and "lone eagles" (i.e., people who can work via computer and fax machine and can live literally anywhere). These clientele know little if anything about agriculture or natural resource management. They often have unrealistic expectations as to what their land can sustain. These groups of people tend to be fairly affluent, well educated and willing to learn, but they need the basics in natural resource education. Their communities desperately need advice to keep from ruining the aspects of rural areas that attracted them in the first place (McDonald 1996).

Urban People Living in Urban Areas

We cannot ignore the majority of our population. The urban populations vote and pay taxes, and it is they who will view the other three groups as "special interest groups" when it comes to governmental funding for our activities. Some urban people own or lease rural land for recreation, others simply desire natural resource recreation, while some are "green couch potatoes" who watch the Discovery Channel and send money to environmental organizations but do not personally get outdoors much. Unfortunately, the majority of the urban public are none of these, but people fairly disinterested in natural resource issues. Here is where we need input into the primary and secondary educational system, with a balanced approach to natural resource conservation education. This can come through 4-H school enrichment programs, Project WILD, through Boys Clubs or Boy Scouts, and primary and secondary teacher education programs.

Conclusion

I offer these four groups and their differing educational needs as a matrix for consideration of our future wildlife and fisheries educational planning. Keep in mind that these four groups need division into subgroups, such as youth, ethnic groups, age groups, single parents, and inner city versus suburban dwellers. Also, the predictions made earlier may not come to pass. The U.S. Census Bureau predicts future population growth with a high, medium and low estimate; all figures used herein were from the median estimate (Murdoc 1995). If, for instance, our immigration laws change, increasing or decreasing the current quota of 820,000 immigrants per year, the structure of the population would be affected (Murdoc 1995). Likewise, recreation participation predictions are based on the assumption that certain age, ethnic and socioeconomic groups will maintain their present level of participation. Our economy could change, the health of different age classes could change and/or some major legislation, such as the Land Grant Act, the G.I. Bill or the 1964 Civil Rights Act, could come along and change the culture of our society.

Due to the varying levels of extension personnel and operational support available in different states, and the varying needs of the states, the level to which we can provide these services will vary. Into that matrix we should figure other service providers, such as state biologists, game wardens, Natural Resource Conservation Service personnel, Sea Grant Marine Advisory Agents, teachers, and volunteers from Audubon and other organizations. In addition, extension faculty need to interact better with the teaching and research components of our institutions. We cannot cover all of the bases ourselves. We must make difficult decisions about which needs are the greatest, where our strengths lie, and how and where we can be most effective.

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Reaching Nontraditional Extension Audiences Using Distance Education: Introduction to Wildlife Conservation, A Case Study

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Purpose of Introduction to Wildlife Conservation via Satellite

The changing face of education in the United States has created new challenges for college faculty and extension specialists. Both groups increasingly are required to address a broader audience, filled with nontraditional students (U.S. Department of Education 1987) and clientele who have differing needs and circumstances than more traditional target groups. Simultaneous pressure on educators to limit spending or reduce program costs has engendered a growing acceptance of new technologies that allow faculty to access large and difficult-to-contact audiences with fewer miles traveled in less time with less repetition and for fewer dollars (Lynton 1992). These two circumstances have coincided to create a nationwide expansion of higher education and extension efforts in distance education (Lane 1994).

Distance education is defined as education which occurs when students and instructor are separated by time and/or distance (Keegan 1983). It is as old as traditional correspondence courses, the radio courses of the 1930s and television classes pioneered in the 1960s. But distance education today has taken on new dimension and value as these older technologies have been improved and exciting interactive media, including compressed video and the Internet, have become available. Combinations of these technologies now allow instructors to reach thousands of students and interact with them easily and at the students' convenience.

A group of universities in Kentucky have joined forces in using these technologies to deliver college courses to high school students for advanced placement and college credit. As a result of this collaboration, Introduction to Wildlife Conservation via satellite was created.

History of Introduction to Wildlife Conservation via Satellite

In 1991, the Kentucky Council on Higher Education's Agriculture Subcommittee, consisting of the deans and department chairs of all the colleges and departments of agriculture at the state's independent institutions of higher learning, decided to create a collaborative series of satellite telecourses. The four, freshman-level agriculture courses would be delivered via distance technology and would target high school students. The project had two primary goals. First, the classes would demonstrate to the state legislature that the participating institutions could cooperate effectively on a project benefitting Kentucky's high schoolers. Second, the courses would combat the outdated image of agriculture as a low-tech, limited-opportunity industry, held by many students, teachers, guidance counselors and school administrators. The four college courses would concentrate on the basic sciences, math skills and technologies involved in modern agriculture, exposing the high school audience to the many fields, careers and opportunities available.

The University of Kentucky coordinated the creation and production of the first course in this series, Introduction to Animal Science via satellite. Berea College, Eastern Kentucky University, Kentucky State University, Morehead State University, Murray State University, Western Kentucky University and the University of Kentucky College of Agriculture dedicated faculty to its production. This group agreed on a text and syllabus and divided the course topics among the participating faculty, based on their interests and training. The consortium partnered with Kentucky Educational Television, the state's public television network, to deliver the class via the KET StarChannel Network. This satellite network consists of three digital satellite channels of KET programming downlinked into all schools in the state. The class aired in Kentucky during spring semester 1992 and has aired nationally each spring since.

In 1994, an informal survey of vocational agriculture instructors across the country indicated strong interest in a similar course in wildlife conservation and management. Faculty interest at the University of Kentucky (UK) College of Agriculture led to the creation of Introduction to Wildlife Conservation, the second in the four-course series. Introduction to Wildlife Conservation first aired in the fall of 1995 with 600 Kentucky students enrolled. Its second season aired in fall 1996, with 250 enrolled students from three states. The program has been conducted solely by UK faculty, as no other institution of higher learning in the state has a wildlife conservation program housed within its department of agriculture. KET provided delivery across the state via the StarChannel Network and out-of-state sites received the course on videotape.

Methods

Class Model

Introduction to Wildlife Conservation via satellite was taught for 50 minutes, three times weekly, for a full college semester each year. The material presented was identical to that covered in the traditional, on-campus course. Topics presented in the course included taxonomy, wildlife management, history and legislation, funding, agencies and policies, basic ecology, populations, mortality and hunting management, endangered species, habitat management, wetlands, waterfowl, damage management, biodiversity, neotropical migrant songbirds, landscape ecology, and management of ecosystems, agricultural lands, forests, grasslands, wetlands, range and backyards for wildlife.

On-site facilitators at participating high schools registered students with Distance Learning Programs in the UK College of Agriculture. Each enrolled student was required to purchase a student handbook and each site was required to have at least one textbook available. On-site facilitators were also required to purchase an on-site facilitator's handbook. In Kentucky, there was no fee for schools to participate in the course or videotape the lectures. Schools outside Kentucky were able to purchase the course on satellite for $100 and enroll an unlimited number of students. Any school could purchase the class on videotape for $400 and enroll an unlimited number of students. All participating schools have the right to use the videotaped lectures as a complete course for one year or until it is rebroadcast. After that length of time, individual lectures may be used in high school classes, but the complete series may not be reused as a course.

Students watched each lecture and used the student handbook to assist with notetaking. No homeworks, quizzes or tests were assigned, collected or graded by the course instructor, except the final examination. Instead, on-site facilitators made and graded such assignments throughout the semester. On-site facilitators created their own homework, quizzes and tests, or used examples included in the on-site facilitator's handbook. This resource also included additional reading materials, graphs, charts, maps, etc.

In the first year, students were able to interact with the course instructor via an 800 phone line during each live broadcast. In addition, they were provided with the professor's phone and fax numbers and postal and e-mail addresses to encourage interaction. In the second year, when the program could not air live due to a delay in KET's launching of its new satellite system, in addition to the professor's personal contact information, the students and on-site facilitators were provided with an 800 phone number they could use at any time during business hours to reach the course instructor. A World-Wide Web homepage for the course was created to facilitate future registrations, provide basic course information, facilitate questions to the professor and provide additional reading materials for those with access to the Web.

Most students enrolled in the course at high schools earned high school credit. Those grades were assigned by the on-site facilitators. At semester's end, students had the opportunity to try to earn college credit at a participating institution of higher learning by making a passing grade on the final examination.

The final was written by the course instructor and consisted of 150 multiple-choice and true-or-false questions. The tests were distributed to high school guidance counselors who administered the examinations in the same manner as the College Board Advanced Placement examinations. The tests were returned to UK where they were scored by computer and grades were assigned by the course instructor. All students who took the final examination were then provided with a letter which documented their performance. Those earning passing grades were assigned a letter grade of "A," "B" or "C." The letter was to be retained by students and used upon enrollment at a participating institution of higher learning to document credit earned.

High school students then have four years from the date of the final examination to enroll at a participating institution of higher learning and receive credit earned in the course. The student enrolls in the on-campus equivalent of the course his/her first semester on campus. He/she pays tuition for the course to the school he/she chooses to attend. The student never attends class during the semester, but his/her grade report for that semester includes the grade or another indication of credit earned at a distance on the local transcript. The college or university the student decides to attend loses no tuition monies or enrollment numbers, but still allows students to earn credits before reaching campus. The student's institution pays nothing for the administration of the course, but has the recruiting benefit of allowing students to earn credit before they enroll.

Creative Team Members and Their Roles

Creating a distance education course requires a variety of skills, cooperative team members, and successful partnering with outside agencies and organizations. Ideally, the creative team for a distance education course should include the instructors, a technical expert for each technology being used, an instructional designer, a visual creator (graphic designer, videographer, animator, etc., depending on the medium) and support staff. However, the reality in most situations currently is that the instructor must wear most of these hats personally with some assistance from a single technical advisor (Lane 1994).

Introduction to Wildlife Conservation's creative team consisted of the course instructor from the Department of Forestry, a faculty member and videographer/director from Distance Learning, technical support from KET, support staff and material contributions from fish and wildlife agencies. The course instructor and Distance Learning faculty member shared the role of instructional designer. The support faculty also shared the role of visual creator with the videographer/director, who had to handle all technical aspects of satellite and videotape delivery. The Kentucky Department of Fish and Wildlife Resources and the U.S. Fish and Wildlife Service provided props, materials and video footage. Responsibilities for creating the course were divided as follows.

The course instructor was responsible for all teaching and handled all questions forwarded by students and on-site facilitators regarding content. He had to put together scripts for video roll-ins and participate in the shooting and editing of these pieces. The instructor also had to collect props and create visuals for use in the studio. And, finally, he was responsible for creating the final examination and assigning grades.

Kentucky Educational Television provided the equipment and studio for the production of all lectures. The course used KET's 800 phone line and operator during the live broadcasts aired in the first year. The program aired via KET's satellite system, using transponder time they provided for delivery of the course. KET handled all scheduling, acted as technical advisor for any downlink/receiver problems and found additional transponder time to rebroadcast some programs. In the second year, when the program did not air live, a replacement 800 phone line available during business hours was provided by UK Distance Learning Programs.

The UK College of Agriculture Distance Learning faculty member, videographer/director and support staff, all housed in the Department of Agricultural Communications, were responsible for supporting the needs of the course instructor, on-site facilitators and students, as well as coordinating the course with KET. Over the two years, this group conducted all marketing efforts, including writing, printing and distributing brochures; obtaining mailing lists; creating news pieces; and developing a promotional video. The faculty member wrote the student handbook, based on notes for the course provided by the primary instructor in the first year. The second year, she rewrote the handbook as an Interactive Study Guide (Cyrs and Smith 1990) based on the actual course lectures from the previous year. Corresponding computer text graphics were also created to match the on-screen information with the outlines in the student handbook. This group wrote and produced several video roll-in packages, created and produced the program open and close, and obtained all the backdrops and studio accessories. They also worked with the course instructor on teaching from a television studio, directed every lecture, traveled with the primary instructor to collect video and then edited that footage to create roll-ins. Distance Learning printed and distributed all student and on-site facilitator handbooks; distributed all texts; handled all orders, invoicing and bill collection; collected all information on individual students and sites; corresponded with on-site facilitators regarding all matters other than content; and handled all orders for, dubbed and delivered videotapes of classes missed by remote sites. Finally, Distance Learning printed and distributed the final examinations to guidance counselors; graded it; wrote, printed and distributed all grade notification letters; maintains those records for future inquiries by universities and students; and wrote, printed, distributed, collected and analyzed all data from written evaluations.

Student Evaluations of Course

Near the end of each semester the course aired, all enrolled students were provided with written evaluations of the course to complete and return. The evaluations included questions about the students themselves, as well as questions regarding course content, instructors and the technology used for delivery. The results were analyzed using the frequency procedure of the Statistical Analysis System (SAS 1985). The following data reflect results tabulated from the 285 (47.5 percent) evaluations returned to UK from the 1995 season and the 110 (44 percent) returned in 1996.

Results and Discussion

Student Characteristics

The majority of students enrolled were juniors (31.4 percent) and seniors (54.9 percent), as recommended, and the majority were male (61.3 percent). The latter statistic is consistent with the majority of male students in Kentucky's vocational agriculture classes, through which most schools participate in Introduction to Wildlife Conservation. Only 19.5 percent of the students responding described the area in which they lived as "urban," with the remainder regarding themselves as "rural." When asked to describe the size of the property on which they lived, students responded: 25.3 percent on less than or equal to 1 acre; 25.6 percent between 1 and 5 acres; 14.2 percent on 5 to 15 acres; 12.4 percent on 15 to 50 acres; and 22.8 percent on more than 50 acres.

Seventy-nine percent of those responding regarded themselves as college-bound. When asked why they decided to take this class, 36.5 percent indicated they were primarily interested in information about wildlife conservation and natural resources. The remainder of the replies were divided among the following responses: exposure to a college course (20 percent); college credit, but not in probable major (17 percent); to meet requirements of probable major (12.9 percent); and other (13.4 percent).

Although the course was recommended for college-bound seniors with the skills and grades necessary to pass a college course, only 20.8 percent of the respondents indicated they had an "A" cumulative high school grade point average. "B" averages were reported by 38.2 percent and "C" averages accounted for 31.4 percent. Of the students responding, 9.4 percent indicated a "D" or "E" high school grade point average. A further indication that many students were not prepared to take a college course was the amount of time students said they spent on the course outside of class each week: 34.9 percent spent less than 1 additional hour; 36.2 percent spent 1 to 3 additional hours; 15.4 percent spent 3 to 5 more hours; 11.4 percent spent 5 to 10 extra hours; and 2 percent indicated they spent more than 10 hours outside classtime working on the course each week. Of the students responding, 35.4 percent expected to earn an "A" on their high school transcripts for this course with 35.9 percent, 20 percent, 6.3 percent and 1.8 percent expecting "B," "C," "D" and "E" grades, respectively.

Remote Site Activities

The on-site facilitator is tremendously important in the creation of a positive or negative learning experience by the students (Cyrs and Smith 1990). Because the course aired only three times weekly, that left two days each week when the on-site facilitator was responsible for the conduct of the course. The evaluations asked student to indicate what other activities they participated in during their "off" days.

The majority indicated they watched tapes of the course (83 percent); discussed course material with their facilitators (75.4 percent); studied their notes (67.8 percent); had student discussions of the material (54.2 percent); and worked on homeworks, quizzes, tests, etc., assigned by the high school instructor to supplement the course (72.2 percent). Fewer than half called the primary instructor for information (10.9 percent), went on field trips (39.5 percent), answered homework questions assigned as part of the telecourse (45.8 percent), read the text (42.5 percent), or read other texts on wildlife or natural resources (29.6 percent). Relatively low percentages reported discussing noncourse material (37.2 percent) and working on other classes (20.8 percent) during the nonbroadcast days.

Responses to Course

Preparation for college. One of the secondary goals of Introduction to Wildlife Conservation was to expose students to a real college course and demonstrate the differences between high school and college. When asked to agree or disagree with the statement, "The course indicates that high school classes and college classes are similar in the amount and depth of material taught," 59 percent of respondents indicated they disagreed or strongly disagreed, while a surprising 34.5 percent agreed or strongly agreed. (The remainder of respondents selected "Not Applicable." This selection accounts for totals not equaling 100 percent in the data reported.) However, 72.7 percent indicated they believed they would have to study more in college than they had in high school to make an "A" or "B" average, while only 21.3 percent disagreed with that thought. Of the respondents who were college-bound, 69.2 percent agreed they were better prepared for college as a result of taking this course. And 52 percent of the noncollege-bound students indicated they would consider going to college as a result of taking this course.

Course materials. The majority of students agreed the course was up-to-date (77.2 percent) and that the level of difficulty was appropriate (41.7 percent agreed the course material was too difficult; 18.4 percent agreed it was too simple). As often seen with introductory survey courses, the majority of respondents (68.9 percent) indicated the course attempted to cover too much material.

In the first year, only 61.5 percent of students indicated the student handbook contributed to their learning in the course. Comparing this number with the percentage indicating the same
for Introduction to Animal Science (78 percent), and considering the number of verbal complaints received regarding the handbook, a complete redesign of the notebook occurred before the 1996 season. The conversion of the handbook to an Interactive Study Guide (Cyrs and Smith 1990) was based on notes taken by the Distance Learning faculty member while watching the entire 1995 course on videotape. An Interactive Study Guide is a highly organized and detailed outline of the course material that coincides very closely with the information being presented on camera. These outlines provide all lists, graphics, charts, drawings and support information to decrease note-copying and increase student attention to concepts being discussed. An Interactive Study Guide is incomplete, however, and requires students to fill in key concepts and terms.

Such outlines have been demonstrated to increase learning (Northcraft and Jernstedt 1975) and the Interactive Study Guide created for the second year resulted in 77.5 percent of students indicating the handbook contributed to their learning in the course. Of the students enrolled in 1996, 89.1 percent indicated the handbook made notetaking easier for them and 73.9 percent agreed it made studying for the final examination easier. Regarding the text, 66.6 percent agreed that it contributed to their learning in the course over both years.

In 1995, students indicated the course material was delivered too quickly for them to take adequate notes (80.6 percent), which coincides with the relatively low number of students who found the handbook contributed to their learning in the course. This number decreased to 59.4 percent in 1996. The nature of an Interactive Study Guide outline allows students to write down critical points, without having to constantly rewind the tape to fill in details, such as all the species of trees growing in a region or the labels for the axes of a chart.

Interaction. The live, on-the-air 800 number was used occasionally during the first semester, but only 19 percent of the students indicated it enhanced their learning in the course. However, 57.4 percent responded they would have liked to have had more on-the-air questions and answers in 1995 and 82.8 percent said the same in 1996, when no on-the-air interaction was possible. This lack of interaction and desire for it may have been an important point when 66.3 percent of the respondents agreed they would prefer to have a teacher in the room with them, rather than on television.

To address this desire for more on-the-air questions and answers, the primary instructor is considering instituting on-the-air office hours. These would be full broadcasts or parts of broadcasts set aside specifically to answer questions students would send in prior to the program or call in live on-the-air. This would eliminate the primary problem most students have with calling in a question during a normal lecture. Phones are generally not available in the classrooms. Consequently, students must walk to another room, dial long distance and wait to go through KET's operator system before they are patched through to the instructor. This results in the student missing several minutes of class and a reasonable reluctance to do so.

Although students had office numbers and addresses for the primary instructor, these avenues were rarely used. The World-Wide Web page was added in 1996, in part, to facilitate interaction between the instructor and students with access to the Internet. However, although about two-thirds of Kentucky high schools are connected with the Internet, the linked computers are often not accessible to students. Internet and e-mail messages are commonly used in other distance education courses taught at the University of Kentucky when students have easy access to the Internet. Therefore, as more student computers are linked with the Internet in high schools, this avenue may increase interaction between the instructor and students.

Teaching. The majority of students agreed the primary course instructor was knowledgeable (80.2 percent) and related the material to real life (61.3 percent). However, the rapid pace at which the material was taught resulted in a majority of students indicating the information was presented too quickly (72.9 percent). In 1995, only 30.3 percent agreed the course material was taught in an organized, easy-to-follow fashion. This result probably was an indication of the lack of coordination between the student handbook and the material being presented on camera. When those factors were improved in 1996, 56.8 percent agreed the course was organized and easy-to-follow.

Overall, the quality of teaching was rated "Excellent" by 12.7 percent, "Good" by 32.7 percent, "Fair" by 34.6 percent, and "Poor" by 20 percent in 1995. These values improved in 1996 to 16 percent "Excellent," 43.4 percent "Good," 31.1 percent "Fair" and 9.4 percent "Poor."

Learning outcomes. The majority of respondents agreed that they changed some of their opinions and ideas about course topics (65.3 percent), learned to respect different viewpoints (64.3 percent), strengthened their abilities to analyze and evaluate information (54.2 percent), gained an understanding of concepts and principles in the field (67.5 percent), and changed their behavior toward wildlife or wildlife conservation (54.2 percent) as a result of this course. Another 55.7 percent of the respondents indicated they would apply one or more of the management techniques described in class on their home properties. The course was less successful in developing problem-solving skills (46.1 percent) and stimulating further reading (45.6 percent).

Value of the telecourse. When asked if they would take another satellite/telecourse, 66.7 percent indicated they would; however, only 53.3 percent said they would recommend this particular course to another student. In its first season, the overall value of the course was rated as "Excellent" by 12.6 percent, "Good" by 38.5 percent, "Fair" by 37 percent and "Poor" by 11.9 percent. These values improved in 1996 to 17.1 percent "Excellent," 44.8 percent "Good," 27.6 percent "Fair" and 10.5 percent "Poor." Based on changes in the data from 1995 to 1996, the majority of the improvement in the course appeared to be the increased usability of the student handbook and its effect on student perceptions of the organization of the material presented.

Conclusions

The majority of enrolled students have been college-bound, male upperclassmen from rural areas with "B" and "C" cumulative high school GPAs. The single most common reason for enrolling has been to learn more about wildlife conservation. More than 70 percent of enrolled students spent three hours or less each week working on the course outside of classtime and a similar number expected to earn an "A" or "B" on their high school transcripts for the course. Most remote classrooms spent the nonbroadcast days reviewing tapes, studying, discussing and working on assignments made locally.

The course indicated to the majority of students that greater academic effort would be required to succeed in college compared with high school. The college-bound students felt better prepared and half of the noncollege-bound were considering college as a result of taking the course.

Students rated the material as up-to-date and at an appropriate level of difficulty, but indicated too much was covered in the semester.

The student handbook in the first year was inadequate and did not enhance learning in the course as it was designed to do. Remodeling the handbook in the second year as an Interactive Study Guide, and coordinating on-screen materials with it, resulted in the majority of students stating it enhanced learning and improved their ability to take notes.

Students preferred more on-the-air interaction with the professor, but did not participate extensively when the opportunity was provided. Improving interaction between the instructor and students will demand creative solutions involving emerging technologies and better use of those already available. The lack of interaction probably was key to the majority of respondents' desire to have the instructor in the room with them, rather than at a distance. Another important factor in that desire may have been the indication by the majority that the material was delivered too quickly.

The course was effective at transferring concepts and principles in the field, honing analytical skills and introducing new ideas and viewpoints. It was also effective at changing student behavior toward wildlife and wildlife conservation.

The overall value of the course was rated as "Good" or "Excellent" by a majority of students each year. However, the 10-percent increase in the second year indicates that changing the course and its materials in response to student evaluations had a positive impact on student perceptions of learning in the course.

The model described has been very successful in Kentucky in three areas. It has proven to be a very workable model for collaboration among the independent institutions of higher learning in the state. It has provided high school students with access to advanced materials in fields they would otherwise have to go to college to receive. And the model has been effective at exposing high schoolers to the nature of college courses and enlightening them as to the effort required to succeed in such courses.

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Private Lands Management: Adapting a Premier Woodland Cooperator Program to Restore and Manage Wetlands

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Public and industrial lands are often managed intensively to meet some combination of objectives, such as aesthetic, economic, environmental or recreational. However, nonindustrial private land ownership in the United States accounts for 60 percent of the land base, including 54 percent of all forested land and about 75 percent of all wetlands (Daly et al. 1992, Daugherty 1995). In the context of natural resources, private lands are often managed only casually or not at all, providing both opportunity and dilemma for landowners and land managers alike.

Nationally, land managers have tried to meet goals of resource sustainability on private lands through a variety of measures, such as acquisitions, easements, regulations and incentives. Barring incentives, these methods assume no initiative on the part of the private landowner. However, another method to achieve these broader goals may be described as "empowerment." By providing training, resources and encouragement, resource managers can empower landowners who have an expressed appreciation of sound land stewardship (i.e., a land ethic) to instill this ethic in others (Leopold 1949).

We describe a private lands management model that gives full decision-making responsibility to the landowner. The diffusion of innovations model characterizes how new ideas may be adopted and implemented by people (Rogers 1983). There are five components of this model: knowledge, persuasion, decision, implementation and confirmation. A landowner will be more likely to form a positive opinion about an innovation when in the presence of a knowledgeable peer who shares his/her positive experiences (Coleman et al. 1966, Rogers 1983). These ideas form the basis of a woodland owner education program, the Coverts Project, begun in Vermont and Connecticut in 1984 (McEvoy et al. 1988, Snyder and Broderick 1992). The success of the Coverts Project in these states, and more recently in Wisconsin, has convinced us to adapt the program from private woodlands management to the restoration and management of private wetlands.

The Coverts prototype has the potential to impact wildlife management on private lands throughout the United States, regardless of habitat type or target species. Whereas other programs primarily provide technical and service-oriented approaches to management, the Coverts program additionally encourages interpersonal communication and the creation of a network of motivated private landowners who willingly adopt wildlife management practices. The result is a network of trained laypersons who educate other landowners and encourage adoption of wildlife management practices.

We will present the premise of Coverts, national data to support the success of this resource management technique, Wisconsin's adaptation of Coverts from woodlands to wetlands, an evaluation of the effectiveness of our wetlands program and recommendations for similar programs. The information provided will facilitate the adaptation of the Coverts philosophy by other states to their desired habitats.

Coverts Programs

Background

The Coverts Project was initiated in response to private landowner desires to manage forests for wildlife and related values, and professional forest managers who wished to change the misconception that preservation is best for all wildlife (McEvoy et al. 1988). It began in 1984 as a cooperative effort between the Ruffed Grouse Society and the Cooperative Extension Services of Vermont and Connecticut. Each state's program sought to integrate wildlife and forestry goals with an emphasis on meeting individual landowner objectives for woodland management. Similar goals were retained as Coverts spread to other states: Massachusetts (1988); Maryland and Ohio (1990); Maine, New York, Pennsylvania and Virginia (1991); Wisconsin (1994); and New Hampshire (1995) (McEvoy 1993).

Coverts brings together motivated private landowners with shared interests in forest stewardship (Snyder and Broderick 1992). At the core of the Coverts Project is a three-day intensive workshop designed to train community leaders and forest owners who are already highly motivated to perform management but have limited technical expertise to do so. Applicants for the workshop are selected on the basis of primary interests, forest management experience, community involvement, communication skills and access to media resources. These criteria are important in that participants will be expected to convey their knowledge to other landowners and the media in attempts to reach as many people as possible. Completion of the workshop earns participants the title of "Coverts Cooperator."

A typical Coverts workshop attempts to provide a balanced program tailored both to participants' visions for their land and societal goals for forest stewardship. It is designed to be fun and educational with ample time for networking among participants (Snyder and Broderick 1992). Both indoor and outdoor sessions emphasize contemporary philosophies and practices of wildlife and forest management that are presented by wildlife and forest managers. Participants receive binders of resource materials, including lists of resource professional contacts, and publications on management practices and outreach methodologies. Participant expenses (e.g., meals, lodging and travel expenses) are paid by program sponsors. A critical aspect of Coverts programs is the provision of information within the context of participant values (Kelman 1958). The workshop presents new ideas that are adopted by Coverts Cooperators and reinforced by peers during informal interactions. A key to adoption and promotion of innovative ideas is the opportunity for discussion among participants and presenters, a component often lacking in shorter workshops.

After the workshop, Extension coordinators provide newsletters, announcements of woodland owner training opportunities, phone calls and site visits to maintain cooperator energy and enthusiasm. These additional post-workshop activities are important to the overall success of the program. They demonstrate the sincerity of Coverts coordinators and reinforce the value of management efforts. In the absence of such an ongoing educational component, even when a management practice is initially adopted, it may be disregarded later (Warner 1983).

National Impacts

Wisconsin initiated a Coverts program in 1994 after learning of its successful implementation in other states (McEvoy 1993). Evidence of a program's effectiveness is needed before others will consider adopting it. For this reason, we summarize the accomplishments of Coverts programs nationwide.

To obtain standardized data on the effectiveness of Coverts programs throughout the United States, we mailed a survey to all state coordinators in November 1996. Coverts coordinators were asked to report on years of operation, participant selection process, number of landowners or managers reached, acres impacted, follow-up techniques, budgets and program spin-offs. To facilitate the reporting of data, survey respondents were asked to check a range (i.e., 1 to 49, 50 to 99) for number of landowners/managers reached and acres impacted. We report data based on the midpoints of these ranges.

All 11 states returned completed surveys. State programs have existed for 14 years (Connecticut and Vermont), averaging 7 years of operation among the 11 states. All state programs are currently active, and all but two have operated continuously from their inception. During their combined 77 years of activity, states have trained 1,770 Coverts Cooperators. These cooperators own or manage 1.9 million acres of land (Figure 1). The average number of cooperators trained by a state each year is 23, with an average ownership of 1,348 acres. However, one Coverts program actively solicits larger land holders, accounting for the much lower overall median cooperator ownership of 500 acres.

The strength of Coverts programs is in the additional people reached through their cooperators, and 9 of 11 states were able to report data on these contacts. However, most of these data accrue from surveys of cooperators who provided *best estimates* only and, therefore, should be viewed with caution. The trained, volunteer cooperators in nine states have reached 110,000 other people with some type of forest stewardship message. Those persons reached by cooperators are estimated to own or manage 1.6 million acres of land in nine states (Figure 2).

The annual budgets of Coverts programs nationally average $12,700 per state with an additional $11,450 of in-kind support. Financial support for each state comes primarily from the Ruffed Grouse Society ($8,791), but other sources such as the National Wild Turkey Federation and the National Education and Training Foundation also provide substantial funds ($2,727). In-kind moneys in each state are derived primarily from Cooperative Extension ($8,650), but state natural resource agencies also contribute ($2,500).

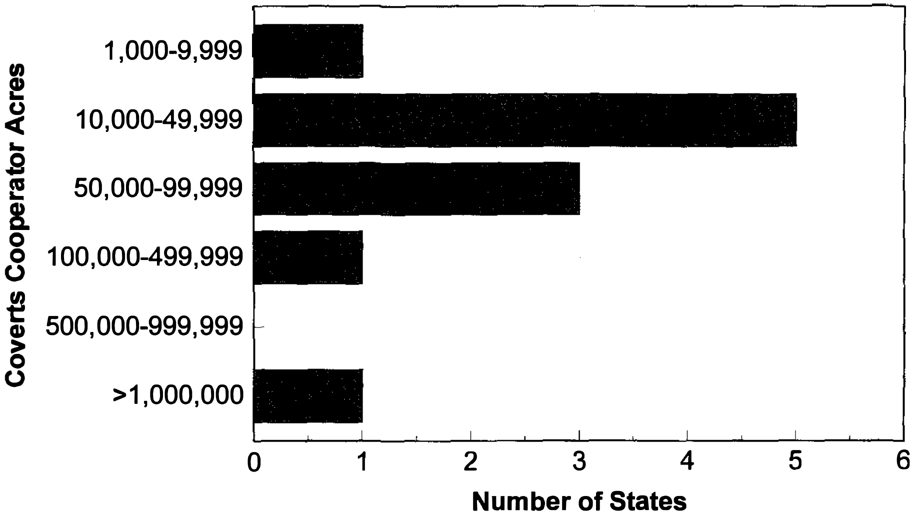

Figure 1. Distribution of Coverts Cooperator acres owned or managed, by number of states reporting.

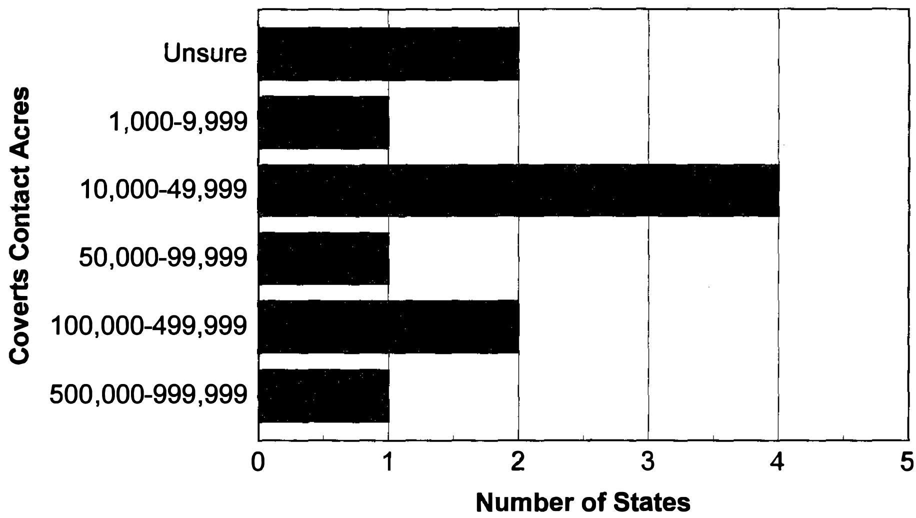

Figure 2. Distribution of acres owned or managed by Coverts Cooperator contacts, by number of states reporting.

Because of secondary contacts made via cooperators, Coverts programs are highly efficient in the number of people reached and acres impacted per dollar spent. For the nine states reporting people reached by cooperators, the average cost per person is $62 over the life of the program, including salaries and in-kind services. Exclusive of salaries and in-kind contributions, the average cost is $23 per person. The average cost per acre influenced[1] by Coverts projects is \$3.48, including salaries and in-kind support; excluding these, the average cost is \$0.88 per acre.

Adapting Coverts to Wetlands

Wetlands on private lands in Wisconsin require even more urgent attention than woodlands. Half of the state's wetlands have been converted to other uses since European settlement (Wisconsin Department of Administration 1995). With the exception of cost-sharing programs, private wetland restoration, management and conservation in Wisconsin have traditionally focused on government regulations, easements and acquisitions. Stimulated by the success of Coverts in Wisconsin and other states, we initiated a new and creative approach to wetland restoration and management, entitled the Wetlands for Wisconsin Project. This project, funded by the Wisconsin Coastal Management Program, targeted private wetlands through a comprehensive, hands-on, educational and outreach program.

Modeled after Coverts, Wetlands for Wisconsin empowers citizens interested in wetland restoration and management. Program sponsors pay for meals, lodging, resources and training at a workshop for private landowners and local government staff. In return, cooperators agree to implement sound wetland restoration or management plans on their own properties and to reach out to other landowners with the message of ecologically sound wetland stewardship. Local government staff who participate but do not own land are responsible only for the outreach component.

Brochures about the Wetlands for Wisconsin Program were distributed directly to landowners (members of the Wisconsin Waterfowl Association and former Coverts Program applicants) and local government staff (Land Conservation Department, Cooperative Extension agents, Department of Natural Resources and other Wisconsin Coastal Management Program contacts). Local government staff received multiple copies and were asked to give additional brochures to interested landowners. We also described the program in the Wisconsin Wetlands Association newsletter. Interested citizens then returned an application request form included with the brochure. As with Coverts, these applications guided participant selection by providing information as to their primary interests, wetland acreage and restoration potential, community involvement, communication skills, and access to media resources. In the end, selected landowners and local government staff attended an intensive, two-day wetlands workshop in May 1996 to become Wetland Cooperators.

Our workshop presenters represented a variety of federal and state agencies and conservation organizations. This tended to negate any perceptions of bias, and philosophical balance was stressed throughout. Workshop topics covered wetland values, wetland characteristics (hydrology, soils, vegetation and wildlife), regulations, technical assistance and cost-sharing, natural wetlands management, wetland restoration and management, plan development, and Wetland Cooperator roles. A collection of wetland publications was given to each participant in a binder for future reference.

[1]Acres influenced include land of Coverts Cooperators and contacts with whom they have discussed forest stewardship ideas.

Printed resources were selected from publications recommended by presenters and from a recent compilation of Wisconsin's wetlands literature. A bibliography of other wetlands materials and purchasing information was also provided. Future networking was facilitated by including directories of Wetland Cooperators and presenters in the binder.

Presentations occurred during two mornings of 15-minute to 1-hour sessions. Afternoons were spent in the field reinforcing each morning's classroom session by visiting restored and managed wetlands. Dinner and an hour of free time were spent at a nature center overlooking a 5,000-acre wetland. This enabled participants the freedom and flexibility to explore the wetland or interact with presenters and fellow participants on an informal basis. A final session entitled, "Developing your wetland restoration/management plan," allowed landowners time to develop goals and objectives for their own lands, incorporating concepts and practices derived from the workshop.

Wetlands Adaptation Assessment

Workshop Evaluation

Workshop evaluations were very positive. The workshop more than fulfilled participant expectations. Comments included:

- "I feel a lot more comfortable about going into my wetland management and construction with the valuable material handed out."
- "The quality of the speakers and the effort in putting the restoration booklet together will push me to meet the challenge of spreading the word to my fellow landowners."

Participants indicated a commitment to the goals of the program when asked, "What is the very first thing you intend to do as a Wetland Cooperator?" Responses included:

- "Draw up a detailed plan and set goals and a timetable—the vision has always been there."
- "See if I can get my neighbors to budge."
- "Call some of the people I've met at the workshop to discuss partnership possibilities."

Each cooperator said that, within a year, he or she expected to convince an average of five people to adopt the wetland restoration and management concepts proposed by the project. Our 19 cooperators committed to reach 88 such people in addition to implementing wetland restoration or management plans on their own lands. We estimated from evaluations that the total restored and managed wetland acreage as a result of the Wetlands for Wisconsin Project would be 5,656 acres, nearly 5,000 acres of which would be a product of cooperator outreach efforts.

Wetlands Impact Assessment

In September 1996, a follow-up questionnaire was sent to Wetland Cooperators. This survey provided preliminary data on the program's impact just four months after the workshop. Wetlands for Wisconsin Cooperator respondents (72 percent) were directly responsible for restoring or managing 1,647 acres of wetlands and associated uplands. They influenced an estimated 160 people in their communities, with a combined ownership of 2,785 acres. The reported total land owned by cooperators and their contacts is 4,432 acres. If we assume similar results by nonrespondents, then cooperators have reached 222 people for a total land impact of 6,137 acres. Wetland Cooperators have also been involved in the following activities: helping neighbors obtain management assistance (69 percent), influencing decision makers (54 percent), showing other landowners their management activities (31 percent), conducting workshops or gatherings on their land (23 percent), and writing or initiating articles for newspapers or magazines (23 percent).

The results of this preliminary survey suggest that the Wetlands for Wisconsin Project was successful in educating and motivating landowners and local government staff. By providing cooperators with resources, knowledge and encouragement, the project enabled a grassroots group of people to restore and manage wetlands on their own properties, as well as influence others to be responsible wetland stewards.

Conclusions

Coverts programs are highly successful in enlisting landowners as active ambassadors of forest management in their communities. The activities of Coverts Cooperators in Connecticut, for example, stimulated the creation of forest management plans by other private landowners (Snyder and Broderick 1992). Nationally, Coverts programs influence many people, impact an extensive land area, and accomplish both at a relatively low cost. This Extension outreach tool is currently a vital link to resource sustainability on private woodlands; however, it also has excellent potential to be applied to conservation issues in other ecosystems.

In Wisconsin, the Coverts model was applied to the restoration, management and conservation of wetlands. Although only in its first year, Wetlands for Wisconsin has had a measurable impact on the state's wetlands and the people who own them. We have summarized the numbers of acres affected and people reached through the program, but it is each individual's effort that makes the program work. As examples, individual Wetland Cooperators have been responsible for: revising management plans on 600 wetland acres through collaborations with individuals attending the workshop, working with others from the workshop to restore their wetlands, and writing a column in a county newsletter to offer wetland restoration assistance to interested landowners. These are some of the ways the Wetlands for Wisconsin Program has been translated into on-the-ground restoration, management and outreach.

Recommendations

Based on our experience with Coverts and the Wetlands for Wisconsin adaptation, we offer the following recommendations for those who wish to implement similar private lands management programs.

- Clearly identify the private lands management need.
- Secure long-term funding to ensure program continuity.
- Identify landowners and methods to reach them (i.e., via conservation organization newsletters, local newspapers, state natural resource agency managers).
- Make the volunteer cooperator role attractive by providing incentives (i.e., pay for workshop expenses).
- Choose presenters with knowledge of practical management recommendations to meet defined goals and objectives. Presenters should come from a variety of agencies and organizations to prevent the perception of a biased agenda and add credibility to the program.
- Choose printed resources with nontechnical, practical management recommendations, and ensure input from presenters. Include directories of participants and presenters to facilitate the network of cooperators and their access to human resources.
- Design workshop agenda to meet program goals, but also provide time for cooperators to apply concepts to their own situation.
- Workshop should be two to three and a half days in duration. Sufficient time is needed for education and interaction, but a longer format could discourage some from attending.
- Provide volunteers with informal interaction time with presenters and each other. It is important that participants enjoy the experience and begin the process of communicating stewardship ideas to others.
- Facilitate outreach efforts by providing a presentation on outreach possibilities, written materials on methodologies and specific tools, such as "Wetland Cooperator" business cards.
- Continue contact with cooperators after the workshop (i.e., newsletters, phone calls, site visits).

The concept of extending scarce educational resources through the efforts of dedicated, skilled volunteers has been the cornerstone of Extension programs for decades. Tens of thousands of 4-H leaders, Master Gardeners and others have carried Extension education to people who would otherwise not be reached. Coverts Projects across the country and now Wetlands for Wisconsin have demonstrated that this successful formula is applicable to a variety of natural resource management issues. Extension educators are now better positioned to capitalize on the private landowner's broad interest in wildlife. These volunteer cooperator programs will ensure that private lands continue to provide sustainable resources while contributing to the nation's biodiversity.

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Attitudes and Human Dimensions in Forest Ecosystem Management

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Background

Extension Research Project Goes Beyond Technology Transfer

The Cooperative Extension Service has established a national reputation for taking the latest in scientific advances and placing these new findings in the hands of those who need it. The project that follows was supported through Renewable Resource Extension Act funds, USDA Cooperative Extension Service, and was exemplary in the role of Extension to make available the latest information for educational planning initiatives on private lands. Funding was channeled through the Department of Forest Resources, Clemson University, which also supported this research.

A companion study to this was initiated through professors at Utah State University's Department of Forest Resources by Dr. Mark Brunson and Dr. Michael R. Kuhns. Their work included private landowners in the state of Utah. Another partner researcher who initiated a companion Indiana private landowner study was Dr. Scott Roberts of the Department of Forestry and Natural Resources, Purdue University. Dr. Roberts is now at the Mississippi State University Department of Forest Resources. The survey booklet that is described in this paper was a collective effort of all these professors and this paper's coauthors. However, the Clemson study included an additional section on an attitudes component that built on earlier attitudinal typologies developed by Dr. Stephen Kellert of Yale University, modified for this study's purposes with his permission.

Combined results of the collective findings that address ecosystem management landowner views in three different regions of the country, the West, Midwest and South, can be found in the *Journal of Forestry* (Brunson et al. 1996). Previous publications and presentations of results solely for the southern region have been made available with a focus on ecosystem management in the South (Yarrow and Guynn in press), communications and education (Yarrow and Guynn 1995), attitudes and perceptions related to wildlife economic management (Yarrow et al. in press), and implications of this study for southeastern deer managers and biologists (Yarrow and Guynn 1996), among others. As this paper addresses results only for the South and primarily relating to material on attitudes toward forest interests, readers who seek additional subject areas may consult the References section for additional publications.

Rather than relaying results identified by scientists unaffiliated with Extension resources, this project's objectives included both carrying out original research and disseminating the findings. Highlights of important data from the research analysis for nonindustrial private forest (NIPF) landowners in nine southern states include a variety of interests such as benefits and reasons for owning private lands, property rights issues, ecosystem management perceptions, preferences for communications channels to receive information, and sociodemographic profiles.

In addition, results from the attitudes component that builds on the Kellert typologies first presented at the North American just over two decades ago are included (Kellert 1976). Besides the change of focus in the original Kellert study from animals to the Clemson study's focus on trees and forests, a different form of statistical analysis was utilized to quantify the results. Results of attitudes and human dimensions studies such as this have great potential in future applications of conflict resolution, planning initiatives, and greater diversification of forest and wildlife opportunities. A cost-effective attitudes assessment tool, such as the one used in this survey, can link resource sustainability to accurate and specific priorities of NIPF land users.

Introduction

Expanding Traditional Boundaries in Forest Ecosystem Assessment

Currently, forest ecosystem planning is in a state of flux wherein singularly focused resource plans continue to incorporate more interactions, both in the natural and social sciences. Managers who plan for constituents with divergent interests seek refined, unambiguous and accurate measures to assess the forest attitudes of particular forest user groups. Without effective ways to assess attitudes, conflicts result from decisions that are made without balanced public input. Assessing attitudes through survey research allows for a greater number of respondents to address more specific issues, free of the bias or unbalanced representation that can be interjected unintentionally in a public meeting forum or verbal format. This study's objectives were to devise and analyze a survey tool to assess forest ecosystem attitudes among selected respondents who maintain a vested interest in the future of forest wildlife land management.

In the southern United States, participation of private landowners in cooperative management practices poses particular regional challenges. Private forest ownership predominates and forest industry is organized and assertive in affecting policy decisions. Of the 200 million acres of forest land in the Southeast, about 70 percent is owned by NIPF owners, 20 percent by industry and 10 percent by the public; as a further note, more than half of all the private industry lands in the United States are in the Southeast (Powell et al. 1994). Finding mutually satisfying ways for joint private landowner management strategies holds particular importance for this region.

Changing Forest Attitudes and Land-use Priorities

Today, increasing human demands for intangible forest benefits from diverse NIPF land users complicate management decisions. "Many practicing foresters appear unwilling to recognize that economic return is not the primary or even secondary reason these lands are owned, perhaps reflecting biases inherent in their training. In study after study, NIPF owners cite amenity values as major reasons for owning land" (Luloff 1995). Other recent studies of NIPF owners reveal noncommodity preferences. In Virginia, preserving nature, maintaining scenic beauty and viewing wildlife were the top three reasons to own land (Hodge and Southard 1992); another study in Illinois revealed providing shelter for wildlife, preserving natural beauty and reserving a heritage for future generations were the top three priorities (Tickner 1993). The implication when recognizing demands for amenity forest values should not be for an either-or management regime. Those experienced in multiple-use management certainly understand ways to integrate timber and wildlife management with these other priorities. First, the careful evaluation of what land users seek must take place, and priorities for a variety of preferences then can be set based on the results of human dimensions planning.

One forester recently noted that historical NIPF stereotypes are evolving so quickly that land managers need to "abandon the tendency to speak with authority on what our NIPF clientele believe and what information they 'need.' It is time to reexamine both our audience and our message" (Jones et al. 1995). Assessing forest ecosystem attitudes is neither an uncertain process or an unnecessary one. It requires effective communication. It also requires that natural resource professionals become more multidisciplinary in that they must move beyond expertise in the customary resource fields in which they were trained and become effective communications facilitators, which is outside their usual educational base. The tendency may be for resource managers, usually natural science specialists, to overlook or downplay the need for human dimensions information, usually a discipline within the social science confines. Unfortunately, the tendency to relegate human dimensions assessment as a secondary priority can result in conflict resolution disputes that create polarization of interest groups. With better tools to assess attitudes available to resource managers, they could effectively gather their own human dimensions information. This decreases the potential for costly conflict of interest battles.

The Need for Forest Ecosystem Attitudes Assessment Components

At present, no viable survey tool exists to assess a spectrum of the public as to their attitudes toward forest ecosystem management and forest values. Planning for the direction of ecosystem management requires careful assessment of public knowledge, perceptions and attitudes before effective management plans can be compiled. Many state and federal agencies have instigated educational and policy initiatives for the implementation of some aspects of forest ecosystem management. Some of these include the Forest Stewardship Program, Best Management Practice (BMP) Guidelines for landowners and industry, and the USDA Forest Service's retraining of employees in the Continuing Education in Ecosystem Management (CEEM) area. The history of programs, laws or restrictions mandated on a national level in a top-down approach have rarely succeeded in regional settings. Just as differences emerge in the landscape and biota of a particular setting, so, too, do particular distinctions exist among the people who live there.

Some groups of people take a more active interest in becoming involved in future direction of forest management than others do. Elected public officials in state congresses, particularly those with natural resource committee appointments, design legislation and appropriate funds to carry out natural resource policy at the state level. Natural resource professionals, such as foresters who are members of the Society of American Foresters (SAF) and wildlife biologists belonging to The Wildlife Society (TWS), all carry the responsibility of explaining and enacting management of trees and wildlife that inhabit forests. In a region like the South which is predominately privately held, NIPF landowners such as those who participate in Forest Stewardship landowner programs hold a vital key in forest management plans, because they will undoubtedly exercise their constitutional rights either to accept or reject any efforts for forest ecosystem initiatives on their property. Pubic lands will certainly be involved in future forest ecosystem planning, as will urban settings, so people who are actively involved in urban forest initiatives, such as the readers of the magazine *Urban Forests*, also hold views that will clearly impact the direction of forest ecosystem planning initiatives. In what ways are the attitudes of these groups toward forest ecosystems similar or dissimilar? Can an effective and concise measurement tool be devised to reflect such attitudes among diverse individuals? If forest ecosystem management is to move forward from the more haphazard, insular process of calling on anyone who decides to appear and speak at a public meeting to a more calculated, objective and precise method of ascertaining views, then better assessment tools must be designed to meet this end.

To determine the basic underlying typologies of forest attitudinal preferences in the southern United States, the current views of representatives of key clientele groups were measured via survey assessment targeting NIPF landowners, those with urban forest interests, elected public officials and natural resource professionals who collectively reflect forest attitudinal distinctions in this time and region; moreover, the development of this attitudinal component for inclusion of future survey questionnaires may provide a valuable assessment measure for researchers who seek accurate and concise measures for the human dimensions of forest planning.

Methodology

Participant Selection Process

Survey participants were selected from nine contiguous southeastern states, including Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Virginia, to reflect four basic constituent categories: nonindustrial private forest landowners (NIPF landowners), readers of the magazine *Urban Forests*, elected public officials in the congresses of state governments and natural resource professionals. The NIPF landowner survey recipients were randomly selected from lists of participating Forest Stewardship landowners provided by the program's administrative head in the selected states. An equal number of participants for each of the states was drawn, for a total of 500.

The urban survey recipients were selected from the readership of the magazine *Urban Forests*. These respondents were also drawn at random from their nine states of residence, with 250 total. The randomization was computer-generated by personnel in the magazine's publication office.

Elected public officials were selected from the existing rosters of state senators and members of the House of Representatives from the guidebook, *State Elected Officials and the Legislature, 1993-94* (Council of State Governments 1994) for the nine states. Phone calls were made to the clerks of court for both the Senate and the House of each state to obtain the names of members who also sat on natural resource or environmental committees, and preference was given to include those members over members with no such committee appointments where possible. A total of 250 elected public officials were selected.

Natural resource professionals were derived from two groups, members of The Wildlife Society and the Society of American Foresters. The 250 TWS members were randomly selected from their *1994 Membership Directory* (The Wildlife Society 1994), with equal numbers per state. The 250 SAF members were randomly computer generated on a list purchased from SAF and obtained from their national offices, also with equal representation per state. Every effort was made to ensure randomization for all respondent groups.

Development of the Survey Instrument

A 14-page survey with 41 questions was comprised of four sections: (1) questions that ascertained general feelings toward forest management practices and environmental concerns on a global scale; (2) questions that assessed knowledge and perceptions toward the term *ecosystem management*; (3) questions that indicated basic attitudes about forests and trees in the patterns first established by Stephen Kellert; and (4) questions to identify demographic and socioeconomic factors.

Sections 1, 2 and 4 of the instrument were compiled and devised during spring 1994 in a team effort involving researchers at Clemson University, Utah State University and Purdue University. Some portions of these survey questions were derived from earlier studies, such as a series of belief statements regarding ecosystem management developed for a survey in the Pacific Northwest (Brunson 1993), the Revised New Environmental Paradigm questions (R. E. Dunlap personal communication: 1993) and ratings of importance for reasons to own forested land which was modified from a study by researchers at Auburn University (Bliss et. al 1994).

In June 1994, the survey was pre-tested by mail on more than 100 participants at USDA Forest Service public meetings in the Andrew Pickens District of Sumter National Forest. Revisions and final selection of survey questions were made as a result of the pre-test. The questionnaire was reviewed and approved by the Clemson University Committee for the Protection of Human Subjects.

Data Collection

Survey packets were prepared following suggestions by Dillman (1978) and Salant and Dillman (1994) to increase response rate. Packets included a personally signed cover letter, a sharpened pencil to complete the survey, a pre-stamped return envelope and a survey. The survey booklets were individually marked with an identification number that allowed deletion of respondents from the pool as surveys were received. Survey booklets were also color coded so that respondents who marked out the identification number could still be placed into the appropriate group by the corresponding paper color alone. Recipients were also checked for the potential of overlap in groups before mailing so that no one potential respondent was included twice. Initial survey packets were mailed during the last two weeks of August 1994, with the first reminder postcard mailed two weeks following the packet. A second survey packet identical to the first except for a new cover letter was mailed between September 19 and 27, 1996, with a second reminder postcard following two to three weeks later.

A computer code book was designed for data entry that began in September and was completed in December 1994. Every survey response was entered once and double-checked for accuracy by a second entry clerk. Data were entered in an ASCII format suitable for many applications.

Although Kellert had pre-coded factors from his testing of attitudes toward animals and those coded questions were obtained in their most recent form (S.R. Kellert personal communication: 1993), the transfer of questions to the application of forest resources had never been tested before the pre-test of this study. In addition, some of Kellert's original questions were altered to reflect the change in focus from wildlife to forest resources. New questions in Section 3 of the survey were designed by Clemson researchers Yarrow and Guynn, and were added to investigate a potential factor entitled "Cathedralistic" that was not a part of Kellert's original typologies. Because of the exploratory nature of this study, principal component analysis (Hatcher and Stepanski 1994) was chosen as the statistical technique to delineate attitude groups within these data. The principal components method calculates a first factor that explains the maximum variance in all the scale items. Then additional factors are calculated in descending order with each explaining the remaining amount of variance left unexplained. These factors are rotated orthogonally, meaning each one is not correlated with one another. Rotating the factors orthogonally through a varimax calculation is a method of simplifying any relationship between scale items, so that each item will tend to load more highly on one factor (Rummel 1970). This technique is commonly used to test for unidimensionality among scale items. By incorporating principal component analysis, unbiased selections of related questions are then grouped and ranked according to their strength of measure.

The typology scale, first developed and tested two decades ago by Kellert to measure human attitudes toward animals, has been used in studies in various parts of the U.S. and abroad (Kellert 1976, 1980a, 1980b, 1993, 1996). The questions developed by Kellert have been refined by him to include nine categories of interests that the originator considers germane (Kellert 1996).

Kellert's Typology of Basic Values

Utilitarian: the practical and material exploitation of nature, which functions to provide physical sustenance and security.

Naturalistic: direct experience and exploitation of nature, which functions to fulfill the human need for curiosity, discovery and recreation.

Ecologistic-scientific: the systematic study of structure, function, and relationship in nature, which functions to provide knowledge, understanding and opportunities to develop observational skills.

Aesthetic: the physical appeal and beauty of nature, which functions to provide feelings of inspiration, harmony and security.

Symbolic: use of nature for language and thought, which functions to facilitate communication and mental development.

Humanistic: strong emotional attachment and "love" for aspects of nature, which functions to allow for bonding, sharing, cooperation and companionship.

Moralistic: spiritual reverence and ethical concern for nature, which functions to engender feelings of order, meaning, kinship and altruism.

Dominionistic: mastery, physical control and dominance of nature, which functions to provide additional mechanical skills, physical prowess and the ability to subdue.

Negativistic: fear, aversion or alienation from nature, which functions to provide feelings of security, protection, safety and awe.

As might be expected in a study that originates groundbreaking research, Kellert makes no claims that his typologies are all-inclusive or that no other categories exist. He states, "Although the scales have been statistically corroborated, they represent only crude approximations of the underlying values" (Kellert 1996). The original Kellert questions were devised to be answered in Likert-scale responses which he then factor-analyzed to determine strength of attitude categories and sociodemographic characteristics of the respondents in each attitude type.

This study adapts the original Kellert questions for a related domain of interest, forest ecosystem attitudes, and modifies Kellert's categories to complement an adaptation from animals to forests and trees as the central focus. In general, the changes simply modify animal examples to tree/forest topics, such as Kellert's aesthetic question, "When visiting a zoo, I most like to see the unusual and attractive animals"; this was altered in the Clemson study to become "I enjoy seeing unusual and attractive trees." Concern for aesthetic differences in assessing human attitudes toward forest management is documented in articles such as that of Gobster (1994). The dominionistic question of Kellert's survey, "I admire the skill and courage of a person who can successfully hunt in wild and rugged country" became the Clemson survey question, "I admire the skill and courage of a person who can successfully cut timber in wild and rugged country." By keeping Kellert's original questions as minimally altered as possible, the survey instrument remained consistent with the original design of a survey tested and discriminating typologies among thousands of recipients over two decades of assorted research applications (Kellert 1976, 1980a, 1980b, 1993, 1995, 1996, Kellert and Wilson 1993).

The placement of attitudinal category questions is random, so that respondents cannot discern attitudinal categories by examining the order in which questions are placed. The Clemson survey is different from Kellert's original attitudinal categories in two respects. First, no attempt was made to design questions to test for the original Kellert attitude "Symbolic." The artistic connection between trees as intangibly connected to metaphors, such as the Persian tree of life, the Judeo-Christian tree of knowledge of good and evil from the Garden of Eden, the hickory stick as an association for corporal punishment in 19th century America, "good" trees like an imaginary money tree or "bad" trees like those in the Enchanted Forest of *The Wizard of Oz* (Baum 1956)—all of these may be much more reflective of culture or living in a particular time and place than they are of attitudes toward forests. Second, questions to examine the possibility of a new typology, Cathedralistic, were devised; these would not have been as appropriate in the domain of wildlife as they are applied to forest attitudes.

Cathedralistic as a typology is defined as "an attachment to the forest as a place of sanctuary and spiritual rejuvenation." In some respects, this is similar to Kellert's definitions of "naturalistic" (a direct experience and exploration of nature) and "moralistic" (spiritual reverence and ethical concern for nature); however, as broadly as Kellert may define these attitudinal components, the specificity in the questions relates directly to animals, not trees or forested settings. Clearly, in the context of the questions in the Clemson survey, the typology Cathedralistic relates to the forest as a sacred or spiritual place.

The typologies identified in this study reflect striking similarities to forest values reported in the work of Bengston and Zhi (1995) and Bengston (1994). In their work, the authors computer-coded content analysis to empirically derive the evolution of forest values from 1982 to 1993. A classification system was devised that identified four broad categories of forest values: economic/utilitarian, life support, aesthetic and moral/spiritual. A content analysis procedure was developed to identify expressions of these values related to public forests in databases representing the views regarding national forests of three groups: the general public as reflected by newspaper articles; forestry professionals as represented in keynote and general session papers from SAF national conventions and articles in the *Journal of Forestry*; and mainstream environmentalists as represented in magazines published by the Sierra Club, the National Wildlife Federation and the Wilderness Society. Changes in value systems were tracked over time by quantitative summaries of the data. Results showed a decline in the relative frequency of expression of economic/utilitarian values and a rise in life support values among forestry professionals and environmentalists.

What these researchers have termed "values" certainly would be described more accurately as "attitudes," according to psychological distinctions wherein values are deep-seated views formed very early in life that are unlikely to change; attitudes, which stem from values, change more frequently. The confusion in terminology distinguishing values from attitudes is pervasive, however; Kellert himself publishes research using both terms to mean the same, as in his papers, "Public Attitudes Towards Critical Wildlife and Natural Habitat Issues" (1980b), "Attitudes and Characteristics of Hunters and Anti-Hunters" (1978) and "Values and Perceptions of Invertebrates" (1993a). In the book *Valuing Wildlife*, many researchers report what could be termed attitudes as values, such as chapters relating the socioeconomic values of wildlife, the importance of fish and wildlife values, the philosophical value of wildlife, and the role of values and valuing in wildlife communication and education (Decker and Goff 1987).

Analysis

The SAS system for statistical computer analysis was utilized for all calculations (Hatcher and Stepanski 1994). For all sections of the survey except the attitudes typologies in Section 3, analysis of frequency of means revealed group priorities. Answers concerning demographic data, benefits of forest land, perceptions and priorities toward ecosystem management and acreage of forest land owned, for example, were derived from an examination of mean scores.

In determining the reliability of Principal Components Analysis in the attitudes typologies, some measures of internal validity are indicative of successful results. Kaiser's Measure of Sampling Adequacy was calculated for both the combined respondents and then for all five respondent groups. All variables attained scores greater than .50, except one question which then was dropped from consideration in the combined survey data because its value was significantly below the average value.

Chronbach's Alpha Coefficient of internal reliability was calculated. The value of .94 for the combined surveys indicates strong internal consistency reliability for the test instrument. Other factors held constant, coefficient alpha will be high when many items are included in the scale, and the items that constitute the scale variables are highly correlated with one another (Hatcher and Stepanski 1994: 509).

After these initial measures reflected sound results, a principal component analysis was performed for all 50 attitude questions that comprised Section 3 of the questionnaire. Determination of the number of meaningful components involved the use of a scree test (Cattell 1966) examining for "breaks" in the scree plot. Components appearing before the breaks in the slope were considered meaningful and were retained. The scree test can be expected to be accurate provided the sample is large (more than 200) and most of the variable communality is large (Stevens 1986). Since it is very often difficult to determine exactly where the scree plot break exists, determinations considering the actual meanings within the logical understanding of questions were also considered. The eigenvalue-one criterion was not used because an examination of that form of analysis for these responses determined that it created too many smaller, fragmented and less logically connected responses than were suggested by the scree plot.

The continuing analysis focused on each population subgroup. Interpretation considered the implications from the components (or underlying constructs) retained for the larger sample, plus additional data from these observed variables considered separately.

Results

A total of 1,004 surveys were received, with response rates for every recipient group being reflective of a clear majority for all, with the exception of elected public officials, as follows: (1) *Urban Forest* readers, 64 percent; (2) SAF members, 77 percent; (3) TWS members, 84 percent; (4) elected public officials, 30 percent; and (5) Forest Stewardship landowners, 74 percent. The overall response rate for all groups combined, adjusted for undeliverable surveys, was 66 percent.

Sociodemographic Profiles

Respondents were predominately middle-aged and highly educated white males, with sex being 85 percent male, race being 98 percent white, the decade of age most commonly indicated was the 40s, and nearly 80 percent replied that they had completed at least a four-year college degree. No attempt was made to stratify the sex ratios or race of respondents for equal representation, so the results reflect more closely the demographics of members of these groups instead of the population in general. In addition to being highly educated, nearly half of these respondents reported that they had completed at least one course in forest biology and/or forestry, with close to one-third having obtained a B.S. or advanced degree in forestry. Rather than being reflective of a cross-spectrum of society, these respondents include many with advanced training in natural resources. More than half the respondents reported income equal or greater than $50,000, and well more than half were Protestants who reported attending religious services at least two or three times a month, although the most common category of church attendance was "every week."

Reasons for Owning Private Land in the South

Of 17 answer categories for the question "Which of the following benefits do you derive from your forested land," the top 5 priorities were as follows: (1) wildlife appreciation, (2) scenic enjoyment, (3) observing flowers/trees, (4) personal hunting, and (5) firewood for home use. Although timber income was one of the remaining potential responses, it did not fall within the five primary responses. In answer to the question "Please rate the importance of the following reasons for owning forested land," in a Likert-scale ranking, priority ranking of 13 potential responses indicated the following top 5 reasons: (1) providing wildlife habitat, (2) preserving natural beauty, (3) personal recreation, (4) simple satisfaction of owning land, and (5) sentimental attachment. Although timber income was a part of the next five reasons (with a rank of 17th), it still was not among the first half of the reasons that were prioritized.

Preferences for Communications Channels

When asked the question "Where do you get your information about managing your wooded land," the respondents noted the following top five sources: (1) advice from college or state forestry specialists, (2) Extension Service brochures or leaflets, (3) newspaper or magazine articles, (4) the USDA Forest Service, and (5) Extension Service agent advice. Library books and radio/television were the two least-preferred sources. Responses to the question "Which of the following educational methods or materials would you prefer to use for learning about your forested lands" included these top five preferences: (1) technical assistance from a forester; (2) brochures, booklets and fact sheets; (3) workshops or classes; (4) periodic newsletters; and (5) educational videotapes. Videotapes of conferences and computer bulletin boards were the least-preferred sources.

Attitude Typologies

Principal components analysis allows for responses to be significant if answers are skewed either in a positive or negative direction. Ten possible initial categories, therefore, resulted in twice as many potential category results, as answers could appear as either highly positive or highly negative ("strongly agree" or "strongly disagree") preferences. In fact, one category of Kellert's initial typology design entitled "Scientistic" was found to be "Anti-Scientistic" in these combined results. The top five attitude typologies for all combined recipients in priority order by variance explained are as follows: (1) Utilitarian; (2) Anti-Scientistic; (3) Cathedralistic; (4) Negativistic; and (5) "Aesthetic Management," which was a combination of questions from the original aesthetic typology combined with questions reflecting the manipulation of forest resources to beautify surroundings.

Analysis of each individual respondent group identified attitudinal typologies that were noticeably different from each other in all but one instance. For the readers of *Urban Forests* magazine, the top five attitude typologies were (1) Cathedralistic, (2) Utilitarian, (3) Scientistic, (4) Negativistic A (safety concerns), and (5) Negativistic B (wildlife fears). Attitude typologies in descending order for elected public officials included (1) Utilitarian, (2) Cathedralistic, (3) Anti-Scientistic, (4) Humanistic, and (5) Dominionistic. SAF typologies were found to be the most similar to elected public officials, with the top three typologies being the same: (1) Utilitarian, (2) Cathedralistic, (3) Anti-Scientistic, (4) Dominionistic, and (5) combined Humanistic-Moralistic-Negativistic responses. TWS attitudes included (1) Anti-Scientistic, (2) Humanistic, (3) Utilitarian, (4) Cathedralistic, and (5) Dominionistic. Forest Stewardship landowners included typologies that more often were combinations of attitude categories: (1) Anti-Scientistic combined with Negativistic, (2) Utilitarian combined with Dominionistic, (3) Cathedralistic, (4) Humanistic, and (5) Humanistic-Cathedralistic combined.

A regression of demographic characteristics onto the combined respondents' typology Cathedralistic, as one example, revealed that education levels (P value .0001, F value 5.67), sex (P value .046 and F value 3.98) and age (P value .072, F value 3.23) were significantly related to this attitude group. Equally revealing is what proved not to be significant. Income level, race and amount of forest income proved insignificant when related to Cathedralistic attitudes for this population. Time and space prohibits the reporting of all attitude typologies and relationships to demographic factors, but such factors are significant and should also allow managers to use demographic data as one factor to suggest predictions, but certainly not as a substitute for attitudes assessment in itself.

Conclusion

Members of the public who once trusted land managers to make decisions on their behalf are now skeptical regarding professionals' recommendations. A better understanding of attitudes, perceptions and human dimensions in forest ecosystem management will allow managers to make decisions based on a clear understanding of what their land users truly perceive as both commodity and amenity benefits. Allowing people to identify priorities removes guesswork and unintentional bias in management decisions.

The Clemson study offers a wealth of representative data regarding perceptions toward attitudes regarding forest use and the human dimensions of forest ecosystem management. But some may be wondering, "Will this solve the dilemma over ways to implement successful ecosystem management initiatives on private and public lands in the South?" Perhaps not today. "What does this study offer to enrich understanding of the problems inherent in land-management planning initiatives?" Here are some of those answers. This study revealed many specific points of the thinking of NIPF landowners of this region that may debunk misperceptions or myths. For example, these respondents do not report that radio or television is a source they trust for information regarding their wooded land; in fact, the media and library books fall at the bottom of their list, while advice from natural resource professionals remains at the top. They report clearly how they wish to receive information. Technical assistance from a trained professional, short and concise pieces of written information, and workshops or classes are their preferences. Computer bulletin boards fall in last place. Where many might perceive that attitudes toward the forest would remain the same for groups of a similar region or background, typologies of natural resource professionals, such as SAF and TWS members, reflect clear distinctions. This research demonstrates that scientists of human dimensions can accurately and precisely assess attitudes and preferences, and that this information is a vital component of resource planning.

Most forms of commerce in America use market analysis of some type to determine the products that Americans are interested in receiving. If one business does not meet that interest then another entrepreneur certainly will. It is time resource managers take a proactive stance instead of reacting to lawsuits and public protests when NIPF priorities are not recognized and understood. What we do about this information, whether people truly respond and begin to incorporate accurate human dimensions assessments, and where we go from here are tomorrow's challenges.

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Coastal and Great Lakes Sustainability Partnership Efforts by the National Sea Grant College Program

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This paper will provide a general overview of sustainability program efforts across the National Sea Grant College Program Network. It will also present selected examples from the states of Louisiana, North Carolina, Rhode Island and Washington on sustainability projects. These projects will demonstrate how universities, government and the private sector have developed partnerships to manage coastal resources on a sustainable basis. The examples will also demonstrate how these types of partnerships can provide economic, environmental and social benefits to local communities and private landowners.

National Sea Grant College Program

Congress established the National Sea Grant College Program in 1966 to "increase the understanding, assessment, development, utilization, and conservation of the nation's ocean and coastal resources by providing assistance to promote a strong education base, responsive research and training activities, and broad and prompt dissemination of knowledge and techniques" (National Sea Grant Program 1995).

The legislation called for a network of Sea Grant Colleges that would conduct education, training and research in field of marine study, and directed that grants and contracts go to "suitable public and private institutions of higher education, institutes, laboratories, and public or private agencies, which are engaged in, or concerned with, activities in the various fields related to the development of marine resources (PL 89-688 Sec. 204c)."

In the 30 years of federal support, 29 Sea Grant programs have been established in coastal and Great Lakes states and in Puerto Rico. These are the heart of a nationwide network of more than 300 participating institutions that draws on the talents of more than 3,000 scientists, engineers, educators, students and outreach specialists each year. This network has provided a powerful national capability in marine resource research and outreach that did not exist prior to 1966 when Sea Grant was established.

The sustainability of our coastal and Great Lakes resources has been a fundamental underpinning of Sea Grant's research and outreach activities since its beginning. Program efforts in the coastal and Great Lakes states have brought people together on a variety of issues to discuss and decide how to "meet the needs of the present without jeopardizing the future" long before sustainability was a popular topic. Over the past 30 years, we have equipped citizens with knowledge and skills that have enabled them to adapt to changing economic conditions and respond to the need for environmental protection. We have developed programs that have promoted an awareness of the economic, environmental and social benefits of sustainable practices—such as more efficient resource use by government, the private sector and homes—and have encouraged local governments, businesses and community groups to engage people in making these improvements.

In late 1995, a new Sea Grant Ten-year Network Plan (1995-2005) entitled, *Coastal and Marine Resources for A Sustainable Economy and Environment*, was developed to identify the key issues and opportunities that will require our attention into the 21st century. Education and technology transfer of sustainable practices to the private sector are critical elements of the plan.

This plan corresponds to a recent report, *Education for Sustainability: An Agenda for Action*, that was part of a national project of the President's Council on Sustainable Development. Representatives from many private, nonprofit and government sector organizations participated actively in developing a set of recommendations and actions on education for sustainability. If sustainability is to be achieved, the report points out that educators should take a leadership role, breaking new ground to prepare society for an age of accelerating change in a world of increasingly diverse and growing populations, an expanding economy, and changing global environment (President's Council on Sustainable Development 1996).

The report defines education for sustainability as "a lifelong learning process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, and commitment to engage in responsible individual and cooperative actions. These actions will help ensure an environmentally sound and economically prosperous future."

Sea Grant has developed numerous research and educational outreach partnerships with universities, government and the private sector to manage our marine and coastal resources on a sustainable basis. These partnerships have provided economic, environmental and social benefits to both local communities and private landowners.

The following are some notable examples of recent Sea Grant program achievements.

- Led the development of hybrid striped bass aquaculture, which has grown from a university demonstration project to a $6 million private fish farming industry in just six years. U.S. hybrid striped bass production is expected to exceed $50 million in five years.
- Developed new strains of salmon that grow three times faster than wild stocks using selective breeding techniques. The eggs of these fast-growing salmon are now being exported to aquaculturalists in Chile, Europe and Japan, creating a U.S. private industry now worth more than $5 million per year.
- Organized the first systematic effort in the U.S. to discover and develop new drugs from marine organisms. This biotechnology thrust has resulted in the discovery of more than 1,000 compounds—including at least 50 with significant potential for treating inflammatory diseases like arthritis and asthma—and awarding of 14 patents through mid-1995.
- Investigated the potential human use of alligator meat that was largely discarded in Louisiana until the mid-1980s. (Louisiana legally harvests more than 25,000 wild alligators and more than 150, 000 farm-raised alligators each year.) Sea Grant supported nutritional and market research development resulting in broad public acceptance of alligator meat as a table food. Today, more than 95 percent of the available alligator meat resource is being utilized in the market both here in the U.S. and overseas. Annual meat sales in Louisiana exceed 1 million pounds valued at more than $3 million wholesale.
- Conducted research on nutrient run-off from agriculture into bays. Transferring this information to government has led four states to adopt "best management practices" (BMPs). Adoption of these BMPs by private landowners has resulted in a 25-percent reduction of nitrogen compounds entering some bays, with a subsequent improvement in water quality.

As previously stated, various state Sea Grant programs have incorporated this education for sustainability approach into many of their program activities. A sample of past and present projects will follow from Louisiana, North Carolina, Rhode Island and Washington that demonstrate the variety of these educational activities with the private sector.

Selected State Sea Grant Projects

Louisiana—Sustainable Coastal and Wetland Systems

Louisiana contains 40 percent of the coastal wetlands found in the continental United States. The importance and productivity of Louisiana wetlands are being assessed by its citizens in view of the fact that 25-30 square miles are being lost annually. Erosion, subsidence, sea level rise, channelizations, canal dredging, saltwater intrusion and pollution are only some of the many parameters that factor into the loss of Louisiana's coastal wetlands.

Economic development in Louisiana is largely dependent on the state's vast natural resource base. Natural resources of economic importance are coastal and wetland environments, with their associated yields of fish, shellfish, wildlife and timber; subsurface hydrocarbon and mineral reserves; and waters for transportation, recreation and tourism, aquaculture, industry, and municipal use. These sustain major industries that include commercial fishing, seafood processing and retailing; oil and gas production, with a large variety of related oil field service and logistical support activities; maritime and inland waterway transportation; petrochemical manufacturing; and nature-based economic activity related to recreational fishing, hunting, boating, shelling, bird watching and diving.

Wetland and coastal resources that were once thought to be unlimited are now being closely examined by various user groups. The tremendous increases in state, federal and local interest in wetland conservation, management and protection have major impacts on Louisiana's citizens. There are approximately 3 million acres of coastal wetlands in Louisiana, with 80 percent privately owned by large corporate or individual landowners with substantial holdings, and by individuals with small but critical holdings.

The complexities of these wetland issues have led Louisiana State University's Sea Grant Program to implement an extensive educational effort. This effort is attempting to coalesce research results, management strategies, government agencies with regulatory authority, private landowners and the citizens of the state to address the problems of resource utilization and management of its fragile wetland environments. These educational activities to ensure the sustainability of Louisiana's coastal wetlands include the following.

- Produced a publication entitled, *Wetlands Functions and Values in Louisiana*. This publication was first published in 1993 and is now in its fourth printing. A slide program and educational CD have also been developed to complement the publication. All have been used heavily by governmental agencies and schools to help everyone better understand the importance of wetlands in Louisiana.
- Conducted more than 30 parish (county) meetings where private landowners and the general public learned about the importance of wetlands in Louisiana, the regulations affecting these wetlands, impacts on these resources, and steps that can be undertaken to reduce the negative impact on wetlands and associated resources.
- Conducted eight coastal wetland field days since 1994 to help landowners understand the importance of wetlands and demonstrate the need for coastal wetland restoration.
- Conducted wetland field days to help agricultural wetland owners become aware of the national Wetland Reserve Program (WRP). A video was also developed to explain the WRP and is provided free to anyone interested in the program. Louisiana led the nation in land offered during the June 1995 WRP sign-up.
- Developed a quarterly wetland education newsletter (begun in 1992) that keeps landowners, farmers, governmental agencies, conservation organizations and the general public abreast of wetland policy issues and initiatives.
- Cooperated with the Natural Resources Conservation Service and the U.S. Fish and Wildlife Service in the development of a Private Lands Technical Assistance

Handbook for Louisiana in an effort to make landowners aware of wetland conservation initiatives available from federal and state agencies and nongovernmental organizations.

- Conducted 10 meetings with the Louisiana Departments of Natural Resources and Wildlife and Fisheries aimed at informing commercial and recreational fishermen about the importance of coastal wetlands to sustainable seafood production.
- Completed a study titled "Landowners' Perceptions Related to Wetland Regulatory Policy in Coastal Louisiana" that has been used to develop and implement a wetland educational program that targets the coastal landowners.

North Carolina—U-Rake-It Clam Project

The small-scale clamming industry is a significant component of the economic fabric of the North Carolina coast. Presently, there are about 60 small-scale clam growers who tend 285 shellfish leases. In 1994, these growers produced 12,100 bushels (about a half million pounds with shell) of clams in North Carolina. This amounted to more than $850,000. Over the past decade, the number of clams harvested by these commercial leases has averaged about 10 percent of the total state harvest. The majority of the harvest has been by traditional commercial harvest methods and recreational users.

Due to the increased demands placed on public coastal resources by an expanding coastal population, conflicts with other uses are inevitable and make it increasingly difficult for growers to obtain bottom leases. In fact, in some parts of the state there is a moratorium on shellfish leasing. The state's concern regards the setting aside of public trust resources for the private use of individuals because the public is denied use of the resource. But, access to these clamming grounds by the public is becoming increasingly limited. In addition, knowledge of clamming techniques by tourists who are without coastal roots is declining. The state grants leases to private growers for the right to use public bottomland for the purpose of growing clams and other shellfish. In essence, the leaseholders have the exclusive rights to the bottom—nobody else can harvest the shellfish there. These leases are approved only after they meet certain criteria: the area must not contain commercial quantities of wild clams and must not conflict with traditional water uses, such as fishing, navigation or recreational uses.

However, clamming is a centuries-old tradition along the coast of North Carolina and a skill that has been passed down for generations. There is a knack to knowing where clams can be found under acres of tidal flats, recognizing the telltale "keyholes" of clams in the sand, and detecting the clink and pull of metal tongs on buried shell. The know-how of harvesting clams is a closely guarded secret; and clamming grounds are off-limits to the public. How can this continued demand for clamming be met in an environmentally and economically viable way?

In 1995, North Carolina Sea Grant coordinated a project, funded through the National Coastal Resources Research and Development Institute (NCRI), to test the viability of a private business that combines competitively priced seafood, an outdoor activity for tourists and easier public access to a long-standing coastal tradition. This "you-rake-it" style clamming business on the Outer Banks, near Hatteras Point, North Carolina, is based on the pick-your-own vegetable patches that are common to rural areas. The goal of this project is to enhance tourism in the local area, and harness its power for the commercial fishermen and shellfish growers who are searching for economic opportunities in the face of declining catches and tougher regulations.

For this demonstration project, a local clam farmer reorganized and roped off part of his shellfish bed leased parcels for tourists and local residents to dig their own catch. The customers pay an admission fee that covers the right to harvest clams (up to 100 clams per person per day), instructions and the equipment, such as a rake and mesh bag. The clam farmer continually seeds his plots with homegrown little neck hard clams from his nursery and larger clams (i.e., cherrystone, topcherry and chowder) that he buys from local dealers. All these clams are the same genus, *Mercenaria*, but they are distinguished by size. In addition to the admission fee, the customer is charged for each clam collected, with prices set between wholesale and retail (i.e., the price the customer would pay for the same clams in a seafood shop). In this way, both grower and customer come out ahead, with the result being that the grower increased his net profit by $3,000 per month and more than 4,000 tourists to the Outer Banks enhanced the quality of their stay, learning more about the traditions and culture of the Outer Banks.

Preliminary reports are positive. It appears that net profits will increase by 20 percent. If it does this well, it is anticipated that 10 to 15 new businesses in North Carolina and at least one new business per state from Texas and Maine will be developed within three years. Upcoming plans are for the North Carolina Sea Grant Program to publish a manual on how to start a recreational clamming business. The Agricultural Communications Department at North Carolina State University will produce a 10- to 12-minute video explaining the more intensive information in the manual. North Carolina Sea Grant Agents will also share the information through East Coast training workshops and regional and national conferences about shellfish and nature-based tourism.

By promoting clamming as a recreational activity, the commercial growers can educate people about the resource and environment, and also cash in on the booming tourism industry—now the fastest growing segment of the state's economy. In the Hatteras Point area alone, there are close to a million people that visit each year. These people are interested in fishing, beach walking, bird watching and other outdoor recreation. U-Rake-It clamming may become an inexpensive and painless way to experience a centuries-old tradition. This new twist of nature-based tourism—merging commercial fishing and tourism—is being promoted by Partnership for the Sounds, which also received NCRI funding to plan for sustainable economic development in the Albemarle-Pamlico region. Involving visitors in commercial fishing is one way to expand tourism, provide extra income for watermen, and educate people about the importance of the fishery and the estuary.

Rhode Island—Promoting Ecosystem Management on Aquidneck Island

In coordination with the Newport County Chamber of Commerce, in 1995 the University of Rhode Island's Coastal Resources Center (CRC) hosted a workshop series for municipal board and commission members from Portsmouth, Middletown and Newport. These workshops helped local officials develop the knowledge and skills necessary to make decisions that balance economic growth with environmental quality specific to Aquidneck Island. In 1996, CRC continued to strengthen its commitment to the Island communities by collaborating with the community planners and leaders, the private sector and Island organizations toward implementing activities to solve key issues through the promotion of community-based ecosystem management on Aquidneck Island. For 25 years, CRC has worked on coastal projects within the state, nationally and around the world to effectively manage coastal resources. On Aquidneck Island, CRC is working in partnership with all Island stakeholders to plan a future that balances environmental and economic concerns for the benefit of the entire community.

The three key project components address priority issues and objectives that have been identified by the Island's residents. Educational activities that will be developed in the near future include:

- The Aquidneck Island *Perspective: People and the Place* video and booklet. These will identify Island-wide issues and community leaders, and describe the evolving relationship between the Island's economic development, quality of life and its natural resources.
- *Perspective: People and the Place* will explain the evolving relationship between the economy, quality of life, and the environment—told by the local residents through stories about their personal histories and perceptions of how life on the Island has changed over time. Emphasis will be placed on treating the Island as an ecosystem, with particular concentration on the interaction between land and sea. This information will be used to initiate a dialogue at public meetings, in classrooms and with the private sector on difficult and conflicting management and policy issues.
- The Greenways Practical Exercises will achieve a shared vision for the Island by community leaders and local landowners. Achieving a balance between economic health and environmental well-being on Aquidneck Island requires a long-term commitment and an understanding of the issues by all stakeholders. CRC is coordinating with Island groups and individuals (such as the Aquidneck Island Planning Commission, Newport County Chamber of Commerce, the Aquidneck Island Land Trust, the Historical Societies, the Aquidneck Island Bicycle Task Force and Citizens Advisory Committees) to implement the Greenways Practical Exercises to provide examples of promoting ecosystem management.

- *The Island Vision and Action Plan* will promote integrated planning by the three Aquidneck Island communities. During winter 1997, CRC will co-coordinate the development of an Island Vision and Action Plan. Participation from all sectors of society will reflect the strong sense of what people want for the Island and for themselves as Islanders. The Island Vision document will illustrate the interrelationship between key Island issues, such as open space and transportation, and will be introduced at public meetings, in classrooms and to the private sector to discuss difficult and conflicting management and policy issues. This intense participation will encourage Islanders to work together for the future, preserve the sense of place and quality of life valued by the residents, and create an Action Plan to achieve the Island Vision.

The CRC Aquidneck Island Project is sponsored by The Prince Charitable Trusts, van Beuren Charitable Foundation, Alletta Morris McBean Charitable Trust and Rhode Island Sea Grant Program.

Washington—A Sustainable Shellfish Industry

Shellfish aquaculture is an important Washington industry with more than 500 farms, most of which are involved in the production of Pacific oysters and Manila clams. Other species farmed on a lesser scale include mussels, Olympia oysters, European flat oysters and Kumamoto oysters. Pacific oysters are Washington's most important aquacultural crop. Annual production of Pacific oysters amounts to 8 million pounds, with a farm value of more than $17 million. This production makes Washington the number one producer of oysters in the United States. The majority of these oysters are harvested on private lands. Over the years, the state of Washington has sold these tidelands or provided long-term leases to shellfish growers. As such, growers own valuable tidelands that are managed with environmental and economic values in mind. Good water quality in these tidal areas is also a necessity for grower profitability.

In recent years, there have been declines in production due to natural and anthropogenic changes in the environment. Declines have been attributed to the El Niño event that occurred between 1991 and 1993. The net effect of the disturbance was a severe drop in annual yield per acre. Also, increasing population growth near prime shellfish growing areas, associated poor land-management practices, failing on-site sewage systems and industrial discharges have resulted in a number of bays closed to shellfish harvesting.

To deal with changing environmental, health and regulatory issues, the shellfish industry needs the latest information to remain economically viable. Private landowners also need information on how they can reduce their negative impacts on the marine environment. Because of these needs, the Washington Sea Grant Program, located within the University of Washington, developed and implemented an extensive educational program targeting private shellfish growers. Additionally, an extensive water quality education program has been developed for the local private landowners that focuses on non-point pollution problems that impact shellfish beds.

Recent educational activities include the following:

- Coordinated annual Shellfish Growers Conferences (since 1990) where research results are presented that address grower problems and technical solutions, such as new hatchery methods and new nursery techniques. Average annual attendance at this conference is 200 growers; this is the largest gathering of private shellfish growers in the Pacific Northwest.
- Provided technology transfer of new culturing techniques that allow shellfish growers to plant and harvest triploid oysters. Through many years of research, a method was found to genetically develop (produce) triploid oysters (extra set of chromosomes). In essence these oysters became sterile, allowing them to grow during summer months when they typically reproduce. Meat yields from triploid oysters are 40 percent greater than natural diploid oysters. Currently, these triploid oysters are being farmed on about 450 acres in Washington and California, providing 540,000 gallons of oysters worth about $16.2 million wholesale per year. This represents a net revenue increase of more than $4.6 million.
- Coordinated with the shellfish and finfish industries on a project involving the reporting, sampling and analysis of phytoplankton blooms that were associated with shellfish and finfish losses. The local growers were trained to collect samples which then were analyzed by university researchers. These blooms can have devastating economic consequences. These included a clam mortality episode at Discovery Bay; a noxious phytoplankton *Heterosigma* bloom in North Bay that killed salmon, perch and flatfishes, and that was immediately followed by a PSP bloom; and a summer oyster mortality episode that occurred during a build-up of *Ceratium fusus*. This led to a coordinated industry workshop with a Sea Grant researcher who provided information on an early warning test kit for *Heterosigma*. Private growers will be able to monitor phytoplankton-related water quality problems and take appropriate action if there is a bloom.
- Coordinated a series of small-scale aquaculture workshops for private landowners throughout Puget Sound. More than 900 shoreline owners learned about (1) the culture of shellfish on their lands, (2) considerations for commercial production, (3) the importance of water quality for shellfish production, and (4) best land-management practices to lessen negative impacts on the water environment. Follow-up evaluations indicated that more than 50 percent of those attending had changed their practices following the workshop.
- Developed an extensive educational effort on non-point pollution for upland landowners. The project focused on failing on-site septic systems. Educational materials included publications, slide programs, videos and posters. Workshops, radio programs and community meetings were developed to transfer this information to the landowner. Failing on-site sewage systems and associated pollution (i.e., fecal coliform) into the marine waters has been one of the major factors causing the decertification of private shellfish beds in the state of Washington. Better management practices by the landowner have resulted due to improved regulations, enforcement, education and technology transfer of new on-site sewage systems. In 1995 to 1996, several bays were recertified and shellfish harvesting could once again continue in these areas.

Summary

The National Sea Grant College Program (NSGCP), through it's 29 state programs, funded research and outreach projects dealing with sustainable development long before it became a popular word and action agenda item. Sustainability is woven into the legislative mandate, the philosophy and the fabric of the program. The legislation was meant to encourage economic development, with an understanding of the effects this might have on our marine and coastal resources; and the intent is to be able to encourage development while conserving our marine and coastal resources.

As such, one of the underlying goals of the NSGCP is to help achieve sustainability of our nation's marine and coastal resources. This goal requires not only scientific knowledge and understanding through research, but also communication and transfer of that knowledge to all citizens and incorporation of the knowledge into environmental, economic and political decisions. As outreach professionals, we need to increase the rate and effectiveness of the dissemination of scientific knowledge into the public policy arena so that management and stewardship of our marine resources can be significantly enhanced. To that extent, we support the recommendations outlined in the *Education for Sustainability: An Agenda for Action* report that points out that education is one of the keys in this effort.

Over the next 10 years, the NSGCP will focus on three major areas with strong sustainability components. These three areas are economic leadership, coastal ecosystem health and public safety, and education and human resources. Under economic leadership, the goals of the NSGCP are to stimulate a stream of scientific knowledge and new technology that will strengthen U.S. leadership in ocean and marine-related industries, and to enhance the social and economic well-being (i.e., sustainability) of coastal communities.

Under coastal ecosystem health and public safety, the goals of the NSGCP are to develop research and outreach programs that will help to ensure healthier coastal and Great Lakes ecosystems through greatly improved water quality; restore more high-quality habitats for living marine resources; foster the integration of the physical and biological sciences with economics and the social sciences in the development of resource management policies; and increase capabilities to deal with coastal and natural hazards in order to protect life and property.

Under education and human resources, it is the goal of the NSGCP to provide national leadership to develop well-prepared professionals who understand the changing nature of science and research in marine and coastal problems. NSGCP will continue to be a leader in providing marine and aquatic environmental information, science and technology to the general public, as well as to those in the pre-college system. It will draw on its partnerships of people, universities, government and businesses to ensure a technically trained work force and a scientifically and environmentally informed citizenry in the 21st century.

The NSGCP will ensure that its funded research, education and outreach activities play a very important role in future dealings with the issue of sustainability, whether on public or private lands. Through these efforts, local landowners, governmental

officials and business leaders will be better aware of marine and coastal issues; thus becoming better equipped to take action to solve problems and assure that sustainable development and environmental stewardship are the norm on both public and private lands in the years to come.

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The U.S. Fish and Wildlife Service/Extension Connection: A Partnership in Action

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In 1977, the 42nd North American Wildlife and Natural Resources Conference hosted a session on Extension much like this one. Then, as today, the closing paper was presented by a U.S. Fish and Wildlife Service (FWS) employee, Jack Berryman (1977: 351) who said, "Clearly, improved decision making requires objective, factual information so that citizens can make intelligent choices. This is the highest of conservation priorities. One step towards achieving it would be a partnership arrangement between the federal Extension Educational System—the most far-reaching educational system in America—and the Fish and Wildlife Service—the national repository of knowledge on fish and wildlife resources." Today, I would like to document the accomplishments of the partnership that was consummated shortly after that conference and issue a challenge to the conservation community to utilize this vital outreach tool more fully.

Organizational History

The papers presented at that 1977 North American session were reprinted under separate cover by the Wildlife Management Institute in July 1977. In the foreword, Dan Poole (1977) stated, "Gratifying progress has been made since March. An agreement has been signed between the Extension Service and the U.S. Fish and Wildlife Service. The latter also is negotiating an agreement with the Office of Sea Grant and is establishing an Office of Extension Education. The Extension Service is recruiting a national fish and wildlife staff specialist." Jim Miller, cochair of today's session, was that staff specialist and still is the National Program Leader. The aforementioned Jack Berryman was the first Chief of the Fish and Wildlife Service's Office of Extension Education. Several organizational and name changes later, the FWS extension function still exists under the Division of Education of the National Conservation Training Center. The agreements with Extension and Sea Grant are still in effect, and the program is ongoing.

Operating Model

The original concept of this partnership was clearly implied in Jack Berryman's statement. The Extension System and the Office of Sea Grant have the delivery systems and the Fish and Wildlife Service has the information. The first part of that statement is clearly evident, but the FWS certainly makes no claim to a monopoly on resource knowledge. Moreover, and this is a dose of realism, the FWS management considers resource issues that fall outside its area of direct responsibility as low priority. Rather quickly, the focus of the FWS Extension Program shifted in three areas. The first was a greater reliance on the knowledge base inherent in the universities and, more specifically, the expertise of the Extension Fish and Wildlife Specialists. The second was a subject matter orientation directed toward areas of mutual interest (FWS and its Extension/Sea Grant partners, rather than needs identified solely by the latter). And the third was placing less reliance on FWS Extension base funding, using these resources more as "seed money." Having made those accommodations to reality, the program has accomplished much in the past 20 years.

The model is simple and efficient. A modest source of base project funding is provided to the FWS Extension component. Extension and Sea Grant people at the state level are kept advised of the FWS resource priorities both through direct communication with the FWS Regional Extension Coordinators and through the Extension and Sea Grant National Program offices. Proposals for projects that address these priorities are submitted from the states to the FWS Extension office. These are cooperatively ranked, appropriate FWS Program offices are solicited for matching funding and the highest priority proposals are consummated with a Cooperative Agreement. Often, the proposals are already partially funded, and multipartner projects have become relatively common. On average, the university (State Cooperative Extension Service) contributes about half the cost in funding or in-kind services.

Accomplishments

This is the 20th year of our productive collaboration, and I believe that we can look back and find much to be proud of. Cooperative products have come from 47 states, the U.S. Virgin Islands, Puerto Rico and even Venezuela. Through Fiscal Year 1996, we can count 297 separate projects with cooperative funding totaling more than $6 million. Of that total, 36 percent has been the aforementioned FWS base Extension funding, 22 percent was received from other FWS funds, 30 percent from the Extension cooperators (a low figure, because in-kind costs were not identified in earlier programs) and 12 percent from other funding sources (Table 1). It is instructive to note that in the first 10 years, 53 percent of funds were acquired from the Extension base, 17 percent from other FWS funds and only 4 percent from outside sources, whereas the last 9 years show only 27 percent from the base, 25 percent from other FWS dollars and 16 percent from the outside. People have been buying into the program!

The FWS base project funding for Extension has fluctuated from a high of almost $209,000 in 1985 to a low of $19,000 in 1982. For the past nine years it has averaged about $114,000. (Fiscal year 1996 was a budgetary loser for many programs, and Extension was no exception!) The average total cost of a cooperative project is $20,230, with FWS base funds contributing $7,331 to this total. While funding does not directly measure the importance or impact of the program, it is an indication of how well it is being received by managers. It is somewhat disturbing to note the steady decline in total program dollars since 1990, but there are many contributing factors. With the recognized need for expanded outreach efforts in the natural resources area, I am confident that this trend will be reversed.

One of the more striking aspects of this partnership has been its wide scope. Subject matter has varied from fish culture and aquatic plants to wetland values, endangered species, wildlife damage control, land management, song birds, pesticide impacts and, particularly, youth educational programs, notably 4-H (Table 2). The FWS has supported the 4-H Wildlife Habitat Evaluation Program (recent winner of The Wildlife Society's Conservation Education award) from its inception. Not only has the extension program's subject matter been encompassing, but the outreach methods have run the gamut. It has supported a variety of workshops, a broad spectrum of publications, films and videos, slide-tape shows, posters, environmental education curricula (notably for 4-H youth) and an interactive satellite broadcast related to wildlife-friendly farming methods (Table 2).

Table 1. Mean cost-share funds (percentage) at three-year intervals.

Year	FWS base	Other FWS	In-kind[a]	Other	Total
1979-81	$80,965 (64)	$29,730 (17)	$28,574 (16)	$5,000 (3)	$177,603
1982-84	67,339 (58)	13,352 (7)	68,156 (33)	4,083 (2)	202,929
1985-87	150,940 (43)	79,843 (23)	94,076 (27)	22,500 (7)	347,359
1988-90	129,243 (25)	120,713 (23)	152,634 (29)	119,301 (23)	521,890
1991-93	117,779 (24)	132,317 (27)	180,615 (36)	63,745 (13)	494,455
1994-96	96,174 (39)	57,059 (23)	65,235 (27)	26,475 (11)	244,943

[a]In-kind costs include all Extension Service or Sea Grant cooperator funds, as well as contributed salaries, overhead, etc.

Table 2. Scope of Extension activities, 1978 to 1996.

Subject matter (number of projects)	Tool used (number of projects)
4-H/environmental education (66)	Publications (126)
Wetlands (59)	Film/video (45)
Fisheries (34)	Workshop/conference (21)
Land management (32)	Curriculum package (19)
Endangered species (30)	Slide/tape (18)
Waterfowl (14)	Poster (8)
Nongame (13)	Other (60)
Animal damage control (11)	
Environmental contaminants (11)	
Miscellaneous (27)	

It is difficult to select specific examples of the program's excellent products without slighting the Extension producers of equally fine efforts...but I will! In the education field, I have mentioned the Wildlife Habitat Evaluation Program. The Adopt-a-Salmon Program is a joint endeavor of the Maine/New Hampshire Sea Grant Marine Advisory Program and the Central New England Anadromous Fish Program of FWS, with support from the FWS Extension base funds, University of New Hampshire Cooperative Extension and the New England Salmon Association. During the year-long program, middle school students learn about the biological and cultural dynamics of a watershed by exploring a wide range of subjects via a newsletter, lessons, activities and field trips, as well as by incubating Atlantic salmon eggs in the classroom. As they witness the development and hatching of the eggs, the students tend to become very protective of the salmon. After they return the salmon to the wild, this stewardship ethic extends to the salmon's habitat.

In the resource area, "biodiversity" has become a rather poorly understood buzzword. Two excellent publications, one directed toward a lay audience and the other to a somewhat more resource-aware group, were produced by Tom Barnes of Kentucky Cooperative Extension. Gary Goff and Paul Curtis of Cornell University Cooperative Extension produced a top-notch video titled, *Biodiversity for Farms and Forests*. I believe that these products have done much to dispel concerns about and increase basic understanding of the biodiversity concept in the target audience, principally landowners. Another Cornell product titled, *Restoring the Balance: Biological Control of Purple Loosestrife*, is a video that typifies the best of Extension products. It provides a thorough background of the problem, demonstrates the early, relatively unsuccessful attempts at control, and then provides easy to understand how-to instructions for the wetland manager and anyone else who wishes to preserve natural wetlands.

Other outstanding Extension products of a different nature are the publication *Pesticides and Wildlife* and its companion publication *Pesticides and Aquatic Animals* produced by Virginia Tech. Both publications provide exhaustive lists of the least-damaging alternatives for farmers, and document the damages caused by improper use of pesticides. Among its funding supporters, the former had the National Fish and Wildlife Foundation and six agricultural chemical companies, one of which chose to remain anonymous. What better way to get attention and buy-in from the agricultural community!

Future

Reflecting on past accomplishments feels good, but we must answer the question, "What are you doing for me TODAY?" And perhaps a more important question, "What could we do in the future that has not been done to date?" It is the latter question that provides the greatest challenge to us all. In the original concept, there was a third leg to our Extension/Sea Grant-FWS stool—the state conservation agencies. At one point early in the program, nearly all of these agencies identified a person as the contact point for Extension activities. From our dusty files I can resurrect the names of these people (proof that feds never throw anything away unless it is important!). At the 1977 session, Del Benson (1977: 296) stated, "The Extension network is often overlooked by traditional wildlife managers." Jack Berryman (1977: 355) stated, "...while there was support for fish and wildlife (extension) from the conservation organizations, there has never been unified action by the state fish and wildlife agencies." At the 4th National Extension Wildlife and Fisheries Workshop held in Madison, Wisconsin in 1984, Buzz Besadney (1984:), then President of the International Association of Fish and Wildlife Agencies said, "The Association and its members are aware of the tremendous potential and the outlets of the Extension Education System, and the interest remains high in increasing the involvement of the state and federal members. It has been a slow process and probably will continue to be so." The truth is that these statements are still all too valid today! This third member group of our hoped-for triumvirate has never become as active a partner in most states as anticipated. There are several exceptions; Kansas, Nebraska and Wisconsin come to mind. But for whatever reasons, and there are probably as many as there are states, the potential to work together in mutual educational efforts has never come to full fruition. Whatever the impediments—be they defense of turf, anti-fed suspicions, lack of communication—there is no lack of common interests, goals and resource problems. We've managed to make our two-legged stool function rather well, but three legs make for stability, and maximum utilization of the unimpeachable capabilities of Extension and Sea Grant can only come with the participation of our fellow professionals in the state agencies. Let's make it happen!

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Closing Remarks: Extension Education at the Crossroads

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Washington, D.C.

Those of you who attended this morning's Opening Session heard Catherine Woteki, Under Secretary for Research, Education, and Economics of the U.S. Department of Agriculture, make some very broad, but significant, statements about: (1) downsizing of government agencies; (2) our mission which involves us directly and indirectly with the Land Grant Universities and state and county partners; and (3) if we fail in the future to sustain a viable natural resource base, we cannot sustain viable agricultural systems and biodiversity, or effectively manage ecosystems. In this session, you have been provided with an array of examples of current natural resource education and outreach programs being conducted across the nation by our land grant university partners in states with Extension and Sea Grant programs. These educational and outreach programs are directly and indirectly linked to the research and instructional programs of the Land Grant University System. I submit that these programs in natural resources are needed more today than ever before in the history of our nation, but they have received and continue to receive, at best, marginal internal support. Over the past 20 years, even though the visibility of natural resource educational programs has been increased among many clientele groups, and the public in general has become increasingly better informed and more concerned about the environment and natural resources, the support for these educational programs from the Administration, Congress and the land grant universities has not increased, nor has the funding support for Extension programs.

Substantial changes have occurred in the expectations of clientele and in our work. Currently, more than 97 percent of the Extension specialists at the state level have Ph.D. degrees, and more than 85 percent of them have split appointments for research and extension programs. A growing percentage of them have three-way appointments with responsibility for research, extension and teaching, which includes serving as faculty advisor for graduate students. Over these same 20 years, as I have observed greater visibility and demand for increased Extension and outreach programs in natural resources, I have noticed a progressive decline in base program funding and Full Time Equivalents (FTEs) for natural resource programs. In fact, with few exceptions, if you examined the past 20-year trends of funding support within land grant universities for natural resource programs, I suspect you would see a decline in base program support and operating funds. However, if you examined the student enrollment trends in natural resource studies, what you would see is a progressive increase, resulting in increased work load for faculty and inadequate operating funds and facilities. The dollars for research and extension programs have gone up slightly, but the majority of the funding for natural resource programs is derived from cooperators and extramural research grants. Concurrently, as enrollment in natural resource programs has progressively risen and public demand for natural resource research-based information has significantly increased, funding and administrative support for these programs has not risen; in fact, in tight budget times they are usually the first programs cut.

Conversely, however, even though enrollment in traditional agricultural production programs has steadily declined during this same 20-year period, funding and administrative support is growing, even though the demographics and congressional constituent support has changed dramatically. Please don't misunderstand me. I do not mean to imply that we do not need to maintain high-quality research and educational programs in agriculture. As a farm-raised boy who bought and has maintained a farm since 1969 as an absentee landowner, I believe in sustaining a strong agriculture in the U.S. However, I also know, relating back to a point in Dr. Woteki's presentation this morning, that if we do not help private landowners and managers maintain a strong natural resource base for future generations to use and enjoy, we will not be able to sustain a strong and productive agriculture. It is essential that those interested in agriculture and those who care about our natural resources work together. We can no longer continue to ignore and be defensive about environmental concerns in the hope that they will go away. The Land Grant University System and USDA-Cooperative State Research, Education, and Extension's research and educational programs need to become more proactive and less reactive. There needs to be more balance in funding and administrative support for natural resource programs. Continuing to reduce or eliminate funding for natural resource programs that at the state level leverage federal funds at an average of $4 of cooperator funding for each $1 of federal funds does not bode well for maintaining a critical mass of natural resource expertise and program delivery capability to reach grassroots, private landowners and managers.

A recent nationwide study (Warner et al. 1992) of the American public titled, "Public Perception of Extension," which was a follow-up study to one conducted in 1982, revealed somewhat similar conclusions but also some important changes. For example, when respondents were asked whether less, the same or more funds should be spent on the seven base programs (nutrition and health; natural resources and environment; leadership and volunteer development; 4-H and youth; family development and management; community and economic development; and agricultural production and marketing), those receiving the greatest support for more funds were in the areas of family and youth, and natural resources and environment. These priorities are consistent with the public's perception of critical issues facing the nation. The topics on which the public wants additional funding are not a surprise. Extension is expected to address the most critical societal problems and, currently, those are our families and our youth, the environment, health care, and jobs.

As a matter of record from this study, the respondents sampled indicated that 54 percent thought more funds should be spent on 4-H youth and family development, 51 percent thought more funds should be spent on natural resources and the environment, and only 34 percent thought more funds should be spent on agricultural production and marketing. Unfortunately, resources for these programs at the state and federal levels do not correspondingly reflect these responses. For example, staff years at the federal and state levels reflect that only about 4 percent of the total staff years in Extension are focussed on natural resources and the environment. I make this point not to lobby for equal numbers, but to indicate the concern for better balance. Further reduction of funding for natural resource education and outreach programs, in conjunction with an eroding of staff-year commitments within the land grant universities, will continue to threaten the delivery capability and integrity of the system to respond promptly to landowners and managers, as well as society's need for research-based, nonadvocacy information.

As we move into the 21st century, we can no longer afford to ignore the public's need nor the land grant universities' research, education and extension programs' need for adequate funding of natural resources and environmental programs. New agendas in Congress and in society are raising new questions and issues and expecting change. The vocal majority of Americans will exert more influence and more demands for agricultural programs that are in closer harmony with sustainability of a strong natural resource base and a quality environment. The social contract underwritten by the public's investment in agricultural science and education is up for change. The questions are how much change and can the necessary changes be accomplished before society creates a new system to address its needs.

When asked the question in this study, "how would you distribute $100 of taxpayer money to educational services beyond high school," respondents said on an average they would spend $45 on teaching students on campus, $30 on providing off-campus extension/outreach education and $25 on research. What probably is most surprising to many faculty is the extent of support for off-campus education and outreach. This provides a strong endorsement for the educational programs of the Cooperative Extension Service and other continuing education programs.

In my final remarks, I want to express Dr. Ruff's and my appreciation to each of the speakers for their solid presentations. Thanks to those of you in attendance for your interest, questions and participation, and to the planning committee for approving this session. The programs you heard highlighted in this session today are solid examples of a diversity of education and outreach programs being conducted by Extension and Sea Grant professionals linked to the 74 land grant universities across this nation.

If any of you have an interest, we just printed a report of *Voluntary Extension Accomplishment Reports in Wildlife, Fisheries, and Aquaculture for Fiscal Year 1996.* Some highlights captured in the summary of these examples of accomplishments in wildlife and fisheries include 58,862 clientele trained, more than 4 million acres of habitat improved by landowners as a result of these educational programs, and more than $4.4 million increase in savings and revenues for private landowners who implemented new technologies and management strategies resulting from Extension education programs in wildlife and fisheries. I will forward single copies of this on request to anyone who contacts me.

Special Session 2. *Seeking Consensus in Resource Management*

Chair

GAIL BINGHAM
Resolve
Washington, D.C.

Introductory Remarks: Seeking Consensus on Resource Management

Gail Bingham
RESOLVE
Washington, D.C.

What is Consensus-building and Why is It Important for Resource Management?

Anyone who reads a newspaper or talks to a neighbor at the street corner knows that resource management decisions are controversial. That fact alone is not the problem. People are not naïve. We know conflict is to be expected—individuals and groups have different needs and perspectives to be satisfied. Viewed in that way, conflict actually can be an important force for positive change when handled constructively. The public is frustrated, however, that the impasses seem to go on and on. Those directly involved may feel even worse. The real problem seems to be that our tools for dealing with differences are inadequate.

The general public and those involved in resource management controversies eventually come to the same refrain—there has to be a better way! And in an increasing number of situations, people are finding that consensus-building approaches *are* better. Reasonable estimates are that in more than a thousand natural resource management issues, parties have asked for mediation or facilitation assistance to engage in a consensus-building effort. Not all have been successful, however. We all need to learn more about what these processes are, when they are the appropriate tool (and when they are not) and how to use them effectively.

What is a "consensus-building" approach? The term "consensus-building" (sometimes called "alternative dispute resolution" or ADR) actually refers to a variety of approaches. Generically, they are *voluntary* processes in which the participants seek a *mutually acceptable resolution* of their differences.

Four common terms are useful to define. *Conciliation* consists of the attempt by a neutral party, generally with no stake in the dispute, to communicate separately with disputing parties for the purpose of reducing tensions and agreeing on a process for resolving the issues. *Negotiation* is a process in which parties meet face to face to reach a mutually acceptable resolution of the issues. *Mediation* involves the assistance of a neutral third party in the negotiation process. However, a mediator, unlike a judge, has no power to direct the parties. Instead, the mediator helps parties reach their own agreement. In an *arbitration* process, the parties voluntarily submit their case to a neutral for decision, often negotiating a tailored set of rules of procedure which they agree to follow.

Negotiation and mediation have been used with success to resolve many conflicts over natural resources; formal conciliation and arbitration are less common. Negotiation, broadly defined, is common in all aspects of our lives and for all kinds of conflicts. Negotiations are often difficult processes to organize and conduct effectively, however, especially when they involve resource management issues, which are both politically and technically complex. The large number of parties, disagreements about the facts and other complicating factors often create circumstances in which parties question the appropriateness of negotiation (sometimes rightly), give up or reach impasse. Mediators have increasingly been called on to help parties convene negotiations, prevent impasse during the negotiations or assist parties to continue when their discussions have broken down.

In mediated negotiations, the mediator does not make a decision about who is right or wrong or what the best outcome should be. Instead, a mediator helps those involved hold constructive discussions by calling meetings, establishing a framework for the negotiation within which all parties agree to participate, and facilitating communication in and between meetings. Mediators often assist the parties in identifying where they may be able to agree or ways in which they can address their disagreements, for example, through joint fact-finding. They also assist by drafting, facilitating discussion of and refining agreement language that then is reviewed for implementability by all parties. Professional mediators hold as a matter of ethics the view that mediators should have no direct interest in the outcome of the dispute, i.e., that they should be neutral. Frequently, however, a party with a stake in achieving a solution or with power or resources to assist the parties, who is not a central protagonist, may take on mediation functions.

A key advantage to both mediation and negotiation is that the parties have significant control over the end result. Decision-making power stays in the parties' hands and is not passed on to a judge or arbitrator.

Mediation can take various forms, depending on the decision to be made and the stage of the dispute. Some of these variations have become sufficiently formalized to be given different names. These include negotiated rulemaking, policy dialogues, joint fact-finding, facilitation (generally applied to public meetings or informal workshops), and partnering (generally applied to construction contracts).

In the resources management arena, consensus-building processes have been implemented in numerous situations, including endangered species, watershed management councils, forest plan appeals, mining issues, grazing, estuarine planning, commercial fisheries and many more. The case studies that follow for this special session are good illustrations.

Elements of Effective Consensus Processes

Most dispute resolution literature urges that specific disputes be managed in such a way as to allow all sides to express their views, preferably directly to one another. (Traditional public hearing or notice and comment procedures used by government agencies do give the public a voice, but do so in ways that actually create incentives for polarization.) Underlying conflicts should not be avoided, because without understanding and accepting their differences people cannot jointly solve problems. This is not to say, however, that all modes of expressing conflicts are constructive. Dispute resolution methods focus on structuring incentives to deal with differences and on improved communication between parties in order to better identify options that satisfy these different interests and values.

To think well about improving effectiveness, it is important to have a picture of one's target. When people refer to "success," they mean several things. Generally, these factors fall into three categories—substance, process and relationships. Examples of common measures of success mentioned by parties to disputes include:

- substance
  - reaching agreements,
  - reaching agreements that satisfy interests or solve real problems,
  - reaching better agreements than otherwise could have been achieved,
  - reaching agreements that are implemented,
- process
  - fair,
  - all affected parties represented,
  - no undue delay,
  - allows adequate consultation with constituencies,
  - not overly costly in time or money,
  - consistent with applicable procedures and laws (e.g., open meeting laws),
  - does not set precedent for other parties not at the table, and
  - encourages the exchange of accurate and complete information.
- relations
  - civil,
  - provide mutual recognition and respect, and
  - improve capacity to solve problems together in the future.

Implementation of agreements that solve real problems for those involved is probably the most important measure of success, but factors such as improved relationships among the parties or development of an improved information base or array of options for later consideration can also be valued outcomes of consensus-building, as some (if not complete) progress toward a resolution.

Considerable research has gone into how to increase the likelihood of success in negotiations or consensus-building efforts. People commonly approach negotiation with the idea that each side takes a position, trades concessions and agrees (sometimes) at a point in the middle. This certainly is an accurate description of how many people negotiate (and one cannot discount these dynamics in dealing with certain issues), however, the disadvantages of this kind of "horsetrading" are that it becomes a battle of wills and creates bad feelings, it takes longer, and agreements reached often are less satisfactory because of a lack of focus on the parties' real needs and concerns.

The principle of focusing on interests rather than positions underlies most dispute resolution theory and practice. One way to understand this concept is to understand *issues* as *questions* to be answered, a *position* as one party's answer to these questions and their *interests* as the reasons they hold that position. In the book, *Getting to Yes* by Roger Fisher and William Ury, these authors champion the view that the essence of successful negotiations is to avoid bargaining over positions. They outline some very helpful principles for how to do this effectively, all of which shift the dynamics to more creative problem solving.

Discuss and address interests. It is critical to ask *why* one side is asserting a particular position on the issues in order to understand what they really need to achieve. Interests can be met in many ways; positions are much more rigid.

Understand the role of interpersonal dynamics in negotiations and help people move on. Fisher and Ury call this "separating the people from the problem," meaning that it is important to understand the role that emotions play in a dispute but not to allow those emotions to block one from addressing each problem on its merits. Personal prejudices and prior history need to be understood—they may constitute problems people want to solve—but people should not let themselves be so motivated by bad interpersonal feelings that this becomes a barrier to self interest.

Generate a wide range of options, minimizing judgments at first. People are less likely to hit an impasse when many options are being evaluated. Somehow, it creates at least a partial perception of everyone being on the same "side of the table," evaluating the pros and cons of options more collaboratively. A common example of this is the technique of brainstorming.

Agree on criteria by which to judge options for resolution. It may be easier at the beginning of a process to list the general requirements that a potential agreement must satisfy than to develop the details of specific options. Such criteria are also very helpful in maintaining the sense of common endeavor in evaluating options as they emerge, for two reasons. First, the legitimacy of each side's needs is at least tacitly accepted—these criteria are often surrogates for parties' underlying interests. In using these criteria together, parties find themselves dealing with how to solve others' problems, and experience their own problems being treated as relevant by the others. Second, where parties agree on objective criteria, it can help break impasses.

Although these are good principles on which to ground constructive dialogue, not every negotiation is entirely interest based—eventually a pie cannot be made any larger and parties are faced with deciding who will get what. A certain amount of competition is inevitable in dividing up a finite resource (or fixed pie). Nor can the effect that political power plays in negotiation dynamics be ignored. But these principles do allow participants in a consensus-building effort to maximize the creativity needed to create more "joint gains"—an essential ingredient in sound resource management decisions. Several contributors to current negotiation theory (e.g., Raiffa, Lax, Lewicki) focus on the "tension between cooperation and competition," distinguishing between "creating value" and "claiming value." While urging parties to seek ways to expand the pie (i.e., to invent solutions that achieve joint gains), they also caution parties that if one side cooperates—for example, by sharing information—and others compete, the more competitive often win.

There are additional reasons why resource management issues are difficult to resolve. Convening a consensus-building process will not make these challenges go away magically. Rather, for a consensus process to be successful, it must be designed with these challenges in mind:

- Controversial natural resources issues often are made more difficult to resolve by intra-organizational and institutional complexities.
- Parties' incentives to address one another's needs may be unclear.
- Forests, wetlands and wildlife populations are finite, increasing the potential for competition among users.
- Technical and scientific uncertainties can complicate negotiations.
- Disputes over natural resources generally involve public issues, not private matters alone; laws, press and governmental institutions all play a significant role.

An important characteristic of consensus-building processes, as they have been implemented over the past 20 years in the resource management arena, is that they are flexible. Individual processes can and should be tailored to each dispute after an analysis of the particular opportunities and barriers involved. Controversies develop at different stages in the "life-cycle" of a controversy, with different degrees of polarization, and with information and options elaborated at varying degrees of detail. Legal constraints on the process and alternatives to settlement available to the parties also vary case by case and at different stages of the same matter.

Institutional Dynamics

Resource management conflicts are more often between organizations or groups than between individuals. Thus, the individuals at the table must get proposals ratified by others who are not participating directly. Because each entity has its own internal decision-making process, negotiators (and neutrals) need to know the degree to which each representative can speak for his or her constituency and the freedom each has to make proposals and to commit to an agreement. Negotiators also must keep their constituencies informed about progress and problems between negotiation sessions to increase the likelihood that agreements, if reached, will be ratified.

Complex or Changing Incentives

In contrast to more traditional administrative or judicial proceedings, few, if any, established procedures are available to structure routine applications of consensus-building processes to resource management issues. (The Administrative Dispute Resolution Act, at the federal level, does provide consistent definitions, and a few selected statutes direct the formation of consensus processes for specific issues.) Each party, with different strengths in different forums, will have different perceptions about the relative advantages of negotiating. Thus, parties are as likely to approach a negotiation with different assumptions on how to structure the negotiating relationship as they are to have different views on the issues.

A standard element of good mediation practice in resolving controversial environmental issues is to conduct a feasibility assessment with the potential parties to a negotiation. All parties should feel they have something to gain, and no one should feel the negotiation process would harm their current standing on the resolution of the issues. Thus, it becomes a goal of the assessment to help parties assess how potential negotiation results would compare with their alternatives. Often, how the negotiation process is organized will directly affect the potential of the process to satisfy parties' interests. A key product of any feasibility assessment will be general agreement (often mediated) among the parties as to who will participate and in what way, the scope of issues, any deadlines, frequency of meetings, information needed to make sound decisions, who the mediator will be (if any), and other ground rules.

Multiple Parties/Issues

Because natural resources, although renewable, are finite and exist in specific places, claims of rights to use the same locations for different uses are made by multiple units and levels of government and diverse private interests. This generally means that resource management disputes involve many parties and many issues, making organizing any negotiation process more difficult. Sometimes coalitions can be formed, where several parties can be represented by one negotiator. Concerns have been raised about limits to participation being imposed in some consensus-processes, where national interests may be at stake over what others might view as local resources. This issue of scale, who has a right to participate, and the inability due to lack of resources of some groups to participate in many different processes needs exploration.

Complex Scientific and Technical Issues

Sound scientific and technical information is essential for creating solutions that work. However, parties to natural resources issues are confronted with large volumes of information, requiring a wide variety of expertise and subject to honest differences of interpretation. Furthermore, gaps and uncertainties in the available information base are inevitable as scientific understanding continues to grow.

Models can be developed to help deal with scientific uncertainties, but they themselves can be sources of dispute between the model builders or sources of confusion in negotiations where parties have unequal technical resources. Joint fact-finding processes, in which parties agree on the design of a model or study in advance, show considerable promise. Similarly, technical committees or information sharing workshops have been used constructively to supplement policy negotiations.

Public/Political Dimension

Another characteristic complicating resource management conflicts is that the issues in dispute involve public matters that may need to be resolved in public forums. Negotiators need to deal with the press and open meeting laws sensitively, and arrive at outcomes that can withstand public scrutiny and comment. Carefully designed, consensus-building processes can maximize the flexibility within public institutions while holding negotiated solutions to the same legal and regulatory standards to which any decision would be subject.

Conclusion

Experience suggests that the following prerequisites and strategies will increase the likelihood that consensus-building can be successful in complex resource management issues:

- all can gain something they value in the process;
- all important players are willing to participate;
- participants agree on the process structure and goal, including a definition of the problem;
- no one will be asked to compromise a basic value;
- participants share information with each other or seek information together early in the process;
- interests are identified and communicated;
- multiple options are encouraged, and parties discuss criteria by which to evaluate them;
- the time necessary for negotiation is available;
- the issue is "ripe" for resolution, and there is a deadline or urgency for decision;
- the process is transparent and communication with broader interests occurs throughout; and
- all parties have authority to make commitments.

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Research as a Route to Consensus? Feral Ungulate Control in Hawaii

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Like many island ecosystems, Hawaii's native flora and fauna have been decimated by competition and predation from exotic introductions. Feral ungulates, including pigs (*Sus scrofa*), goats (*Capra hircus*) and axis deer (*Axis axis*), have devastated native vegetation (Cuddihy and Stone 1990). Significant native communities remain only in a few high-elevation, remote, protected areas. Even in these places, feral ungulates thrive, threatening the last examples of native ecosystems (Katahira et al. 1993). Although there has been debate about how much loss of native vegetation is due to feral ungulates, there is widespread agreement that these exotic animals do damage vegetation and that their numbers should be reduced in these remote, protected areas.

Despite widespread agreement that feral ungulates are a problem, how to solve it has provoked a virulent debate. Among the methods that have been used to remove feral ungulates in Hawaii are public and professional hunting with and without dogs, aerial shooting, fencing (to prevent invasion or reinvasion from adjacent areas), "Judas animals" (in which a radio-collared animal attracts conspecifics that then can be shot), live-trapping, and snares. The method that has sparked the most public debate has been use of unattended neck snares in remote areas. Even a very few feral ungulates, especially pigs, can do a great deal of damage, and populations can rebound quickly from low numbers (Katahira et al. 1993). In very remote and rugged areas which may be accessible only by helicopter, the most cost-effective method of controlling ungulates at low numbers has been unattended neck snares (Anderson and Stone 1993). Snared animals, particularly pigs, which have thick, strong necks, may sometimes die slow and painful deaths. This issue attracted the attention of animal rights groups and humane societies, some of which launched vociferous public relations campaigns against land managers who used unattended snares, such as The Nature Conservancy of Hawaii. In addition, some native Hawaiian and other hunters opposed use of snares because the meat is wasted and areas with snares may be closed to hunting due to safety concerns.

Hawaii Animal Control Research Consortium

As part of an attempt to resolve this controversy in a way that would both protect native vegetation and be more humane, some of the disputing parties formed the Hawaii Animal Control Research Consortium. Membership included The Nature Conservancy of Hawaii; federal land managers (including the National Park Service and the U.S. Fish and Wildlife Service); state land managers from the Division of Forestry and Wildlife, which is responsible for natural areas, forestry and wildlife; the Hawaiian Humane Society; the Human Society of the U.S.; People for the Ethical Treatment of Animals (PETA); and a veterinarian interested in hunting. The purpose of the Consortium was to find control methods that would be both humane and effective in remote natural areas by reviewing available methods and sponsoring research to develop improved methods. One of the ground rules for participation in the Consortium was that membership would not constrain any member from using particular control methods, such as snaring, in the meantime.

An early act of the Consortium was to hire consultants (the authors) to (1) review existing ungulate control methods worldwide, (2) make a field reconnaissance of feral ungulate control in Hawaii, and (3) conduct a workshop with stakeholders in the feral ungulate control debate and experts in various control methods in order to set an agenda for research to develop improved control techniques. Underlying the formation of the Consortium and the consultancy was the belief that it would be possible to defuse the controversy by finding new control methods that would be acceptable to all of the major parties. This paper focuses on the workshop as part of that consensus-seeking process.

The Workshop

The workshop was sponsored by the Consortium, which invited the participants and arranged the meeting. The fact that one member of the Consortium, The Nature Conservancy of Hawaii, paid a disproportionate share of the costs was cited later by a participant who was dissatisfied with the outcome as undue controll by the Conservancy. Workshop participants included the members of the Consortium; consultants; biologists and managers from state and federal protected areas in Hawaii; federal animal damage control personnel; technical experts (in control of island exotics using hunting, aerial shooting, poison baits and snares; hunting dogs; and immunocontraception) from universities and management agencies outside Hawaii; veterinarians; and Hawaiian hunters. The meeting was held in a university facility in Honolulu, and the first author served as facilitator. A day prior to the workshop, some of the participants, including the consultants and several of the technical experts, attended a meeting sponsored by the Hawaiian Humane Society where those concerned with the animal rights and humaneness aspects of feral ungulate control expressed their views. The wide gap between the primarily moral focus of animal rights enthusiasts and the primarily technical focus of the scientific experts was particularly striking in that preworkshop meeting.

Objectives and Criteria

The format of the workshop was to (1) evaluate a selection of control alternatives using objectives and criteria determined by the participants; (2) use the same criteria to identify potential improvements to existing methods and possible new methods; and (3) set priorities for research to develop and test these improved and new control methods. The facilitator had prepared for the meeting by reviewing written material on control methods and the ensuing controversy, and developing a preliminary set of objectives and criteria that appeared to capture the major interests of the participants. After an attempt to elicit objectives from the participants at the meeting, the participants declared themselves satisfied with the facilitator's list of objectives, which then were used to evaluate a selection of control alternatives. To be desirable, a method must be *effective* in reducing ungulate densities to near zero and holding them there, and it must be feasible to deploy such a method broadly over remote and heavily forested areas. It must be *cost-effective* in the sense of providing that control affordably and justifiably (i.e., resulting in long-term reduction of ungulate numbers). The method must be *legal* under current regulations (e.g., broadcast poison baits are illegal). It must be *safe* in the sense of not causing death or injury to humans using the method, other humans, ecosystems (e.g., through contaminants in the food chain), or nontarget plants or animals. It must be *humane* in the sense of minimizing both the number of deaths and suffering (including time to death, pain and fear) of target and nontarget organisms. It must be sensitive to community concerns, in particular, *not wasteful* of meat that might otherwise be eaten by humans, an issue that is especially important in native Hawaiian culture. It must have *low impact* on neighboring lands. And, it must enjoy *community support*.

Alternatives

The participants then selected several control alternatives for evaluation: (1) immunocontraception; (2) hunting with dogs; (3) aerial shooting; (4) fencing (as an adjunct to other methods); (5) snaring; and (6) live-trapping. These methods were chosen for a variety of reasons, some because they were known to be effective, at least in some circumstances (e.g., snaring, aerial shooting and hunting with dogs), some because they were advocated strongly by some participants (e.g., hunting with dogs, immunocontraception and live trapping), some because they avoid killing (e.g., immunocontraception, live trapping and fencing), some because they had been so controversial (e.g., snaring), and some because they were thought to have good potential for improvement (e.g., hunting with dogs and snaring).

Evaluation

The participants created a set of large charts evaluating how each method fared according to each of the criteria. Information to support these evaluations was drawn from the formal and informal expertise of the participants, citing published and unpublished literature and personal experience. Participants noted where information needed to make a particular evaluation was lacking and how it might be acquired. Then, using the objectives and criteria as guides, the participants brainstormed innovative methods of control that would offer improvements over existing techniques. Some of these included training dogs to drive pigs to hunters, controlling hunting dogs via remote collars, using repellents or habitat modification to make habitat unattractive to ungulates, lethal vaccines, and abortifacients.

Research Priorities

Insights from the evaluation of existing methods and brainstorming of new methods then were used to set priorities for research and analysis. Some of these were short-term analyses, such as using data on ungulates that have been removed in control efforts to learn about the demography and life histories of ungulate populations in different habitats and at different densities. Understanding the relationships between ungulate populations and habitat characteristics and between ungulate densities and reproductive rates is essential to planning long-term control programs. Other priorities included testing control methods in Hawaii that have achieved some success elsewhere, such as different types of hunting dogs and baits or attractants (which could be used to deliver immunocontraceptives, lethal vaccines, abortifacients, or poisons, if legalized). Also deemed important was public education on the special role of pigs in Hawaiian culture. New and longer-term research suggestions were to examine the relationship between ungulate numbers and ecosystem damage, study ungulate population dynamics and social structure, and study stress of hunted prey.

Broader Issues

The workshop participants then turned their attention away from the evaluation of control methods and toward some broader wildlife management concerns that impinge on decisions about ungulate control. In agricultural areas and natural areas set aside to protect native flora and fauna, feral ungulates are considered pests, and the goal is to reduce their numbers to zero, if possible. Elsewhere in the state forest reserves and game management areas, they are considered game animals. Pigs are especially prized as game animals by some native Hawaiians who hunt for wild pigs to use in celebrating life events such as births and marriages. In some areas, hunting is important to subsistence.

The special role of pigs in Hawaiian culture is complicated. Polynesian settlers brought Polynesian pigs that were managed as highly prized domestic animals, although they probably foraged in the lowland forest near villages. These pigs certainly must have damaged native vegetation, but the extent of that damage is not clear (Olson and James 1984). European settlers brought European pigs to the Hawaiian Islands. These much larger pigs became feral and reproduced abundantly, expanding farther and farther into areas of higher elevation and more pristine vegetation, an expansion that is continuing today. Feral European pigs have probably supplanted the Polynesian pig entirely; they are clearly destructive to native vegetation, not only in Hawaii but in mainland and island ecosystems worldwide (e.g., Coblentz and Baber 1987, Peine and

Farmer 1990). Today these feral European pigs are linked to native Hawaiian traditions involving pigs (important deities were pigs), but the practice of hunting for wild pigs to celebrate life events is a relatively recent cultural development. Some native Hawaiians who are especially interested in traditional use of native plants and preserving native vegetation are skeptical of Hawaiian pig hunters' appeal to the spiritual importance of pigs as justification for maintaining them in substantial numbers.

These conflicting views of the desirability of pigs in the Hawaiian landscape interact with patterns of land ownership to produce a nightmare of opposing objectives and management choices on adjacent properties. Traditional land tenure patterns divided the islands into narrow wedges running from the higher elevations to the sea. Remnants of these patterns today result in interlocking parcels, where state and federal natural areas abut state forest reserves and private land, where ungulates are considered game animals. It is very difficult to protect these parcels from invasion or reinvasion from adjacent properties where ungulates are not being controlled to low numbers (Katahira et al. 1993). Fences running along the contour to protect higher elevations from invasion from below are less effective when they must stop at the property boundary. Attempting to maintain ungulates at near-zero densities on one side of a property line when they may be maintained at higher densities on the other side is a losing battle requiring ongoing high investments of money and personnel, and equally ongoing killing of feral ungulates. This situation violates criteria of humaneness, as well as cost-effectiveness. Workshop participants discussed some of the elements needed to resolve this dilemma, including: (1) better data on pig populations and pig hunting on state-managed lands; (2) better public participation in decisions on management of feral ungulates on public and private lands; and (3) limits on legal liability for private landowners who allow pig hunting on their property. The participants made no attempt to arrive at a conclusion to this management dilemma themselves, since that was not the primary purpose of the workshop.

Critique of Workshop Process

Sponsorship

Forming the Hawaii Animal Control Research Consortium, funding consultants to review control techniques and convening a workshop to set a research agenda were all part of a coordinated effort by several parties to find a negotiated, rather than adversarial, solution to their dispute about control of feral ungulates. Like most such attempts, the results were mixed, both in terms of dispute resolution procedures and in terms of substantive outcomes. The Nature Conservancy of Hawaii played a pivotal role in forming the Consortium, soliciting bids from consultants, convening the workshop and providing funding. The predominance of Nature Conservancy funding is understandable; they were under the greatest pressure to find a resolution to the dispute so that they could continue controlling ungulates in their preserves, and, as a private organization, they had the flexibility to allocate funds to this effort. Nevertheless, the unequal funding prompted one participant to charge that The Nature Conservancy had exerted undue control over the whole process through its funding.

Representation

In public environmental disputes, it is typical to have many parties and many issues, and this dispute was no exception. As described above, representation at the workshop of parties who make decisions about feral ungulate control, those most likely to be affected by those decisions and those in a position to influence implementation of control decisions was fairly complete. Many "sides" of the dispute were themselves heterogeneous, as reflected in the participation of both animal rights (PETA) and humane society representatives, whose underlying interests can differ considerably. We have already noted that, due to timing conflicts, representation of native Hawaiian interests was incomplete, being limited to those most concerned with pig hunting. Timing and location of dispute resolution procedures can influence access by affected parties. The workshop was held in Honolulu, which was convenient for those with offices in the capital and for experts flying in from outside Hawaii, but not necessarily for those traveling from other islands. Although the Consortium paid the travel expenses of those who did not have other sources of funding, they still had to miss work and other commitments for two days in order to participate.

Coalitions

As is not atypical in complex, public disputes, some unlikely coalitions formed among the parties. The animal rights group (PETA) teamed up with Hawaiian pig hunters and federal Animal Damage Control representatives to advocate hunting as the preferred method of control; they shared this position although their underlying interests differed. Some participants found this alliance hard to understand, particularly since hunting with dogs can cause suffering for both the prey and the dogs, which are frequently gored by boars and even killed.

Ground Rules

Some participants commented after the workshop that they felt the discussion had not been entirely open and candid, despite observance of ground rules to smooth communications among parties with long-standing grievances. One participant felt that the dispute between The Nature Conservancy and PETA over use of neck snares had been glossed over during the workshop and wondered if there had been some explicit or implicit "deal" to leave this highly contentious issue alone. Another participant believed that some of the native Hawaiian hunters had not been candid about both hazards to hunting dogs and the waste of meat that sometimes resulted from their hunts. In an effort to improve the comfort level of some of the native Hawaiian participants, some were allowed to bring companions (otherwise, attendance was restricted to those who had been invited by the Consortium).

Role of Experts

As is typical in disputes whose resolution requires some technical analysis (Ozawa and Susskind 1985), both the consultants and outside experts in various fields (e.g., immunocontraception, feral ungulate control in Australia, baits and attractants) were on hand to help resolve technical questions about control techniques, ungulate biology and behavior. The role of technical experts is often portrayed as one of offering dispassionate, objective information to aid in resolution of science-intensive disputes. What becomes clear in practice, as in this case, is that technical experts bring their own values and enthusiasms to the discussion, and speak as vocal advocates of particular control techniques as often as they speak as disinterested purveyors of objective information. This is probably unavoidable, but it is best to recognize this dichotomous role of experts at the outset in order to avoid confusing personal advocacy with technical expertise.

Multicultural Issues

The multicultural context of this dispute was a pervasive influence on the process. The dispute over snaring, formation of the Consortium, and the workshop took place when the push for restoration of native Hawaiian rights was at a particularly high pitch. At least some Hawaiians viewed the use of unattended snares by some land managers as violating both humaneness and respectful use of the land's resources, principles important in native Hawaiian culture. The dispute over neck snares became another rallying point for native Hawaiian rights. As we have described, the workshop organizers were not successful in achieving complete representation of native Hawaiian perspectives on feral ungulates and native vegetation. Some participants in the workshop felt that the Hawaiian hunters who attended may have been using the occasion partly as a forum for their concerns about broader issues of Native rights. This is yet another example of the way in which regional and national political issues can color attempts to resolve local disputes (Daniels and Walker 1995).

A particularly interesting influence of Hawaiian culture in the workshop was a perceived mismatch between the organized, interest-based approach to stating objectives and criteria for evaluating alternative control techniques used by the consultants, and one that was familiar to at least some of the other participants, and the more relationship-based approach taken by traditional Hawaiian problem solving, *ho'oponopono* (Meyer 1995). The consultants set aside some of the organizational structure they had anticipated using and were able to proceed with a constructive review of control techniques where all parties contributed to the discussion. Nevertheless, the approach and goals of *ho'oponopono*, which seeks to restore harmony to a community through expressions of guilt and forgiveness, and those of more technically based negotiation, which seeks to find a solution that satisfies the interests of the parties within the constraints of technical feasibility, remain somewhat at odds.

Results and Implementation

Despite these limitations in the negotiation process, participants at the workshop were successful in developing a research agenda to guide both short-term and longer-term investigations that might be sponsored by the Consortium. These included (1) development of radiotelemetry for monitoring snares, traps, fences and live-capture devices; (2) improvements in the efficacy and humaneness of hunting with dogs; (3) testing of neck snares that would kill more quickly and reliably; (4) development of baits and attractants that could be used in conjunction with trapping or for delivering immunocontraceptives, lethal vaccines or, if legalized, poisons; (5) design and testing of improved methods of fencing for capture or exclusion of feral ungulates; and (6) development of immunocontraceptive vaccines for pigs, goats and deer that could be administered remotely via baits.

Implementation of this consensus research agenda has been variable, depending largely on the motivation and resources of individual participants. Some members of the Consortium agreed to participate only in research that did not involve use of snares. An animal rights group refused to participate in implementing any part of the research agenda when some other members refused to discontinue using unattended neck snares while other methods were being developed and tested (although an original condition of participation in the Consortium was that members would be free to continue whatever management they deemed appropriate). It is worth noting that in many environmental disputes, there are parties whose interests are best served by perpetuation of a dispute rather than its resolution. Activist groups whose ability to recruit new members, garner financial support and build public recognition stem largely from controversy can hardly be criticized for turning their attention elsewhere when a consensus process no longer serves their needs.

Federal and state agencies participating in the Consortium were hit by severe budget cuts shortly after the workshop. They were unable to allocate scarce resources to research on new methods for controlling feral ungulates. Compared with other pressing needs (such as controlling exotic plants), and considering that some of these agencies had devoted considerable effort to research on control of feral ungulates in previous years, further investment in control technology was not a high enough priority to be funded from a tight budget. The budget crisis stalled work on radiotelemetry devices that would work in wet conditions and on development of baits for pigs and deer when federal and state matching funds could not be released.

With funding from the state natural areas program, The Nature Conservancy of Hawaii field-tested a different type of neck snare thought to kill more quickly, but it proved unreliable under wet conditions. With pig numbers already very low in Nature Conservancy preserves, collecting enough data to make a comparison among capture techniques takes a very long time.

Immunocontraceptives, although they probably cannot achieve the near-zero numbers desired in remote preserves, could complement other control measures. Although immunocontraceptives are a long way from operational use in wild populations, they appeal to humane society interests, particularly, because they are much more humane than lethal control techniques. Two Consortium partners are sponsoring tests of a contraceptive vaccine in a captive swine herd, but there are many obstacles between this test and use in the wild.

A partnership of state, private and federal landowners built additional fences to exclude pigs from an area on Maui where snares are still in use. This is expected to reduce the need for snaring. Meanwhile, the adjoining lower-elevation forests are now being opened to public hunting, with the goal of reducing pig populations there; adjacent upland, fenced sites are managed for near zero pigs. This project involves the hunting community in the protection of the forest and provides complementary management programs for adjacent forestlands. This is an excellent example of the kind of coordinated action that is needed to successfully protect fragmentary preserves surrounded by land where ungulates are not controlled to low densities, although funding to continue this effort is uncertain.

The Nature Conservancy of Hawaii and federal Animal Damage Control personnel continue to collaborate in improving hunting with dogs so that it can be used effectively, safely and humanely in remote and rugged areas where ungulates are at low densities, and with minimum risk to nontarget organisms, such as the endangered nene (*Nesochen sandvicensis*). In collaboration with native Hawaiian hunters on Molokai, The Nature Conservancy, the State Division of Forestry and Wildlife, and the National Park Service have continued a "test hunting" program begun before the workshop to maintain low ungulate numbers in preserves using volunteer hunters with dogs. This arrangement blurs the distinction between public and professional hunting, since the hunters are subsidized by The Nature Conservancy and Division of Forestry and Wildlife with helicopter transport into remote areas and other assistance to encourage them to hunt in rugged areas with few prey that otherwise would be unattractive places to hunt. These measures have been at least partially successful in maintaining low numbers of pigs and goats in some reserves, prompting The Nature Conservancy and the State to continue the program and defer any return to snares in these areas. In other areas, goat populations have rebounded in inaccessible terrain, and a resumption of aerial shooting is being considered by the State. This "test hunting" is a good example of a contingent agreement, where the participants agree to try out a proposed solution, evaluate the results jointly and then agree on a further response if the original solution is not successful. The effort is guided by a working group with representatives from the hunters, the local community, state and federal land management agencies, and The Nature Conservancy of Hawaii.

The Underlying Problem

The consensus process pursued by the Consortium via the workshop was reasonably successful in producing a research agenda, at least part of which has been implemented. The workshop was quite successful as a means of joint fact-finding and mutual education among the participants, who differed widely in field experience, research experience, and institutional and personal objectives. Nevertheless, a call for research on a controversial management issue can be perceived as a stalling tactic, putting off but not resolving the underlying issues that created the dispute. In this case, developing a control method that would meet all the criteria proposed in the workshop (e.g., safe, humane, effective at low densities, affordable, not wasteful) would solve at least part of the immediate problem: controlling feral ungulates in remote natural areas in a humane manner. However, even the most humane control method will leave untouched the underlying problem of how to reconcile conflicting objectives for management of ungulate populations on adjacent ownerships. Although it might be desirable from a strictly ecological perspective (if there is such a thing), eradicating feral ungulates, particularly pigs, from the Hawaiian Islands is not a realistic goal at present. This means that the tension between managing for relatively abundant pig populations on one side of a property line and for near-zero pig densities on the other side will continue. Some hunters believe that pig populations in the more accessible, general forest areas have declined, as they well may have with increasing hunting pressure from a growing human population. Some hunters worry that vigorous control efforts within preserves could have a negative effect on pig populations in adjacent ownerships. However, there are few data on pig populations or hunting success to support an objective analysis of the population status of pigs outside nature reserves.

The values conflicts that inform the dispute over how to manage feral ungulate populations statewide (including animal rights, integrity of native ecosystems, native Hawaiian rights) are complex and loaded with political tensions that have little to do with pigs and plants. Making any headway at all on this vexing problem will require enormous cultural sensitivity, public education, public participation and ingenuity. Public education on the role of pigs, native ecosystems and hunting could help provide a more complete picture of the links between ungulate management and Hawaiian rights. Proponents of specific goals, such as protection of native rainforest, can be careful to couch their arguments more in terms of the benefits of intact ecosystems, rather than in terms of the evils of pigs. Public participation of all stakeholder groups in designing an ungulate management plan that spans different ownerships is essential. The folly of disregarding local opinion when installing control measures has already been demonstrated on the north side of the Island of Hawaii where local residents removed expensive fences that interfered with their use of the forest. Land swaps to rationalize management goals in particular areas may be feasible. Better regulation of purposeful introductions of exotic species, such as axis deer, on private land and a more proactive approach by the State to manage exotics on public land are needed to forestall future problems.

Even with the best of intentions and a thoughtful process for working together, a solution to this underlying problem will no doubt be elusive. More humane control techniques for use in the meantime will make the wait for a more comprehensive plan for managing feral ungulates less painful and less divisive.

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Miracle in Montana—Managing Conflicts Over Private Lands and Public Wildlife Issues

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Background

Hunting access has a long history of conflict in the West (Brown 1960, Rounds 1975, Guynn et al. 1984, Knight et al. 1987, Swensson 1996). Leasing of private lands by outfitters closes access to sportspersons. Landowners' desire to be compensated for allowing public hunting is fueled by lower profits from traditional agriculture (Guynn et al. 1987), wildlife damage to crops (Irby 1996) and property damage by hunters (Guynn et al. 1984). All of these factors contribute to a decline in free public hunting on private lands and to sportspeople's frustration over finding a place to hunt (Rounds 1970, Guynn et al. 1984). Deep-seated values involving private property rights, hunting traditions and government influences on the outfitting business are all at stake in the ensuing conflicts.

These conflicts came to a head in Montana when 12 different bills concerning private land/public wildlife issues were introduced into the 1993 Montana legislature. Each bill was sponsored by a different interest group and all bills conflicted in content. None of the bills passed. Instead, the legislature passed House Joint Resolution 24 asking the Governor to appoint an advisory council of 18 citizens representing sportspersons, outfitters and landowners and to charge the Council with striving for consensus on solutions to the multitude of issues.

The Council was formed by Governor's Executive Order Number 6-93 in 1993. This paper's author worked closely with the Governor's Council throughout its entire 18-month operational period to resolve issues. In this capacity the author provided a combination of citizen participation, conflict resolution and meeting management techniques that facilitated the Council in reaching consensus on 20 different recommendations and gaining support from all interested publics. The Council's 20 recommendations were embodied in legislation and passed the 1995 Montana Legislature with a resounding majority (House 88 to 11; Senate 46 to 4). This resolution of longstanding conflicts was a first for Montana and proclaimed by the Governor as a "miracle" (Governor Mark Racicot personal communication: 1995).

The results of this win-win (Doyle et al. 1982) conflict resolution effort were innovative and of gigantic proportion. Approximately $3 million per year in new income is raised for the Montana Department of Fish, Wildlife and Parks as a result of this successful resolution of conflicts. The monies are used to fund an expanded public hunting access program for Montana sportspersons. Outfitters' concerns about "booked" clients having to draw for a license are now eliminated, yet Montana sportspersons protected a longstanding legislative limit on the number of nonresident big game hunters per year. Also, landowners are provided compensation for allowing public hunting (up to a limit of $8,000 per landowner per year).

The public participation and conflict resolution techniques utilized were critical to this effort's success. It is my considered opinion that successful resolution of issues would have been impossible without the intensive use of these techniques.

Public Participation Techniques

The 18 advisory council members appointed by the Governor may have reached agreement on controversial issues, but without public involvement and commitment of the interested publics to recommended solutions, the Council's efforts to resolve conflicts would have been meaningless. Recognition of this basic fact generated a major effort on the part of the Governor's Council to employ the following public participation techniques:

- development of a public participation plan;
- open meetings of the Council held in different areas around the state for stakeholders;
- mailings of information to all identified interests;
- involving publics early in the process for "buy-in";
- development of local "working groups" of stakeholders to advise the Council;
- three drafts of recommendations with 30- to 60-day comment periods and changes in each draft that reflect comments; and
- use of post card replies to those submitting written comments, facilitating their knowing they had been "heard."

Public participation was based on planning as outlined in Bleiker (1990). Planning included identifying all potentially affected interests and involving them in early development of the Council's recommendation process. Each Council member was charged with representing *their* segment of the separate interest groups (i.e., outfitters on the Council represented the Montana Guides and Outfitters Association; landowners represented the Montana Stockgrowers, Woolgrowers and other Associations, etc.; and sportspersons represented the Montana Wildlife Federation, other local sportsperson's clubs, etc.). All interest groups were kept informed as the Council progressed, and Council members were responsible for representing the interests of those groups in all Council meetings and discussions. Council members maintained regular phone and in-person contact with the leaders of various interest groups to accomplish these tasks. In addition, immediately after the Council was formed, a mailing list was developed of more than 800 individuals and interest groups in Montana identified as concerned about private land/public wildlife issues. Summaries of all Council meetings were sent to each person on the mailing list immediately after each statewide Council meeting. Announcements of next meeting dates and locations were included in each meeting summary and publics were encouraged to attend.

Further attempts to involve interested publics were made through assembling six local working groups. These groups were formed in different geographical areas of the state and included representatives of outfitters, sportspersons and landowners. The local working groups were tasked with providing suggestions for dealing with local issues, reviewing the statewide Council's draft recommendations and providing input. The use of local groups provided the Governor's Council with a grassroots base from which to operate and generated suggestions as well as comments on the Council's draft ideas.

In addition, the Council developed a plan for involving all other interested publics that may not have been in direct contact with Council members. This public involvement plan included eight public meetings held in various geographic locations throughout the state. The purpose of these meetings was to introduce the first draft of Council recommendations and receive public comment. A similar round of public meetings provided review of a second draft and generated further comments.

Public meeting formats were similar for all the public meetings held. A modified open house format (Bleiker 1990) was used. This format provided for individual discussion between Council members and interested persons and reduced the potential for polarization. The format was informal and each person attending an open house meeting was presented with a written list of Council recommendations. Posters were put on the meeting room walls explaining each recommendation. Next to each poster was a blank poster sheet for writing in comments. Also, a Council member wearing a visible name badge was positioned near each poster. These Council representatives were there to receive verbal comments and to clarify any information-related questions. Local group members from the geographical area where the meeting was held attended each meeting in their respective areas and provided the Council with a degree of local credibility at each of these public meetings. Council members were instructed beforehand to listen to all comments, and while they were encouraged to explain the rationale for Council recommendations, they were advised to practice active listening and refrain from *defending* any of the recommendations. During these open house meetings, Council members often facilitated small informal, spontaneous discussions about various recommendations and recorded the input for future overall Council consideration. All participants at each public meeting were encouraged to sign up on the Council's mailing list to receive any further drafts or other information from the Council regarding recommendations.

Two drafts of recommendations were prepared using all the previously mentioned public involvement methods. The first and second drafts both utilized 60-day public comment periods. Significant changes were made to both the first and second drafts on the basis of public comments received. After the public review of the second draft, a third draft was prepared and a 30-day comment period was held. Because the second and third drafts contained significant changes made by the Council in response to the public review, this process helped develop a level of trust between all the interested publics and the Council.

Another technique used was for the Council chair to send a post card reply immediately each time a mailed comment or suggestion was received by the Council. These post card responses thanked the person who sent a suggestion or comment for their input and assured them that their suggestion or comment would receive the Council's consideration. This technique was successful in helping to build public trust by letting all respondents know that their suggestions and comments were considered important.

Conflict Management Techniques

Holding meetings of groups of people with different and opposing interests can result in polarization and increased levels of conflict if these meetings are not handled properly (Bleiker 1990). Conflict management techniques were used in this project and included the following:

- clearly defined objectives, timetables, sideboards and expected deliverables, to prevent groups from diverging into tangential subject areas or other loss of focus;
- clearly defined authority levels of the Council and authority relationships to the Governor, local groups, organized groups, etc., to prevent false expectations on the part of the publics or Council members;
- Council member agreement to use a *consensus* decision process for Council decisions *before* dealing with the issues;
- timing of Council meetings to include meals, timing of breaks, etc., to provide for group development and trust building;
- fostering continuity between meetings by precluding substitutes from representing absent Council members at meetings;
- active listening exercises to promote clear communication; and
- starting with small issues to experience some "success" and build trust before addressing larger issues.

The Governor's office clearly defined objectives, timetables, sideboards and expected deliverables as soon as the statewide Council was first appointed. This served to prevent various Council members (or groups they represented) from branching into peripheral subject areas which often had long histories of conflict and were usually important to only a few stakeholders. When such temptations arose, the facilitator or one or more Council members would remind the Council body that "it's not part of our charge from the Governor's office." Maintaining a focus on the issues specifically in the Council's charge was important in preventing additional conflict issues from draining the Council resources and impeding progress.

A common problem in working with interest groups on controversial issues where multiple public involvement strategies are used is that groups and/or individuals can develop false expectations about how the final decisions will be made (Bleiker 1990). Frequently, when an appointed committee meets with an interest group that is unanimous in its position on particular issues, that interest group may believe that the decision was "made" in their meeting. This conclusion is supported if members of the committee make statements such as, "We are here to listen to *you* at this meeting," or "We want to know what the public thinks."

Often, such a committee may have numerous special interest group meetings and each special interest group may unanimously express views that conflict with other interest groups. This sets the stage for each of several groups to assume a decision was made in *their* meeting and thus, to disagree on what the decision was. If the perceived decision body is in a position only to recommend to someone else (e.g., the Governor), interest groups' expectations can differ even more greatly from the final decision. Thus, failure to clarify the entire decision process including the decision authority for each particular meeting and the authority levels of individuals and groups involved in the process can sow the seeds of false expectations with an ensuing harvest of disappointment, ill will and feelings of betrayal. Perhaps this was the reason for the old adage, "Never ascribe to malice what can be explained by stupidity."

The Governor's Council took precautions to prevent such false expectations by clearly defining the authority levels of the Council and authority relationships to the Governor, local groups and organized interest groups. The Governor's office made final decisions on the acceptance of recommendations, but legislation had to be passed in the General Session of the Montana Legislature. The Council made it clear at each public meeting and in all communications that it only had the authority to *recommend*, and that while the Montana Department of Fish, Wildlife and Parks (MDFWP) was not involved in developing the content of the recommendations, MDFWP had veto power over any Council recommendations it thought were unreasonable. The complete public participation process was explained at each opportunity so that individuals in any one meeting were aware that many other interests were also participating.

Another important factor in the success of this case study was the Council members' resolution early on about what constituted an appropriate decision process for the Council itself. Consensus was stressed as the preferred way to make decisions. Group consensus is usually harder to achieve than a simple majority vote; however, it stresses a win-win attitude and ensures that each recommendation has to have something in it for everyone so that all can support it. A majority vote process creates a win-lose situation (Doyle et al. 1982). The Council agreed that if one member could not support a recommendation, then it would not be sent forth to the Governor's office. This created a veto power for each member and was a great comfort to those who perceived they were in a minority position on any one issue. Empowering Council members with veto authority had the effect of building trust among all because no one had to fear being "steamrolled" by a majority. It sent the message to all that, "As a group, we are interested in finding recommendations that all of us can support."

Timing was also important in addressing the Council's decision process. It was important to have all members agree on a decision process at the first meeting, *prior to* addressing issues. If the group had waited until it was in the midst of a controversial issue before addressing how decisions were to be made, then Ajzen and Fishbein's (1980) theory of reasoned action suggests that those Council members who thought they had a majority for the issue would probably have chosen to vote. The win-lose vote process thus sets up group members to be unsupportive of decisions where they have lost the vote. In the Montana case, this would have lessened Council support overall and made it very difficult for the Council to rally public support for their final package of recommendations.

Team building is an important intervention if individuals are expected to work successfully together toward mutual goals (Burke 1982). The Council Chairwoman and I believe that the greater the lack of initial trust among individuals in a group, the more important team building interventions become (Nina Baucus personal communication: 1993). Given the long history of conflict over private land/public wildlife issues in Montana, we regularly utilized a variety of simple team building interventions as described by Pfeiffer (1991). The timing of the Council meetings was planned to include meals and overnight stays at the same location to enable group members to get to know each other in social settings free from work-related obligations. This proved to be successful in further aiding the team's development and building trust among Council members.

Previous Governors in Montana had unsuccessfully attempted to use advisory councils as a means to address controversial issues regarding public wildlife on private lands. One reason for past failures was the practice of members of previous councils sending substitutes to represent them at meetings. This had the effect of creating a new (different) set of representatives at each meeting, thus creating a lack of continuity (Nina Baucus personal communication: 1993). This pitfall was avoided by strictly disallowing substitutes to represent Council members at any meeting.

Fiske and Taylor (1991) use cognitive dissonance theory to predict that people are (1) motivated to avoid information that is inconsistent with their attitudes or choices, and (2) biased to pay attention to information that reinforces their beliefs. This motivation can create major communication problems and was a potential threat to the Council's effectiveness in resolving issue conflicts. In order to overcome this threat, Council members used a modification of the active listening technique described by Robert (1982). The technique required Council members to describe for each issue the concerns of another interest group represented in the Council. For example, a landowner might be asked to describe the concerns of outfitters or sportspersons. Once an interest group's concerns were described, the representatives on the Council for that interest group were asked if the description was accurate and complete. Based on the interest group's response, another description of concerns was developed, and this continued until all could agree it was accurate. This active listening exercise promoted clear communication and helped overcome the threat of information avoidance or selective retention.

According to Argyris (1993), individuals seek to keep constant their theories-in-use and associated behaviors. This helps explain behaviors ranging from passive resistance to outright sabotage that are invoked when individuals fear change and perceive that their long-held philosophical positions are threatened. A technique that helps overcome such influences is to start with small issues enabling the experience of some "success," thus building trust before addressing the larger issues (Guynn et al. 1989). This technique draws on Fiske and Taylor's (1991: 551) conclusion that, "The self-regulation of action is highly dependent upon cognitions and affect. How people behave in a situation depends upon how they define it and the personal goals they adopt for the situation." The technique of starting with smaller issues was successfully applied in the operation of the Governor's Council. The resulting group success on small issues aided in the development of group trust and a collective recognition that success was attainable. This provided a positive basis from which all Council members could proceed in working effectively to resolve the larger issues.

Meeting Management Techniques

The major vehicles for Council Member interaction were regular meetings of two to three days, held on an average of once per month. Thus, successful meeting management was critical to the accomplishment of the Council's goals. Peyton and Eberhardt (1990) list five requirements for a good meeting: (1) everyone is working on the same problem, (2) everyone understands and is using the same process, (3) someone must be able to maintain an open and balanced conversation among participants, (4) someone must be able to protect individuals from personal attack and maintain an environment of fairness, and (5) everyone's roles and responsibilities are clearly defined and agreed on for the meeting. The key to holding effective Council meetings was to structure the meeting participants' interaction based on Peyton and Eberhardt's five points, so that everyone felt they had an opportunity to participate and that their perspectives were fairly considered in the process. Interaction Associates' facilitation techniques (Doyle et al. 1982) were used to maximize meeting effectiveness and to establish a cooperative working relationship among all participants.

Establishing a cooperative, fair and trusting meeting environment provided a basis for Council members to begin their attempts to resolve conflicts. However, a framework was also needed to address issues in a systematic way. A seven-step problem solving process (Koberg et al. 1981, Doyle et al. 1982, Arnold 1992) was used to successfully address issues: (1) problem acceptance, (2) problem analysis (including clarifying selection criteria), (3) definition of main problem components, (4) generation of alternatives for solving the problem, (5) selection of alternatives to implement, (6) implementation of alternatives selected, and (7) evaluation of results.

My experience in working with groups has been similar to Doyle et al. (1982) in that there are almost ubiquitous group pressures to move to step four immediately, with little or no effort expended on the first three steps. Perhaps this is a manifestation of Western culture where we are habituating to see all major problems solved in 27 minutes with three commercial breaks. However, if groups move too quickly and arrive at generation of alternatives prematurely, it can create problems when step five is reached (where agreement on the selection of alternatives is required). For example, if one person in the group is focused on a particular facet of the problem and another person is focused on a different facet, then getting agreement on solutions will be difficult, if not impossible. It is important that all facets of the problem are understood and each worked on in turn by the whole group. Overhead transparencies depicting drawings that could be seen two different ways (Boring 1930, Leeper 1935) were used to make this important point with Council members. They saw that they could all be looking at the same information but "seeing" different parts of the problem. This technique was successful in creating an understanding of why problem acceptance, analysis and definition are three critical preliminary steps that increase the potential for achieving agreement on which alternatives to implement.

Council members found that generating lists of alternatives was a relatively easy step. Typically, local groups, interest groups and others had a plethora of suggestions. The Council used brainstorming (Doyle et al. 1982) to further develop each list of possible solutions. The facilitator encouraged creativity with combining, compressing and drawing out techniques (Doyle et al. 1982) which inspired generation of new ideas among Council participants. Next, the Council reviewed the generated list and evaluated each solution using force field analysis (Doyle et al. 1982). Once evaluation was complete, the Council members accomplished step five by working with a consensus process to select alternatives.

Step six of the problem solving process (implementation of alternatives) was dependent on passage of legislation. This legislation was passed after the Council had completed its job of formulating recommendations and disbanded. However, the Council addressed step seven (evaluation of alternatives implemented) by recommending the establishment of a review committee as part of the legislation. The review committee's task was to evaluate the effectiveness of the Council's recommended alternatives after they were implemented and to suggest changes. The first report of the evaluation committee to Montana's legislature is due in late March 1997 and few, if any, major changes in the Council's 20 original recommendations are expected (A. Charles personal communication: 1997).

Conclusions

The success of the Governor's Council in this case study was a "miracle" to those in Montana with experience in the controversies surrounding management of public wildlife on private lands. The success of this Council lies in its departure from past approaches to the issues. Insanity has been defined as "doing things the same way and expecting different results." The Montana Governor's Council expected different results, but they also had the courage to break from the potential insanity of doing things the way they had done them in the past. The basic techniques of conflict resolution, public participation and meeting management have been available for decades, but those of us in the wildlife profession too frequently have failed to avail ourselves of those techniques when dealing with the increasingly controversial issues surrounding resource management. Oliver Wendell Holmes (1995: 11) once said, "...we must sail sometimes with the wind and sometimes against it— but we must sail, and not drift, nor lie at anchor." I urge all of us to follow Mr. Holmes' call in regard to setting sail on the stormy sea of natural resource controversies, but only when prepared with the techniques described in this paper.

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Finding Consensus Amidst Controversy: Establishing Forest Management Standards

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In an era when both fear of government intervention and polarization between resource protectors and resource users is escalating, the Forest Sustainability Standards Work Team (FSSWT) is an example of how to put controversy aside and develop consensus forest management standards. It was a successful experiment in both private/public partnerships and science-based decision making.

The completion of this project was the result of five key elements: (1) official and unofficial endorsement of the project, (2) adequate administration and facilitation support, (3) having the right players at the table, (4) agreement on the final product, and (5) public involvement. Challenges were addressed and overcome, and the result is *Good Forestry in the Granite State, Recommended Voluntary Forest Management Practices for New Hampshire* (FSSWT in press), a comprehensive field guide to integrated resource management that will be published in May 1997.

Background

Forests cover more than 80 percent of New Hampshire's roughly 5 million acres (Freiswyk and Malley 1985). There are 3 biophysical regions and 33 ecological land type associations (New Hampshire Department of Resources and Economic Development [NHDRED] 1995). Three primary forest types cover the landscape: white pine, northern hardwood and spruce/fir. The hemlock, red oak and aspen/birch types are less common but ecologically and economically important (SPNHF 1997). Interspersed across the landscape are a variety of unique natural communities, fragile areas, and wetlands and riparian corridors.

Most of the forest land is privately owned. Eighty-six percent of the forest land in the state is owned by more than 83,000 individuals and corporations (Cullen 1995). The average ownership size is just 40 acres. Some 200 public and private foresters are licensed by the state to aid in the management of these lands, and close to 1,000 of the estimated 1,400 timber harvesters have completed or will soon complete voluntary certification (E. Kingsley personal communication: 1997).

The philosophies of the landowners, foresters and loggers vary—making consensus difficult. In a state with no income or sales tax and a correspondingly slim state budget, policy discussion are infused with a strong dose of practicality and ingenuity.

Incentives to Seek Consensus

The New Hampshire natural resource community split divisively in the early 1990s over legislative proposals to regulate clearcutting. This forest practice is regulated by the eastern neighbor, Maine, and limited in certain locations across the western border by the State of Vermont. Attempts to introduce legislation to control the practice in New Hampshire raised the specter of a forest practices act and drew battle lines between various members of the forestry and wildlife professions.

In absence of compelling evidence on either side, and in light of the high level of controversy, the legislature passed no legislation, but called for a study. A limited study, consisting of three public hearings and two field trips with no additional research, failed to quiet those that promoted legislation.

To forestall additional legislation, a year-long effort was undertaken to recodify and slightly revise the existing forestry laws. Substantive revisions did not occur, but the recodified laws called for the state to coordinate an effort to identify recommended voluntary forest management practices for certain sensitive sites.

At the same time, the Northern Forest Lands Council (NFLC) released its final recommendations (NFLC 1994). The NFLC, a group of 17 individuals representing Maine, New Hampshire, Vermont and New York had completed four years of federally financed research and public opinion gathering on how to sustain the patterns of forest ownership in the 26 million-acre expanse of forest that covers the northern portion of the four-state area.

The NFLC recommended that each state define credible benchmarks of sustainability in the form of practical on-the-ground techniques. The NFLC provided nine principles (below) to guide each state in their work, but left the actual design and implementation up to each state.

Principles of Sustainability (NFLC 1994)

- Maintenance of soil productivity.
- Conservation of water quality, wetlands and riparian zones.
- Maintenance or creation of a healthy balance of forest size classes.
- Conservation and enhancement of habitats that support a full range of native flora and fauna.
- Protection of unique or fragile natural areas.
- Continuous flow of timber, pulpwood and other forest products.
- Improvement of the overall quality of the timber resource as a foundation for more value-added opportunities.
- Addressing aesthetic impacts of forest harvesting.
- Continuation of opportunities for traditional recreation.

Project Organization and Participation

Faced with both a legislative mandate to create voluntary standards and the NFLC's call for benchmarks, a proposal was drafted to create FSSWT. The proposal was circulated to natural resource opinion leaders for their unofficial endorsement. With their approval, the State Forester officially called together the FSSWT in June 1995.

The project was administered by a core group of the Society for the Protection of New Hampshire Forests Society (a 90-year old nonprofit conservation organization), the New Hampshire Timberland Owners Association (a forestry trade association), the New Hampshire Division of Forests and Lands, and the New Hampshire Department of Fish and Game. The Society provided facilitation for the group.

The 24-member team was a complex mixture of academics and practitioners, designed specifically to bring together those parties that think about sustainable forestry and those parties responsible for implementing it on the ground. There were scientists with decades of research experience, field foresters, ecologists, loggers, landowners and environmental advocates.

There were different expectations and social and scientific challenges to overcome, and vastly different philosophies represented by the various FSSWT members. To establish trust within the group and clarify the work ahead, the first six months of the project were spent defining a mission, setting an operating protocol and gathering public input.

Defining the Outcome

With a strong mission, clear protocol and the NFLC's nine principles, the FSSWT had to focus its efforts and define the outcome. The group soon discovered that meeting the dual mission of setting site-specific voluntary forest management practices and identifying benchmarks and landscape-level strategies for sustainability were two distinct projects.

In neighboring states, keeping the two subjects linked has meant that discussion over the site-specific techniques has been postponed until the larger level landscape questions can be resolved. In New Hampshire, the FSSWT determined that there was sufficient information available relative to on-the-ground practices that should be packaged for landowners, loggers and foresters without delay. In order to move ahead on the site-specific recommendations, the FSSWT broke into two subcommittees. One worked on the recommended voluntary forest management practices, the other is still gathering data to address landscape-level questions.

Results

The Recommended Voluntary Forest Management Practices (RVFMP) subcommittee began by establishing that the final product would be a three-ring notebook with short chapters that could be taken out and used by landowners and the professionals working with them. The group brainstormed a list of possible subjects to address the nine principles, identified volunteers to write an initial version of each chapter and established an organizational framework.

Each chapter follows a specific pattern, with an *Issue* section that describes why a subject is important, an *Objective* section to clearly identify the purpose of the proposed recommendations, a *Considerations* section to point out practical situations that may alter how an objective is realized and *Recommended Practices* to guide actions in the woods.

The 34 chapters fall under six broad categories:

- *Soil Productivity:* erosion and soil damage; soil nutrients.
- *Water Quality, Wetlands and Riparian Zones:* wetlands and riparian zones; water quality.
- *Habitat:* overstory inclusions; permanent openings; beaver created openings; aspen management; deer wintering areas; mast; cavity trees, dens and snags; dead and down woody debris.
- *Unique and Fragile Areas:* rare plants and natural communities, vernal pools; seeps; high elevations; woodland raptor nests; heron colonies; bald eagle and osprey nests; bald eagle winter roosts; old-growth forests.
- *Timber Quality and Flow:* regeneration; forest structure; managing for high quality trees; controlling logging damage; clearcutting; insects, diseases and wind damage.
- *Aesthetics and Visual Quality/Recreation:* timing of forest management activities; truck roads and skid trails; landings; slash disposal; aesthetics of clearcutting; recreation; cultural resources.

Challenges

The greatest social challenge was the fear that the process would turn into regulation. With the clearcutting sentiments still barely under the surface, practitioners did not want the work of the FSSWT to end up as the material for a new forest practices act. This potential obstacle was addressed by drafting a mission that clearly specified the voluntary nature of the recommendations. The FSSWT also dispelled public fears by holding public comments sessions and distributing a newsletter.

The group also faced scientific challenges. Resource professionals did not want to lose good science for the good of collaboration. There was a fear that consensus was only a euphemism for policy of the lowest common denominator. To clarify that the FSSWT would aim for the highest possible standard, an operating protocol was developed. The protocol established that the work would be based foremost on best-available science. In the absence of best-available science, the FSSWT would use unpublished research and professional judgment.

There were strong philosophical differences between members of the FSSWT and to avoid future conflict the group determined that consensus did not have to mean unanimity. As part of consensus it would be possible to have a majority and a minority report. (The thought of a minority report was only raised once during the process and the group resolved its differences so that it would not be necessary.)

Each individual also had a different editing style and way of approaching recommendations. The framework that had been designed to ensure consistency between chapters became key to resolving differences. Many of the conflicts over specific language were resolved simply by taking phrases out of the recommendations section and putting them in the consideration or issue section.

Additional Efforts

The broad-based process undertaken by the FSSWT is also being used in several other New Hampshire initiatives. The state recently completed a Forest Resources Plan. The foundation for this plan was a detailed assessment of the condition of New Hampshire's forests completed by a team of resource professionals. The actual plan, which sets a direction for the state for the next 15 years, was written by a volunteer steering committee

In October 1995, eight landowners signed a historic Memorandum of Understanding for the management of high-elevation forests. The specifics of the memorandum were the result of two years of facilitated dialogue between landowners and wildlife biologists.

An Ecological Reserves Steering Committee is moving ahead to build the scientific foundation for and eventually design a reserve system for the state. Scientific and policy teams both work on consensus and the steering committee is seeking public input.

Lessons Learned

Like any complicated project, it is possible to look back and evaluate how it could have been made stronger and more effective. One difficulty was the lack of realistic time and budget estimates. The project started with no dedicated staff and no budget. Grant funds were solicited throughout the project and budgets established based on the money raised.

Administrative duties were divided among a number of organizations. As a result of this fragmentation and overloaded professional schedules, minutes often were not taken and the newsletter failed to get out in a timely fashion. The project did not budget sufficient time or money for an editor that would make the entire document read in one voice. Fortunately, one team member did a complete edit of the document to bring the chapters, authored by more than a dozen different individuals, into a more cohesive product.

The strength and neutrality of the facilitator was important. The Society provided facilitation and had a different staff person at the meetings for content. While this worked most of the time, the facilitator also authored several chapters and it was impossible to facilitate those sections with neutrality, and another team member usually had to step in.

In conclusion, it is possible to find consensus amidst controversy and establish forest management standards. Consensus-based projects can build trust and accomplish objectives. It is important to note, however, that it was fear of regulation that originally prompted action. The voluntary standards produced by the FSSWT will not replace laws. Nonetheless, *Good Forestry in the Granite State* provides an exceptional landowner and professional education tool and hopefully will change practices on the ground so that regulations are less necessary.

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Special Session 3. *Connecting Leadership to On-the-ground Resource Management*

Chair

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Connecting Leadership to On-the-ground Resource Management

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Welcome to our session. Speaking on behalf of myself, session cochair Rick Dornfeld, and presenters and their coauthors, we are honored to be presenting this session to you.

To begin, I would like to give you some of my background. It will help you understand why this session is before you today. From 1967 until last year, I was a career wildlife manager with the Minnesota Department of Natural Resources (MnDNR). My positions included park planner, area wildlife manager, state private lands coordinator and regional wildlife manager. In my early years, I confess to using "command and control" techniques.

Successes with ecosystem efforts during the last two decades have caused me to evolve toward a leadership style I term "Leading from Behind." Its essence is in a Lao Tzu quote from 6th century B.C., "When the best leader's work is done, the people say they did it themselves."

Opportunities thereafter allowed me to look deeper. I presented papers at North American Wildlife and Natural Resources Conferences in 1993 (Nelson et al. 1993) and 1994 (Nelson 1994). In 1994-1995, I spent six months in Fort Collins, Colorado, as a U.S. Fish and Wildlife Service Management Assistance Team project manager developing an Ecosystem Stewardship and Partnering Workshop for use by agencies.

This workshop, based on case histories, features private citizens for content input and as instructors, and has leadership as a core element.

In August of last year, I left the safe shores of wildlife management and did what one coworker termed "crossing over to the dark side." I am now Acting Regional Administrator, working with all MnDNR disciplines in Minnesota's southeastern region.

This session is an extension of my work on successful ecosystem projects, North American conference papers, Fort Collins sabbatical, numerous workshops, consulting with other state and federal agencies, and regular in-depth discussions with my cochair, Rick Dornfeld.

We designed this session as a unit to provide provocative perspectives on leadership, effects of leadership on employees and customers, and closing the gap between leadership and the field. The session authors, regardless of organizational level, have been highly effective in accomplishing or catalyzing on-the-ground resource work. Their papers are backed by successful case histories and a broad range of experiences.

Perhaps a few questions will help start your thinking and frame the contents of the session.

(1) How direct is your connection to on-the-ground resource work? How many days a year do you spend on-site evaluating field efforts and listening to employees and partners? I know a highly successful mid-level resource manager who, for the last 14 years, has been out of his office more than three days a week. He delegates and empowers so he has time to be proactive and nearer the action, and time to spend with field personnel, partnerships and decision makers. I know another mid-level manager that spends almost no time with field people unless required to be there for a hot issue. Which is closer to your field connection, and how well is it working?

(2) As a barometer for how you are doing, do you ask staff to evaluate your performance? And, do you provide a safe enough work atmosphere so that respondents voluntarily sign their evaluations? Last month, I requested the 56 regional office employees, including clerical, to rate my first six months of performance. Is this something you might try?

(3) Whom do you consider to be the agency's customers: citizens, license buyers, all critters, politicians? Is this a topic of internal debate? With a political pendulum that never stops swinging, how long can an agency maintain a position that is not embraced by the public?

(4) What is the comfort level of your agency with early public involvement? Does your agency have to "get its act together" behind closed doors before citizens are involved in an issue? Would you consider having private citizens participate in internal budget discussions or a discussion of discipline differences on an issue? If citizens are customers, why not?

(5) Does your agency know how to evaluate and reward subtle leadership styles? Do agency rewards favor the employee that is Leading from Behind (Nelson 1994) and sharing credit, or do they favor the "gladiator" or command and control style leaders?

(6) Are leadership and partnering considerations a part of your agency culture? How many agency bookshelves hold leadership books? In a five-day training session, how much of it would you devote to science and how much to leadership? Is leadership a topic at agency coffee tables? Is leadership reserved only for top leaders, or does it permeate the whole outfit? In my experience with a variety of agency training workshops, leadership and partnering is in a distant second place. Perhaps the interest of workshop leaders and participants in science overshadows the need for more training in working with people. Few of us entered this profession because of a strong desire to work with people.

(7) Does your agency have trouble keeping field personnel engaged in planning? Are your agency plans viewed by staff and customers as brief, user-friendly guides for accomplishing on-the-ground work, or as voluminous, inflexible obstacles to natural resource management opportunities. Does your agency plan get shop-worn, or does it gather dust on a shelf?

(8) Does your agency embrace diversity in employees and partnerships? Does it reach out and listen to minorities? Are those who may not agree with you, internally and externally, among the first your agency invites to the table?

Besides questions, I bring several hopes to this session. I hope that you find the papers provocative and inspiring. I hope that the session causes you to reflect on your style of leadership, relationships and comfort with a diversity of customers and employees. Finally, I hope you will find nuggets of information that will help you improve your effectiveness.

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Beyond Command and Control

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This paper is designed to limber up your thinking to get the most from this session. It starts by giving you a personal view of the state and direction of the wildlife (including fish) resource and wildlife agencies. I do this to remind you that agencies face great challenges and current efforts are insufficient. Then I'll review both traditional and emerging paradigms in management science to convince you that we must change our way of looking at the challenges. Finally, I'll argue that first the command and control model for leadership itself must change.

Projecting the Trends

When I think about where the current trends will put us in a couple of decades, I see some gains, but basically we're in serious trouble.

The wildlife resource will be poorer. The pressures and impacts of development accumulate relentlessly. World demand for food is projected to explode, so benefits from federal conservation farm programs appear transient. Harmful policies and programs impacting the landscape improve little following the severe floods and fires that result.

Participation in wildlife recreation (especially consumptive) will be lower, and political support for both recreation and wild lands have eroded. Anglers and hunters are declining as a fraction of the voting public. There is a rising disdain for killing for sport. Even catch and release angling is attacked as barbaric. Consider the shift within this century. President Theodore Roosevelt's hunting was a key part of his image. Public enthusiasm sold toy animals that today would be "TR's African Safari action figures." Media coverage of President Bush's hunting carried a tone of exposé. Even the environmental movement is now in decline (see Chase 1995), and growing populations and urbanization work against nonconsumptive recreation.

Government programs and agencies will be smaller. During the 1920-1930s, we're told, government was seen as a solution, and bureaucracy clearly was seen as the best way to get things done (see Osborne et al. 1992). The public now is suspicious of bureaucrats' motives and expects agencies to be incompetent. Policy debates just assume further downsizing and shrinking budgets.

Despite a couple of notable exceptions (election wins in Washington and Arkansas), the trend for wildlife agencies seems to me to be tracking with the rest of government. I've been told a common view among western governors today is that wildlife agencies are embarrassments, out of control and not to be trusted. We're seen as resisting new priorities (such as diversifying the workforce), generating bad press, and pandering to hunters and anglers to the detriment of other constituents. Politicians' reaction is predictable. Power and independence have been withdrawn from agencies and their commissions, agency responsibilities pruned, and legislative oversight intensified. The turnover in directors in most states is now very rapid, and average tenure continues to decrease. Finally, the public seems to be losing its trust in us. Agency biologists' pronouncements even about key fish and game species are often rejected as unbelievable. Ballot initiatives seeking to overturn agency regulations are becoming common.

Last, I see serious weaknesses within our agencies that suggest future decline. The economic outlook for most is disheartening. The fraction of the budget in financial reserves and discretionary spending is declining. There's a growing dependence on a single source of income (nonresident hunters). Yet we're facing cost inflation, plus new demands, such as paying landowners for depredation losses and "takings," and controlling introduced species and new disease outbreaks. There is little support for professionals to stay current, or to learn people management or public involvement skills. Few agencies seem to be looking ahead. Few are doing much to develop new "markets." Even the retirement within the next five years of a large fraction of employees has just started to receive attention, but I've heard of no planning or action. What agency captures knowledge and lessons learned from its retiring staff? Related to this, many agencies seem to do an inadequate job of managing document and data archives. Can we explain to the public or our political overseers where the money went and what good it did?

When I really stand back, it's clear that we are in a bind. Our mandates ask us to provide for recreation and uses that are in decline—and operate off the proceeds. We're also supposed to protect the resource. Yet we simply can't protect the resource with just the lands we own or lease. We can't force landowners to manage for wildlife or stop development. We can't even stop unwise programs and policies by other arms of government. We're headed for crisis, and embedded in governments that are doing the same. We've assumed we're competent and trusted, and are ill prepared for defending ourselves in front of a skeptical review, let alone a hostile one.

Many agency leaders have seen a need for change, and I know agencies are trying. We have competent employees unmatched in dedication. We've tried harder, we've cut waste, we've attempted improvements, and we have sought funding for nongame programs. But these efforts have not reversed the trends. Where is the leadership that will guide us past these troubled waters?

A Shift in Paradigms

For a couple of years now, it's become clear to me that our typical approach to change just isn't doing the job, and that the organization and leadership models I'd accepted in the past didn't jibe with reality. When too many observations don't fit the theory, you are approaching a paradigm shift (Kuhn 1970).

In the last 15 years there has been a flood of management books saying we must embrace entrepreneurship, quality, customers, values and visions. We must decentralize, empower employees and let them participate in management, reengineer and systematically learn. But efforts by businesses to do so have been disappointing (Block 1993).

Among these management books, a few also claim the paradigm is shifting. Wheatley (1992) sees the fundamental problem as the paradigm assumed when management science was founded early in this century. The world was in awe of the industrial miracles such as the assembly line of Ford Motor Company. Management scientists appropriated the paradigm from the Newtonian world view of scientists of the 17th century that dominated until the 20th: that the universe was a clockwork created using simple and knowable principles by a Master Intelligence. We could know a thing by studying its parts scientifically. Things were fundamentally as independent, controllable and predictable as the balls in a game of billiards.

Given the focus of early management science on factories, the paradigm of the world as a machine was obvious and useful. Given the free market, it was appealing to liken the organization to a machine-like army whose purpose was to win profits by warring on competitors. An army had a rigid hierarchy, bureaucracy, policies, procedures, divisions, forecasts and unified plans that delivered the direction and coordination also needed for a factory. Ultimate authority was vested in the commander/president. Lesser officers/managers designed the work for the soldiers/workers, trained them and watched while the work was done. This certainly worked well in the U.S. through World War II.

I see wildlife agencies mostly still acting from the Progressive Era model they were founded with. We were to be professional experts entrusted to make decisions and act as trustees for the public good. We were to manage the resource and even judge what recreational pursuits were worthy. The public was to be the beneficiary and user, but had little role in decision making. Agencies were accountable only to respected citizen trustees serving on the equivalent to a bank's board of directors. Professional judgement was a sufficient base for resource management decisions. Information went up the chain of command to "managers" who allocated funds and issued orders.

Wheatley (1992) argues that, if we want to use scientific theories as a paradigm for management science, we should at least use those of modern science. Today, we know that although useful under many conditions, there are fundamental errors in the Newtonian paradigm. The development of the theories of evolution and quantum mechanics, and more recent developments in systems theory, information technology and chaos theory have stimulated the abandonment of old paradigms in science and the rise of new ones. These shifts are not complete, nor have they yet had much influence on the paradigms of society at large.

I admire Wheatley (1992) for seeing provocative possible applications of new science findings for understanding and improving organizations. For example, "This new world is also asking us to develop a different understanding of autonomy. To many managers, autonomy is just one small step away from anarchy....Yet everywhere in nature, order is maintained in the midst of change because autonomy exists at local levels. Sub-units absorb change, responding, adapting. What emerges from this constant flux is that wonderful state of *global* stability."

Noting that there is this similarity between natural systems and organizations doesn't *prove* anything. But management scientists didn't prove that the clockwork paradigm was superior to alternatives before applying it to organizations throughout most of this century. That's the nature of a paradigm (Kuhn 1970).

Block (1993) is the other author I'll mention who sees a need for a paradigm shift in management science. He sees the fundamental problem in the way we view leadership. Before the 1980s, management science talked about *managers*. During the 1980s the focus shifted to *leaders*. Block (1993) says, "...a nation looked for leadership and wondered where it had gone. The attraction of the idea of leadership is that it includes a vision of the future, some transforming quality that we yearn for. Managers get things done, but without heart and passion and spirit. Leaders bring spirit, even integrity into play." And "Our search for great bosses is not that we like being watched and directed. It is that we believe that clear authority relationships are the antidote to crisis and ultimately the answer to chaos."

Looking more closely into what we mean by leadership, Block (1993) sees it as based in patriarchy. "Patriarchy expresses the belief that it is those at the top who are responsible for the success of the organization and the well being of its members." Patriarchy depends on a acceptance of dependency among those led. "Dependency rests on the belief that there are people in power who know what is best for others, including ourselves." This patriarchy/dependency relationship is idealized feudalism, with benevolent nobles and dutiful serfs. I see it as what we mean when we refer to "command and control."

Why is the leadership function of agencies not saving us from a dismal future? Block (1993) says, "Is anyone capable of providing us the leadership we are looking for? And if not, is it the failing of the people in power, or is the problem in the nature of our expectations?" Block proposes an alternative to patriarchy: partnership. "Partnership carries the intention to balance power between ourselves and those around us. It brings into question the utility of maintaining consistency and control as cornerstones of management. It comes from the choice to place control close to where the work is done and not hold it as the prerogative of the middle and upper classes. It also flows from the choice to yield on consistency in how we manage, and thus to support local units in creating policies and practices that fit local situations."

According to Block, partnership requires replacing dependency with empowerment. "Empowerment embodies the belief that the answer to the latest crisis lies within each of us.... [It] is our willingness to bring [democracy] into the workplace." With respect to setting direction, he notes there are sideboards established by the agreements and mandates made during the founding of an organization, yet within those, everyone needs to be part of creating the vision for the organization, and setting its future direction. "Placing ownership and felt responsibility close to the core work is the fundamental change we seek."

The roots of Block's two alternatives go deep. I think they are consistent with Sowell's (1987) two archetypical visions underlying much of Western thought on society and government. He finds these articulated well in writings from the late 18th century, but they are older.

Block's summary of the literature on leadership is: "The books have been written..., the experiments have been conducted, and the results are in. We know, intellectually and empirically, that partnership and participation are the management strategies that create high-performance workplaces." But you can't achieve this if you cling to command and control. As Block says, "The act of leading ... by determining the desired future, defining the path to get there, and knowing what is best for others is incompatible with widely distributing ownership and responsibility in an organization."

Implications

When I think about applying Block's (1993) ideas to our agencies, one thing is very striking. The partnerships and empowerment relationships he advocates for organizations apply even more to our relationships with our employers: the public. Outside of regulations, trying to command and control the public doesn't work—especially where you have little legal power.

Following Block (1993), we should approach other agencies and the public as equals. Coming from partnership, we can relate to members of the public as our friends and neighbors, as people of intelligence we talk with openly and honestly. Partners can leverage greater progress out of limited resources. Partners share information freely. We can teach willing learners what we know about the value of wild lands and wildlife, and how the natural ecosystem works. In turn, we can learn about the preferences and values of others in our community, and how things function in the social and economic parts of this same ecosystem. Partners can build a common vision for the future of wildlife and local environmental quality. Each partner may choose to devote resources (within his or her constraints)—or not. Approaching problems with an expectation that everyone there is empowered may stimulate creative thoughts and new solutions.

How can we protect the resource on land we don't own? Once wildlife and wild land values are an objective of the partnership, they're objectives of all the landowners—plus Boy Scout troops, the Kiwanis Club and the city parks department. While we're at it, opportunities may arise for us to offer new services to the public. That is, to create new "product lines."

Conclusions

When I look at Wheatley's (1992) search for meaning, I see that goals, empowerment and relationships are to be found in abundance in the new science. When I look at Block (1993), I see that partnership and empowerment are rooted in our democratic way of life. If leaders cling to command and control, it isn't because this is what works in our agencies. It isn't because it works with the public. It isn't because this is in the Constitution. It isn't because it's the natural order of things.

If wildlife agencies are to recapture a central role in the future, fundamental and massive change is required. Change will become the norm, not the exception. Examples of agencies newly innovating at the field level are everywhere (see Frentz et al. 1995). But localized innovations will be gone like a sand castle on the beach if the leadership remains the same old ocean, repeating the same old tides in thrall to the Newtonian motion of the moon and sun (Block 1993). I think one of the first steps needed is to redefine leadership in the agencies—and do it in partnership with the public. The public and agency employees will know if there is a future for the agency from what leaders say, and especially if their actions match those words.

My most surprising conclusion is that in a very fundamental way, the new management science paradigms are shifting toward the way we always knew things to be. The old paradigm assumes the world is a clockwork and institutionalizes paternalism/ dependency. It leads to a government like Vladimir Lenin's, an organization as rigid as Henry Ford's and a worker's experience like an assembly line robot. The new paradigm assumes the world is like an ecosystem: highly complex and chaotic systems within systems of relationships that spontaneously generate order and global stability. It institutionalizes partnerships among empowered adults. It leads to a government like James Madison's, an organization as complex and dynamic as the Internet and a worker's experience as alive and adventuresome as the settling of the West. We always knew Aldo Leopold's marsh needed no leader to command and control. Now we need to see that wildlife agencies don't either.

Acknowledgments

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Connecting Agency Leadership to Natural Resources Management On the Ground: The View from Below

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Southwestern Minnesota's landscape was shaped by the Wisconsin Glaciation approximately 10,000 years ago. Hundreds of depressional wetlands and lakes were created by the retreating glacier. For centuries, these basins held water and fulfilled their functions in a natural panorama. Settlement of the Minnesota prairies by European immigrants and citizens of the eastern United States began in earnest during the mid-1800s. With settlement of the region came ever increasing pressure to drain wetlands and plow the prairie for agriculture crop production. Decades of attack from civilization resulted in the loss of the majority of wetlands and severe degradation of the regional watersheds.

An attack is again being mounted in southwestern Minnesota, but this time the objective is restoration of wetlands and improvement of water quality in contributing watersheds. Many of these conservation projects are spawned at the local level with natural resource field managers becoming the primary source for guidance. Projects range from simple to extremely complicated and require today's field managers to be highly versatile.

We offer a brief description of highly successful watershed-based wildlife restoration projects in southern Minnesota; the Lake Wagonga/Grass Lake Project, the Heron Lake Watershed Project and the Swan Lake Area Wildlife Project. We will discuss several strategies that upper-level management can adopt to assist field project managers in the development and implementation of these large, rapidly evolving projects. Over the course of the last 10 years, we have also identified several pitfalls that managers at all levels should avoid when dealing with large, field-initiated restoration projects.

The Projects

Lake Wagonga\Grass Lake Project—Case History

Located in the southern half of Kandiyohi County in southwest Minnesota, this project was precipitated in March 1988 when a petition to install a winter aeration system in 1,700-acre (688 ha) Lake Wagonga was presented to the Kandiyohi County Board of Commissioners by a local sportsmen's club concerned about the periodic "winter fish kill" taking place in the lake due to oxygen depletion. Others in attendance at this meeting expressed concern that aeration would have a negative impact on migratory waterfowl using the lake. This controversy prompted the county board to table their decision until the Minnesota Department of Natural Resources (DNR) could be consulted. With several aeration systems already operating in the county, the DNR did not want to make a recommendation hastily, as had been done in previous cases. Instead, DNR Fish and Wildlife personnel agreed that the entire 22,400-acre (9,065 ha) watershed should be examined to make a more informed decision. From this study, the Lake Wagonga Cooperative Management Plan was drafted. It highlighted three broad objectives for the watershed: improve water quality, develop wildlife habitat, and increase quality outdoor recreational opportunities.

Improvement of water quality in the upper watershed included the restoration of a drained, 1,222-acre (495 ha) wetland remembered as Grass Lake. To restore this basin, several problems had to be dealt with, including obtaining easements or fee title from 17 landowners, a county ditch transversing the basin, storm water run-off from half of the city of Willmar (population 18,000), adjacent agricultural land drainage into the basin and an underground oil pipeline. It was essential to evaluate the project from the perspective of all the partners involved. To accomplish this, there has been a continuous exchange of information to eliminate any "surprises."

Upper-level management from several agencies has had input into the project, but respected field decisions. They have been most helpful in orchestrating funding, making grant applications and securing easements. It has also been found that local units of government, especially the counties, exert a great deal of influence on the outcome of the project.

To date, all of the necessary groundwork has been completed for this project. Major funding is being pursued through the North American Wetlands Conservation Fund, the City of Willmar and an appropriation from the Minnesota State Legislature. Several smaller donations have been secured by the partners. At Lake Wogonga, the water quality issue has been addressed by installing mechanical fish barriers and a winter aeration system. It is hoped that these measures will improve in-lake water turbidity caused in part by undesirable fish species.

Heron Lake Watershed Restoration Project—Case History

Heron Lake, a shallow prairie lake located in southwestern Minnesota, was, at the turn of the century, a wildlife mecca. Its waters supported abundant invertebrates and plants, including wild celery (*Vallisneria americana*) and hardstem bulrush (*Scirpus acutus*). It attracted 50,000 nesting Franklin's gulls (*Larus pipixcan*), up to 700,000 canvasbacks (*Aythya valisineria*) during fall migration, and hundreds of thousands of other waterbirds. Market hunters and duck hunters flocked to the area.

By the mid-1980s, Heron Lake's health was in a serious state of decline. Farming had intensified in its 302,080-acre (122,250 ha) watershed, resulting in the drainage of almost all of the wetlands and straightening of many of the streams. The watershed was transversed with an extensive system of drain tiles and ditches. The increased water flow caused Heron Lake to rise as much as 5 feet (1.5 m) in 24 hours. Water entering the lake increased loads of nutrients, sediments, and by-products of urban and rural wastewater. Carp (*Cyprinus carpio*) entered the system in the early 1900s and, along with bigmouth buffalo (*Ictiobus cyprinullus*) and black bullhead (*Amereirus melus*), decreased aquatic vegetation, and increased turbidity and nutrient loading. Diking, to reduce the flooding of cropland, reduced the lake's size from 8,250 to 6,400 acres (3,339-2,590 ha). Wild celery and hardstem bulrush have been essentially eliminated and replaced by sago pondweed (*Potamogeton pectinatus*) and cattail (*Typha* sp.). Even these species were stressed due to water level fluctuations, turbidity and sedimentation. Sago pondweed would not produce tubers or seed. Canvasback use almost ceased and Franklin's gull use declined.

In the late 1980s, many people were concerned about the sad state of affairs, though concerns varied: farmers wanted to prevent cropland flooding; hunters wanted better wildlife populations and high fall water levels to aid in boat travel; anglers were concerned with fishing opportunities; riparian owners wanted private land rights protected; the general public wanted increased access; and so on. One thing they all could agree on was that water quality and quantity must be addressed. If advances in these areas could happen, much would be achieved. It required putting aside their differences and personal biases and working together for common goals, realizing this would aid in their personal objectives and move the project forward. This ultimately resulted in the formation of the Heron Lake Watershed Restoration Association (HLWRA), a diverse group of nearly four dozen local, state and federal conservation groups, agencies, and individuals. At the core of the HLWRA is an 18-member voting board, consisting of representatives of local groups and units of government. State and federal agencies participate and provide technical advice, but do not vote. The HLWRA rewrote an integrated resource management (IRM) plan drafted by the DNR, offered it for public review, and adopted the 20-year, 15-page consensus IRM plan focusing on water quality, erosion control, flood control, fish and wildlife, recreation, education, and economics. With this, a century of watershed degradation and human conflict is ending, and a strong restoration effort began (Nelson et al. 1993).

The accomplishments to date in the HLWRP include rebuilding Heron Lake dam, installation of a $431,00 electric fish barrier preventing fish migration upstream into Heron Lake, acquisition of more than 4,000 acres (1,620 ha) of fee title and more than 1,000 acres (400 ha) of conservation easement (including more than 2,000 acres [810 ha] of existing and restorable wetland basins), completion of a Clean Water Partnership (CWP) Phase 1 to identify point and non-point pollution and nutrient loading, securing of funding for CWP Phase 2 which begins to attack the problems identified in Phase 1, hiring of a watershed ecologist by the Heron Lake Watershed District, starting the Heron Lake Environmental Learning Center that employs an ecology bus for an outdoor classroom, starting a buffer strip easement program, locally developing a Heron Lake Surface Use plan, and securing more than $12 million to use on the project.

The DNR was actively involved in the growth of the HLWRP. Agency personnel assisted in bringing segments of the project together to find common ground by providing technical information, improving communication, attending local meetings, building trust and doing "on-the-ground" projects.

Swan Lake Area Wildlife Project—Case History

The Swan Lake Area Wildlife Project, located in Nicollet County in southcentral Minnesota, is one of the oldest of the comprehensive watershed-based wildlife projects initiated by the DNR. Like most large prairie marshes, the 10,000-acre (4,037 ha) Swan Lake and it's 2,500-acre (1,009 ha) companion, Middle Lake, were in a degraded condition in the mid-1980s due, for the most part, to increased agricultural drainage and the attendant loss of quality nesting and brood rearing habitat. Concerns from local conservation groups and a study by the Minnesota Waterfowl Association prompted the DNR Section of Wildlife to draw up a 10-year, $15 million restoration plan. This plan encompassed 108,000 acres (43,601 ha) and not only included the relatively small watersheds of Swan and Middle lakes, but also a portion of the lower Minnesota River watershed that included numerous existing and drained perched wetlands.

The plan called for the replacement of the existing fixed crest water control structure with a new variable crest structure sized to handle the increased volume of water being pumped into the lake, purchase and intensive management of up to 8,000 acres (3,230 ha) of land within the project area to replace lost nesting cover and restore satellite wetlands, and improvement of wildlife habitat on private land through financial incentives. Funding was sought from the Minnesota State Legislature through the Legislative Commission on Minnesota Resources (LCMR). After much review, the LCMR recommended and the State Legislature approved a $2 million appropriation to begin the project.

With this initial funding as seed money, the Project was able to secure an additional $4 million from a variety of sources, including Ducks Unlimited, Inc., the North American Wetlands Conservation Fund, local conservation organizations and individuals. The project is now 10 years old and, although moving slower than anticipated, it is still progressing toward the original goals.

Discussion

Because the Swan Lake Area Wildlife Project was one of the first of its kind in Minnesota, there were few models to draw from. Plans, procedures and funding initiatives were developed at the local and regional levels by the DNR Section of Wildlife, with review and input sought from local interest groups after the plans were presented. It soon became painfully obvious that the area's agricultural community and local units of government did not buy into the DNR plan as proposed. Unfortunately, there were few opportunities at this late stage for these interest groups to help shape the plan. Opposition soon grew, lines were drawn and the result was a divided community. With hindsight, some method of consensus building should have been used to develop a plan such that each special interest group could claim a benefit from and an ownership in the outcome.

In the Heron Lake project, it has proven to be very effective to have local planning meetings organized, sponsored and chaired by local groups, rather than the agency. This leaves the local partners in control, which may be uncomfortable to upper-level management staff, who feel the agency should always be the visible lead. Of course, there are times when the agency should be the lead, but always trying to be the lead has been shown to be unproductive in our projects.

Efforts to complete the Lake Wagonga\Grass Lake Project are now being "spearheaded" by the Kandiyohi County Soil and Water Conservation District (SWCD). Through their local leadership and support from their lead agency, the Minnesota Board of Water and Soil Resources (BWSR), progress continues. This strategy has also put the project in control of a local government (county) rather than a state agency.

There were times when funding initiatives and resource allocation developed by DNR field and regional staff appeared to be at odds with central office planning. These conflicts in priorities contribute to an erosion of confidence among field managers and partners. Before projects are initiated, upper-level management needs to agree on appropriate levels of support for new projects and have plans in place for incorporating these projects into mainstream operations and budgets.

To be effective, the field manager must gain the confidence and respect of the community and major partners in the project. This can only be done by complete immersion in the community so that, through familiarity, the community can develop the level of trust necessary for success. There are times when things are happening very rapidly in the project. This may take the field manager's full time and commitment. Realizing that field managers' other duties may suffer during this period, upper-level management should be ready to fill in behind them.

Additional strain can be put on field managers' time, allowing less for the project, if they are required to attend all meetings regardless of the content or reason. Occasionally meetings appear to be scheduled simply for the sake of having a meeting. The field manager should determine which meetings are important, have purpose and ultimately will move the project ahead.

The field manager must be given a broader than normal range of decision-making authority within the bounds of his/her position. The field manager also needs the freedom and authority to participate in nontraditional roles, deal with local partners and set the specific direction or involvement of the agency in the overall project. Upper-level management should offer this freedom to the field manager and support his/her decisions, while assisting the field manager to recognize those missions which cannot be compromised. Trust and confidence in the field manager will be achieved if the community sees that he/she has the authority to make decisions and the resources to follow through.

There should not be a cumbersome multilevel approval process for activities. A delayed response can cause a missed opportunity. These opportunities are usually the difference between success and limbo. Support agencies, such as land acquisition, legal services and engineering, must be involved and committed from the beginning. If necessary, special procedures must be developed to streamline these procedures. At the same time, if things are not ready to progress within the project, agency deadlines can be meaningless and may be harmful.

Upper-level management must expect occasional controversy. This controversy must not be feared, but used to push the project ahead and possibly bring in new partners. Controversy may give a stale project new life. With most controversies, a slow response with lots of information flowing to the partners will work well. The local partners can be very good at rectifying problems or concerns when given adequate and accurate information from a trusted field manager.

Plans should be general and flexible but thorough. This allows the field manager to capitalize on opportunities and controversies that may not be readily apparent at the early planning stages. As these arise, more specific plans can be developed to address new issues. It becomes a question of planning for direction verses planning just for the sake of a plan. Upper-level management should accept that the same canned plan will not work everywhere and allow the field manager, and the project, to adapt to local concerns, methods and needs.

One of the underlying principles in the success of any long-term project is a unifying theme that can draw energy from a diverse group of interests so that the forward momentum of a project can be sustained to its completion. This theme, such as the health of a lake, river or watershed, and the projects that are developed around the theme, must be of sufficient scope and size to attract a wide array of special interests who continuously input energy, funding and direction into the project such that the project soon takes on a life of its own. If the project is too small or of limited scope it may die for lack of support if a principle player must curtail activities.

Conclusion

Many times, the best action is one that appears to be totally locally driven, with little agency involvement. This can be accomplished by a locally trusted field manager, backed by the agency and upper-level management, providing good information to local partners and letting them set direction. This direction may not always be what the agency predicted (it could be better), but it must not compromise the agency's overall mission and move the project ahead.

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Good Management and Benign Neglect

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Thank you for the opportunity to address the 62nd North American Wildlife and Natural Resources Conference. I have been asked to give you my perspective on management, specifically management by way of benign neglect, which in my view includes a lesson on coloring—you know, with crayons and coloring books—a skill that some of you may have let wither on the vine these past few years.

As both a U.S. Fish and Wildlife Service (Service) manager, responsible for around 1,000 employees, and a father of two small children, I sometimes feel the need to "color outside of the lines." For most of us as children growing up, or more recently, experiencing parenthood, we know how important staying within the boundaries is as you grow up. Those first experiences with crayons and paper are just the beginning of "boundaries" or "restrictions" placed on you each and every day in the real world. And most of us learned the lesson well—if you're going to color, you have to stay in the lines to succeed; to do it differently will definitely not get you an "A" on your report card, in fact, you may have to start over.

But that's exactly what it might take to get an "A" in today's world—start over; go beyond; color outside of the lines. Take a new look at how things have "always been done" and if needed, take a chance on some different ideas, maybe even risk the label of "renegade" in your office.

When recently asked about my specific management style, I mentioned the book, *Shogun*. The individual I was talking with looked at me and said, "Isn't that the story about some guy in Japan that used people and when he got everything out of them that he wanted, he killed them?" That's not exactly the part I was thinking about. The part that intrigued me about Toranaga, the Shogun character, was his ability to bring out an individual's particular skill and utilize it to its full extent. That often meant Toranaga was not in the forefront of an issue—but grooming those people who were eager to find solutions and all who excelled in their particular field, which ultimately ended up benefitting Toranaga and his long-term plan to be Shogun. That's much of my intent with the people I manage, except I don't wish to be Shogun. I think it's important to provide them with the opportunity and support needed to excel in certain areas and provide them with the knowledge that I'm open to new ways to accomplish our mission. Times have changed in both the private and public sector, but in both arenas, less money and fewer people seem to be the norm. In order for us to accomplish our goals, we have to look for new innovative ways to do our jobs. My job as a manager is to provide the atmosphere and support for employees to color outside the lines when looking for ways to accomplish their goals in conserving and protecting our nation's natural resources. And sometimes, that atmosphere "just happens" with benign neglect as long as the staff has solid technical and people skills.

In my eyes, that is really what occurred in two of the Service's national programs.

It wasn't our top leaders in the Service who decided we needed a contaminants program. At that time, the Service's Research Division directed most contaminant activities, consisting of research and monitoring. The research and monitoring efforts provided data that indicated that wildlife health and habitat quality were often being compromised by environmental contaminants. The need to resolve these problems presented an opportunity for a new breed of highly motivated biologists who could bridge the gap between research data and the regulatory arena. Many of our managers did not understand how a contaminants program could be used to further natural resource goals and often took a hands-off approach, opening even more opportunities for these biologists.

Some of these creative biologists recognized that many contaminant-oriented laws and regulations (e.g., CERCLA) opened up new opportunities for protecting fish and wildlife resources and a new angle for addressing more traditional resource issues. The issue of contaminant threats on national wildlife refuges was a core function of the program since the early 1980s. In 1982 and 1983, investigations conducted at Kesterson National Wildlife Refuge revealed that irrigation drainwater posed a serious threat to fish and wildlife where irrigated lands contained soils high in selenium. The situation was found in many locations throughout the 17 western states. Because of the widespread implications of the issue to the Bureau of Reclamation (BOR) and agricultural interests in the West, the issue became politically charged, and the significance of the issue was downplayed. These newly armed biologists, using contaminants data and available natural resource laws (actually, the Migratory Bird Treaty Act was the real impetus for further action and with some assistance from the press and public opinion) succeeded in convincing managers in the Service, BOR and the Department of Interior that wider investigations were needed for refuge and other lands influenced by federal irrigation projects. Ultimately, 32 sites have been investigated for irrigation-related problems in the western U.S. since 1984. The level of contamination at five locations was significant enough to require remediation.

More recently, oil waste pits, which are believed to have killed hundreds of thousands of birds, with at least 225,000 birds annually in southeastern New Mexico alone, have become a focus for the contaminants program and law enforcement. Oil waste pits are frequently used to contain and evaporate produced waters (water that is brought to the surface with the oil) from oil and gas production in many arid western states. Although separator systems are used to separate the oil and water, incomplete separation is a common problem that results in waste pits partially or completely covered with oil. This situation presents a serious hazard for migratory birds. Birds flying over these pits mistake them for ponds or lakes, and land to rest, drink and feed. If their plumage is oiled, the feather structure becomes impaired and they may perish from drowning or hypothermia. They also may perish due to direct or indirect toxic effects of any oil they ingest while preening. Service law enforcement agents have occasionally tried to tackle the problem since at least the mid-1970s. However, the widespread nature of the problem and the large number of companies involved made it a difficult task. The environmental contaminant biologists, in cooperation with our law enforcement agents in the Mountain-Prairie Region, decided to take a different approach in an attempt to solve this problem. Within Region 6's eight states and 741,000 square miles, there are approximately 70,000 oil wells, all of which have potential for problems with birds and oil waste. State by state, law enforcement agents and biologists evaluate oil well sites. If problems with bird mortalities are believed to exist, the Fish and Wildlife Service agent first contacts the political structures in the area to make them aware of what work is going to occur and the reasons for our actions. By providing this particular audience with the information first, there are no surprises. An invitation to observe the problem firsthand is extended at the same time. You can tell someone something, but the impact of seeing it for themselves often brings support from even those who believe that the government is like that old definition of a baby: an enormous appetite on one end and no sense of responsibility on the other. If constituents contact their local congressional offices with questions about activities in their area, the answers are there. The local representatives know exactly what's going on and why, and can provide that information immediately, without having to go any further.

And the agents didn't stop at the politicos, the real focus of this approach was to educate the oil and gas industry in each state. All the known operators within a state are invited to a one-day workshop. The workshop is designed to educate the company representatives on what the problem is, what the solutions are and what their liabilities are under the Migratory Bird Treaty Act. The same basic information is also sent out in a letter, but the value of the workshop is that it allows the attendees to ask questions. The attendees are also left with the knowledge that law enforcement agents will concentrate on inspecting waste pits in that state. You would not believe the success that we've seen in the four states where this approach has been taken. In Colorado, since the summer of 1995 when surveys were started, 77 percent of the pits were either completely or partially covered with oil and posed a threat to migratory birds. By the end of that year, the number was down to 10 percent. And much of the credit goes to the oil industry for their help in bringing their own operators into compliance. In 1996, more than $2.7 million was spent by the oil industry to clean up their oil waste pits; indications already this year are that this amount will be much greater in 1997. Many companies have voluntarily eliminated these waste pits or netted them, significantly reducing the risk. This has likely spared hundreds of thousands of migratory birds in each of these states. Not only did our employees color outside the lines, they used "forbidden colors"—they were so bold as to tell folks what the problem is *and* offer solutions.

Some people, and I am one of them, believe that the success of the contaminants program within the Service came about by way of benign neglect. Oftentimes, the more management focuses on an issue, the more mired in "stuff" it gets. The mere fact that no one quite understood what the program was "supposed to look like" opened up unlimited possibilities as to what it could become. It was the people in the field who decided not to go with the traditional methods and headed down another path, which has proven to be a very successful one.

The same goes for our Private Lands Program, which links private landowners who want to restore wildlife habitat on their lands with expertise and funding from the Service and other partners interested in habitat conservation. Prior to 1987, as rumors from the field started coming in about a different way of doing business, our leadership fought the idea. But the field quietly pursued what they could see was a program that was working on the ground—where it counted. Individual project leaders started meeting more with members of the community, listening to what they saw as problems, solutions and visions for the future. They soon realized that we weren't that far apart, but it would take everyone to accomplish the goals. It could not be done by the government alone—nor did the community want it that way. Service employees took a "leap of faith" outside their generic position descriptions and became active members of the community. They talked with folks about important issues like local economies and rural lifestyles. Of course, natural resource issues were also discussed. Ultimately, we found out that we shared common values about wildlife, rural living and the West. It was no longer government reciting rules and regulations; it was an entire community working toward common goals. That concept was hard for top-level managers to "manage"; it was outside their comfort zone.

Does this "approach" work? The answer is an emphatic yes!—with time, patience and commitment. One example of a flourishing Partners for Wildlife effort is the Blackfoot River Watershed project in western Montana. The Blackfoot Valley is the setting for a poetic book by Norman Maclean and critically acclaimed movie by Robert Redford. "A River Runs Through It" recalls Maclean's memories of growing up on the Blackfoot River in the early 1900s. Those of you that have read the book or seen the movie know that Maclean and Redford raise "coloring outside the lines" to new heights. Let me illustrate that point by sharing a short passage from the book:

"Like many fly fisherman in western Montana where summer days are almost Arctic in length, I often do not start fishing until the cool of the evening. Then in the Arctic half-light of the canyon, all existence fades with my soul and memories and sounds of the Big Blackfoot River and a four-count rhythm and the hope that a fish will rise.

"Eventually, all merge into one, and a river runs through it. The river was cut by the world's great flood and runs over rocks from the basement of time. On some of the rocks are timeless raindrops. Under the rocks are the words, and some of the words are theirs.

"I am haunted by waters" (Maclean 1975: 104).

Powerful words about a place with unparalleled beauty; rare, native fish; magnificent wildlife; and small, independent communities. A place that is also threatened by increasing development and recreational use, and a long history of poor mining, logging and grazing practices. All of these factors helped motivate the Blackfoot community to look for creative ways to preserve their rural lifestyle, a lifestyle that readily acknowledges the value of natural resources.

Fish and Wildlife Service employees were not excluded from these discussions. On the contrary, we were invited to participate in a dialog about the future of the Blackfoot Valley. Certainly not the norm these days. Eventually those discussions led to the formation of a grassroots organization called the Blackfoot Challenge. Gary Sullivan will provide an in-depth view of the Blackfoot Challenge later in this session, but I can tell you that the Challenge has many functions. Monthly meetings provide a forum for discussing complex resource issues. Funding partnerships are also explored. The Challenge acts as a clearinghouse for any relevant information that could affect communities in the valley. Membership is diverse and includes landowners, agencies, NGOs, business, industry and elected officials.

The Blackfoot Challenge has thrived. To date, more than $5 million has been raised for habitat restoration, easement acquisition, biological weed control, water quality improvement and grazing management. The Montana Partners for Wildlife Program has played a key role in leveraging money and delivering projects. Habitat restoration accomplishments over the past six years are equally impressive. More than 200 miles of stream habitat have been restored, habitat that is critical for species such as bull trout and westslope cutthroat trout. In addition, 1,500 acres of wetlands and 15,000 acres of native prairie have been restored or enhanced. And perhaps most importantly, nearly 45,000 acres of privately owned riparian, wetland, native prairie and timber land have been protected by perpetual conservation easements. Easements allow traditional ranching activities but prevent subdivision, sodbusting, wetland destruction and other incompatible commercial development. All of these accomplishments are the result of landowners, agencies, conservation organizations, business and communities working together in a coordinated effort.

Our success in the Blackfoot Valley has been rewarding but not easy. It has required time, perseverance, luck, creativity and commitment. A key ingredient was allowing Service employees to look for creative solutions to complex problems. Partners for Wildlife is a program that promotes creativity and encourages employees to "color outside the lines."

On a national scale there are many "Blackfoot Challenges," although known by different names. Through the end of last September, these partnership efforts had restored 128,500 acres of native grasslands, 370,000 wetland acres, 956 miles of riparian habitat and 90 miles of instream habitat. All of these accomplishments were possible because 15,700 private landowners invited us on to their property.

"Management by Objective," "One Minute Manager," "Total Quality Management," "Leading from Behind"—whatever the latest management philosophy or fad, the common thread between all is to effectively and efficiently reach a desired result. Were managing people as simple as plugging numbers into a formula, the desired results would be guaranteed. But it depends on the individual, whether the managing should be micro, macro, from the sidelines or a no-holds-barred approach. However, being aware of the human frailties we possess is paramount to achieving a goal effectively and efficiently. Depending on the person and the project, the goal and the method used to achieve it are open for discussion, not restricted by what has always been in the past. Otherwise, you're back coloring inside those lines again.

As financial resources fail to keep pace with work load, each manager will be asking their employees to do more with less. Not only because of management philosophies, but because of downsizing, more people will be responsible for their own actions, they will be asked to relearn things they have forgotten and use skills that had been put aside. It is an opportunity for managers to bring out and develop skills that may otherwise have gone unknown. A sign of the times is not the same sign it was 10 years ago, and managers as well as field personnel need to recognize the opportunities that today's challenges offer. Kick the habit—color outside the lines every now and then.

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Bridging the Central/Field Office Gap under the ACE Basin Project

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Recently, public and private organizations have boasted their successes through cooperative conservation initiatives. No less apparent is the success of the ACE Basin Project in South Carolina. The focus of the ACE Basin Project, an acronym for the Ashepoo, Combahee and Edisto rivers, has been that of a partnership or a cooperative venture from its beginning in 1988.

This paper describes how a task force initiated an ecosystem protection and enhancement project without a defined plan. The paper further describes an innovative approach to directing and managing a conservation program and how activities and decisions at the field level were linked with the highest level within a state wildlife agency.

Case History

The ACE Basin is centered approximately 40 miles south of Charleston, South Carolina, and comprises some 350,000 acres of diverse habitat types in Hampton, Charleston, Colleton and Beaufort counties. The need to protect one of the east coast's largest undeveloped coastal areas was recognized well before an ACE Basin Task Force was formed. Murdock (1980) identified the area for the U.S. Fish and Wildlife Service (FWS) as a "significant wildlife resource area of South Carolina." She may have been the first to use the acronym ACE. Biologically, much of the Basin's value is attributed to the interspersion of upland habitat types and diverse wetlands, including bottomland hardwoods, salt marsh, brackish marsh, freshwater marsh, managed freshwater and brackish impoundments, marsh hammocks, and tidal mud flats. Of the 98,000 acres of wetlands in the Basin (Morgan 1974), about 26,000 acres are diked impoundments (Tiner 1977) and more than 55,000 acres are forested wetlands (Blagden 1992). Because of the wetlands, the ACE Basin has not been developed. It was not because the wetlands interfered with human development activities (since wetlands are often filled), but because the wetlands were responsible for providing rice fields during the rice culture era of the late 1600s through the mid-1800s. The Basin's managed impoundments originated during this era. More than 179 million pounds of clean rice were produced in South Carolina in 1859, representing 95.9 percent of the nation's production (Heyward 1937, Linder 1995). Following the demise of rice production in South Carolina, the plantations and rice fields that lined the banks of the three rivers were maintained primarily for their hunting and aesthetic values. Today, management of naturally occurring plant communities within the diked systems provides food, cover and loafing areas for waterfowl and many other wetland-dependent species (Miglarese and Sandifer 1982).

Because of the ACE Basin's importance to waterfowl, it was identified as a priority focus area by the Atlantic Coast Joint Venture of the North American Waterfowl Management Plan (South Carolina Wildlife and Marine Resources Department 1989). Historically, the Basin wintered up to 14 percent of the dabbling ducks in the Atlantic Flyway. The Basin provides habitat for more than 500 species of birds, mammals, reptiles, amphibians and plants (FWS 1990). In 1996, 28 bald eagle *(Haliaeetus leucocephalus)* nests and 817 endangered wood stork (*Mycteria americana*) nests in four colonies were located within the Basin. During the spring of 1996, the ACE Basin supported 76 colonies of 12 wading bird species, 41 percent of the state's total (South Carolina Department of Natural Resources [SCDNR] 1996). Seventeen endangered or threatened species inhabit the Basin. An extensive biological inventory of the Basin by The Nature Conservancy (TNC) revealed 33 types of natural communities and 8 rare plant species (TNC 1993).

Development of the Initiative

Three events occurred between 1986 and 1988 that provided the impetus to bring partners together to formally begin the ACE Basin initiative. First, in 1986, the South Carolina Department of Natural Resources partnered with Ducks Unlimited (DU) in acquiring and enhancing a 696-acre wetland property adjacent the state's Bear Island Wildlife Management Area in Colleton County. This effort was the state's first project funded under the Ducks Unlimited MARSH (Matching Aid to Restore State Habitat) Program. Negotiations to acquire the property were very difficult because it was held by 10 shareholders of a hunting club and there was much disagreement over the sale of the property within the group. The Director of the SCDNR (Director) had assigned the Chief of Wildlife Management (Chief) the responsibility to partner with DU to bring a MARSH Project to completion as soon as possible. The directive was given to the Chief, an employee three levels below the Director, to personally move forward with a project and advise supervisors of the progress. In essence, the normal agency chain of command was intentionally breached.

After considerable negotiations with landowners, a complicated acquisition scheme necessitated the purchase of shares from all but one shareholder. Then, a land exchange with the remaining shareholder necessitated an additional land purchase. The acquisition was brought to conclusion only to realize that enhancement of the managed wetlands would cost almost twice as much as projected prior to the purchase. The entire purchase and enhancement of the area was to be covered by DU MARSH funds but they were not adequate to cover the increased costs. This shortage was resolved through an agreement where the state expended money from its waterfowl stamp contingency with DU agreeing to replace the funds as future MARSH monies became available. Restoration began immediately after the acquisition and a formal dedication ceremony was held on October 27, 1987, for the property now known as Springfield MARSH. The project was promoted by the news media and the dedication was attended by one of the state's Senators, a Congressman, the Governor and many local politicians. During the ceremony, the Governor noted that "this project illustrated that state and private groups could successfully work together, sharing their talents and resources to protect and restore valuable wetland habitat." The project strengthened the Director's confidence in the subordinate employee and further substantiated the Director's commitment to stewardship and cooperation with resource partners. The project and the dedication served to solidify a relationship between SCDNR staff and key legislators that later contributed to significant federal dollars for the ACE Basin Project.

Another event that influenced the ACE Basin initiative was the transfer of 2,984 acres of tidal marsh and 112 acres of upland to SCDNR from TNC in 1988 for inclusion as part of the Bear Island Wildlife Management Area. These lands were given to TNC by Dorothy and Gaylord Donnelley with a verbal request that they ultimately be transferred to the state. The transfer to the state required a considerable amount of negotiations between TNC, the Donnelleys and the SCDNR. Again, the Director assigned the Chief to negotiate the transfer. The negotiations were necessary because there were differences of opinion by the three parties as to how the area would be hunted under the state's wildlife management area (WMA) program. The successful conclusion of these negotiations again served to enhance confidence levels between the Director and the Chief. The donation also further illustrated that private landowners, conservation organizations and state governments have a common interest and commitment in protecting valuable natural areas. A dedication ceremony following transfer to the state again brought the Governor into the ACE Basin Project spotlight.

The signing of the North American Waterfowl Management Plan (NAWMP) between Canada and the United States on May 14, 1986, was the spark that really set the initiative in motion. This agreement set the stage for cooperative efforts between nations, public agencies, regional and local governments, private organizations, corporate businesses, and individual citizens through the establishment of joint ventures and partnerships. It was this agreement that would later solidify FWS involvement in the ACE Basin Project.

With these three events occurring and with an agency climate of commitment to stewardship and cooperation with resource partners, it was only natural for a cooperative partnership to focus on the rich ACE Basin ecosystem. In April 1988, representatives of SCDNR, DU and TNC met at Mary's Island Plantation in the Basin to plan a strategy for the ACE Basin. This meeting occurred on a site that would later be one of the first approved acquisition projects under the North American Wetlands Conservation Act (NAWCA). With the approval of the Director, the Chief attended the meeting with instructions to pursue the partnership if other partners were committed. Frequent meetings followed between the three partners and within a few months the FWS joined the initiative with participation from the regional office in Atlanta. Soon, an invitation was extended to a private landowner to join with the partnership, and the ACE Basin Task Force was officially established to spearhead the protection initiative.

Commitment and Support of the Initiative

The Task Force immediately realized that the protection of the ACE Basin would be difficult, complex and expensive. It would require support of citizens, community leaders and politicians at the local, state and national levels. Since government agencies were a part of the Task Force, it was apparent that some people perceived mistrust over the role of state and federal government in the project. The typical accusations of a government takeover of private lands were voiced by some locals. The Task Force was concerned over the potential of growing opposition to the project. Some locals in the community wanted to see a written plan addressing the intentions of the Task Force and their organizations. Due to a desire to remain flexible and opportunistic, the Task Force had come to consensus against creating a formal plan to undertake the protection effort. The Task Force did agree to publish a summary statement that described the initiative and confirmed the separate agencies' and organizations' commitment to abide by certain conditions that were desired by a skeptical public. The Task Force members and their respective agencies and organizations agreed to maintain the natural character of the area by:

(1) promoting wise resource management on private lands and protection of strategic tracts by public conservation agencies;
(2) supporting the continuation of traditional uses, such as hunting, commercial and recreational fishing, forest management, and farming;
(3) acquiring land or easements only from willing sellers and participants (condemnation would not be a part of the habitat protection effort);
(4) maintaining or improving access for the public; and
(5) providing wildlife management assistance to landowners interested in improving or enhancing natural habitats.

The published statement successfully curtailed most of the early opposition to the ACE Basin effort. But more important, since the statement was approved by the governing body of the state wildlife agency, it provided a clear framework under which SCDNR staff could undertake individual efforts at the field level. It allowed field staff to make firm statements as to the intent and actions of the agency's governing body and made possible decisions normally not made at the field level.

The ACE Basin Task Force began promoting the protection initiative without a formal plan and without any type of legal mandate or document that designated the Task Force as an official entity. Support for the project was greater than any of the initiators had envisioned. Within one year of the project's initiation, the Task Force had obtained endorsements of support from more than 70 separate groups. It became clear that the project demonstrated that all sectors of the state's population could work together on a comprehensive environmental protection effort. With such broad-based public support and growing support from upper levels of management within the Task Force members' agencies, the Task Force members began taking more risks in pursuing protection efforts. They were now in a position to act quickly to capitalize on future protection opportunities.

As support for the ACE initiative increased both within the Task Force partners and from outside groups, the SCDNR's involvement increased. The Chief could not continue to undertake statewide duties and meet the demands within the ACE Basin, located 115 miles from his Columbia headquarters. A staff wildlife biologist within the Wildlife Management Section was assigned full-time responsibility in the ACE

Basin Project area. The staff assignment provided an on-the-ground link to the Department's Columbia office via the Chief. The Chief had direct access to the Director although the formal chain of command went from field staff to Assistant Chief to Chief to Division Director to Assistant Director to Director. When possible, the normal chain of command was followed, but the relationship that developed between the Chief and the Director during previous acquisitions and project undertakings made for routine contact between the two. The close working relationship resulted in a knowledge of personal philosophies between the Chief and Director. The Chief had the Director's approval to deal directly with him on all matters concerning the ACE Basin Project. This authorization did not preclude maintenance of the supervisory status existing within the normal chain of command. An added responsibility was placed on the Chief to routinely advise his in-line supervisor, the Division Director of Wildlife and Freshwater Fisheries, of all activities dealing with the project. This breach in the chain of command allowed for rapid contact to the highest level within the agency and the transfer of decision criteria during periods of confidential negotiations that on occasion addressed commitments of millions of dollars. The innovative approach of allowing decisions outside the chain of command was for the most part effective as the ACE Basin Project progressed. When problems developed between supervisors and subordinates, it was because an employee failed to brief his supervisor of activities or decisions before they were made public.

With the assignment of the full-time staff in the Basin, it became apparent that improved coordination between the Task Force agencies was advantageous. A Memorandum of Understanding (MOU) was signed between the SCDNR, FWS, DU and TNC whereby the Department's employee functioned as the Project Coordinator. The MOU stipulated that its purpose was to facilitate cooperation in achieving a habitat protection program within the ACE Basin area. The agreement recognized that the partners individually and collectively had major responsibilities for management and protection of habitats in concert with other resource objectives. The agreement provided for the sharing of manpower, equipment and facilities of the partners. Funding was contributed by all parties to the agreement. The MOU was signed by the Task Force members and upper level administrators of the separate partners. The MOU, signed by the SCDNR on December 21, 1989, provided the legal framework for the partnership.

When the early successes of the ACE Basin initiative became apparent, involvement by SCDNR staff increased rapidly. The adage, "success breeds success," certainly was apparent as all divisions within the SCDNR desired involvement in the project. SCDNR activities within the ACE Basin area increased so rapidly that by late 1990, they established an ACE Basin Committee comprised of representatives from all sections and divisions involved in the project. The Committee was chaired by the SCDNR's ACE Basin Project Coordinator and included their ACE Basin Task Force representative. The purpose of the Committee was to integrate the goals of the Project with appropriate resource management responsibilities of the SCDNR's various divisions. One of the first actions of the Committee was the establishment of a newsletter, *ACE Basin Current Events*, published twice annually by the SCDNR. It was intended to inform staff and the public of the SCDNR's role in the ACE Basin Project and communicate overall activities and cooperative accomplishments of Task Force members (South Carolina Wildlife and Marine Resources Department 1991).

Major Components of Initiative

The majority of the lands within the ACE Basin are owned by private landowners whose past and current management activities focused on agriculture, forestry and wildlife. The emphasis of the Task Force encouraged the continuation of private ownership. The members realized that there was a need to preserve not just isolated habitat parcels but to protect the entire ACE Basin ecosystem. Past protection efforts of the SCDNR concentrated on securing relatively small isolated parcels. The vision of ecosystem management through partnerships had not been adequately instilled throughout all staff levels. Though it is not always publicly acceptable nor economically feasible to purchase extensive areas and place them in public ownership, the public does support some government ownership when negative alternatives such as development are imminent. For this reason, the Task Force promoted the acquisition of ecologically significant property by government entities when public funds could be realized and because unique resource components and some critical habitats require intensive management to protect their ecological value (e.g., managed wetlands that were former rice fields).

Beginning in 1989, the Task Force aggressively moved the ACE Basin Project into the public forefront highlighting five key components.

State Wildlife Management Areas (WMA). The Bear Island WMA, owned and managed by the SCDNR, has been the state's main focus in the Basin for more than 40 years. This area was expanded to 12,021 acres by the acquisition of the 697-acre Springfield MARSH in 1987, the 2,696-acre gift from TNC and the Donnelley family in 1988, and a 966-acre acquisition in 1989 under the ACE Basin initiative. This latter acquisition involved a complicated purchase from a private hunt club that included participation from the state, DU, TNC and the National Fish and Wildlife Foundation (NFWF). Complex negotiations and commitments involving state and partner dollars, as well as grant funds from the NFWF, were made by Task Force members. Here again, the success of this acquisition hinged on the ability of the Chief to make commitments and decisions without lengthy waits and approvals from top line administrators.

Currently, the Bear Island WMA provides quality waterfowl wintering and migration habitat on more than 5,000 acres of managed wetlands. In addition to public hunting, the WMA provides excellent wildlife observation, recreational fishing, research and educational opportunities. The significance of this state-owned and managed property is that the public has full access to the lands. Public hunting is conducted under an equal opportunity draw system.

The most creative acquisition under the ACE Basin initiative, and probably the most complicated acquisition project under the entire NAWMP, was the purchase of Mary's Island Plantation (referenced earlier in this paper). This area, named the

Donnelley WMA in honor of Dorothy and Gaylord Donnelley, currently has portions titled to the Corps of Engineers (COE), DU and the state. The state has full management authority under agreements with partners on the 8,048-acre area. Acquisition details for this property will be discussed later in this text.

ACE Basin National Estuarine Research Reserve. Another element of the Basin initiative was the establishment of the ACE Basin National Estuarine Research Reserve (NERR), officially approved on March 27, 1990 (U. S. Department of Commerce 1992). The reserve is a cooperative federal/state program administered by the SCDNR's Division of Marine Resources in cooperation with the National Oceanic and Atmospheric Administration and the state's Office of Coastal Resource Management. To date, more than $2 million in federal funds have been appropriated to match nonfederal dollars within the reserve. The heart of this area is a series of isolated coastal islands, accessible only by water. The boundaries of the reserve encompass a core area including the islands (totaling 11,942 acres) and a buffer zone including 62,656 acres of wetlands, 59,405 acres of open estuarine waters and 5,308 acres of uplands (totaling 128,769 acres). The Task Force was instrumental in negotiating the fee title acquisition or donation of six of the eight islands in the core area. In addition, the Task Force members assisted with establishing conservation easements and negotiating management agreements for other lands within the reserve boundary. The reserve program focuses on research and education while protecting ecologically important estuaries for use as field laboratories. The reserve was viewed as a compatible tool to secure permanent protection and long-term management capabilities on a critical portion of the Basin—habitats that may not be threatened by immediate development but are ecologically important. Efforts by Task Force members to secure reserve designation concentrated on funding, negotiating land donations and enhancing public support for the reserve. Efforts also included a coordinated lobbying effort at the Washington level for support and an accelerated nomination process.

ACE Basin National Wildlife Refuge. Prior to the initiation of the ACE Basin Project, the FWS had proposed the establishment of a refuge of 18,000 acres within the Basin (Murdock 1980). The ACE Basin Task Force members believed that the time was right for public support of fee title acquisition of properties by the federal government. In January 1989, the Task Force launched an effort to encourage legislative support for a federal appropriation for the ACE Basin National Wildlife Refuge. The effort was successful, and to date, more than $15 million have been appropriated for land acquisition. More than 11,000 acres have been purchased for the refuge.

The success of the refuge was the coordinated and aggressive lobbying effort of all Task Force members and their organizations in Washington. More than $1 million were appropriated for renovation of the historic Grove Plantation House that serves as the refuge headquarters. Success in obtaining the appropriated funds was enhanced as partners made trips to Washington to brief legislators and present Congressional testimonies at several budget hearings. The documented support by large numbers of entities and organizations contributed to strong legislative support for the refuge.

A notable fact about the refuge designation was that the entire planing process was completed in less than two years. The Final Environmental Assessment was published in August 1990 (FWS 1990).

Conservation agreements and private land agreements. A fourth element of the initiative was the establishment of conservation easements and land-management agreements on private lands. Conservation easements, permanent covenants that private landowners place on their properties, were written to fit the needs and desires of the individual landowner to protect wildlife habitats and preserve natural values. The Task Force members expressed mutual statements of support to convince landowners to protect their properties with easements. DU and TNC are the primary partners with the ability to hold and enforce the conservation easements. It is unlikely that substantial additional acreage will be acquired by government agencies within the ACE Basin in the near future. Therefore, future protection efforts must concentrate on private lands. More than 39,000 acres of private lands are permanently protected by conservation easements (24 separate conservation easements are held by either DU or TNC) (SCDNR 1996). Additional easements were being negotiated as this paper was being prepared.

Another approach to protection in the Basin utilizes private land agreements. A Memorandum of Understanding was signed between Westvaco Corporation and the Task Force organizations covering 17,000 acres of forestland. Under the MOU, Westvaco pledged to manage lands in a conservation manner utilizing state Best Management Practices (BMPs). Westvaco implemented a visible public relations program in the Basin and developed a nature trail on their property.

Closely associated with the easement element was the purchase by conservation organizations of lands that were in imminent danger of becoming developed. The lands then could be sold to conservation-minded buyers with an easement attached. One of the most ecologically valuable parcels of property within the Basin was protected through this action. The property was the Mary's Island Plantation, located in the center of the Basin. In 1989, the Task Force felt that this property was secure as it was owned by a family trust, with trust members visibly committed to conservation. Suddenly, the trust decided to divest of the property and there were offers by developers to purchase the lands. The Ducks Unlimited Foundation (DUF) with assistance from TNC purchased the 9,000-acre property with the intent to sell it to conservation-minded buyers with attached easements. This was a risky venture as there were no assurances to DU that a conservation-minded buyer would surface. Department staff assisted DU's field staff in convincing the DUF of the importance of protecting the property and pledged major support in managing the property and seeking buyers with a conservation intent.

The commitment by the DUF to purchase the Mary's Island property ultimately led to periods of intense negotiations between DU and the SCDNR. The acquisition necessitated a coordinated lobbying effort in Washington that resulted in a series of complicated and unpredictable happenings. DU received funding from two separate NAWCA grants, obtained funding from the NFWF which involved matching dollars from TNC and Dow Chemical Company, resold a portion of the property to the COE as a component of a mitigation plan for the Richard B. Russell Project in another drainage basin (an action that required major lobbying at the Washington level by the state), resold two parcels to family members of the trust that divested of the property, and then resold a parcel to the National Wild Turkey Federation (NWTF) utilizing monies held by the Federation in a trust (NWTF superfunds) for the state. The bulk of the complicated negotiations involving the acquisition and sales were conducted during 1990. A decision in 1992 by DU to divest of its remaining ownership in the property resulted in further negotiations that led to formal agreements between DU and the state whereby the state would have full management authority over the property with a separate agreement stipulating the fee title transfer to the state within a 10-year period. The ability of DU field staff and the Chief to negotiate and build consensus on conditions in the agreements made the deal possible. The complexity and involvement of the many partners in the Mary's Island Plantation acquisition and the subsequent development of a management plan warrants a separate paper of longer length than the current presentation. The commitment to stewardship and a cooperative spirit between DU, the SCDNR and many other partners made the complicated protection of this critical property a reality.

Private lands assistance. The final element of the partnership was a private land initiative. Private landowners were offered comprehensive technical guidance by biologists with the SCDNR, FWS, DU and TNC. This private lands initiative jump-started in December 1991, when the SCDNR received a $50,000 federal grant under the Coastal America Program through the NFWF to assist in the private lands effort. DU and TNC each contributed $12,500 as matching funds, while SCDNR committed $37,600 to match the grant. A private lands brochure was published to promote the private lands technical assistance program within the Basin. This program remains a major component of the ACE Basin Project.

Summary of Project Success

The ACE Basin Task Force's initial objective was to protect 90,000 acres of the 350,000-ACE Basin. The Task Force and its member organizations underestimated the support from the public and the ability of the partners to pool their talents and resources to accomplish successful habitat protection. More than 126,000 acres are now protected within the Basin and the partners have expanded the goal to protect 200,000 acres by the year 2020. The project has demonstrated that when a partnership approach to ecosystem protection is pursued with strong public support, the result can be monumentally successful, particularly when shared visions of accomplishment are pursued.

Elements Contributing to Success

I attempted to identity elements that contributed to the success of the ACE Basin Project. Though it was difficult to identify all of the factors, there are a number of elements that surfaced in evaluating the project:

(1) Development of trust and respect between partners.
(2) Participants must be full and equal partners, visibly supportive of but not subservient to other partners.

(3) Partners must have a shared or common vision. The partners must see beyond the horizon. They must be visionaries and visualize what successes will mean to the future. Usually there is some catalyst or galvanizing element that has brought partners together in a shared vision. In the ACE Basin Project, the Task Force members had previous experiences where an appreciation of the Basin's resource values developed.
(4) Partners must be opportunistic and work under a flexible program. The partners must be ready to capitalize on events and circumstances that surface and that can contribute in a positive way to the project's success. A rigid plan can become the project's worst enemy.
(5) Partners must be willing to take risks. Most successful endeavors are successful because the participants took risks.
(6) The public must identify with the need for the project. If the public can relate some personal experience to a common threat, support seems to surface rapidly. In the ACE Basin, the common threat was development, readily seen by all citizens in the adjoining metropolitan areas of Charleston and Savannah.
(7) Partners must be able to make decisions at the table. In a rapidly moving project, indecision can be a cause of missed opportunity. Immediate decisions often facilitate earlier consensus.
(8) Opportunity must be provided for everyone's involvement. The most effective partnerships involve all those desiring to participate on the team.
(9) Make the opposition a part of the partnership team. Involving the opposition often causes positive changes in the opposer's philosophy or, at least, it may help bring consensus to the group.
(10) Meet at least some goals or stated objectives as soon as possible. Measurable outcomes are great products in marketing a partnership.
(11) Focus on the objectives. Partners should not lose sight of the focus of the initiative.
(12) The chain of command must be short.
(13) Select competent leaders and participants. Utilize the most talented staff available.

When the above ingredients come together, the product should be a coalition based on collaboration and consensus building with a process of joint decision making where solutions emerge that no single partner could have envisioned or enacted.

Conclusion

The ACE Basin Task Force maintained its primary objective of keeping the Basin as it was at the outset of the project—an unspoiled, intact ecosystem. The project developed like a giant puzzle, with many pieces—a puzzle that may take many years to complete. But, as pieces came together, a clear picture took shape. The picture was a gift to future generations where our descendants have the opportunity to realize the blessings of nature that we now hold so dear to our hearts. But the picture did not just happen. The ACE Basin Task Force took risks, was opportunistic and capitalized on many events and circumstances that resulted in the protection of thousands of acres of habitat.

Activities and decisions at the ground level were linked directly with the highest level within the state wildlife agency. The traditional chain of command was intentionally breached yet in-line administrators were informed of and oriented to the project's activities. The agency director delegated authority to subordinate staff three levels down the chain of command to make decisions and commitments based on a shared knowledge of the personal philosophies of the employee and the agency director. This delegation of authority, along with a strong agency climate of commitment to stewardship and cooperation with numerous partners, had much to do with the early success of the ACE Basin Project. The agency's commitment resulted in visible cooperation throughout all staff levels, shared funding among the different partners, cooperation in funding initiatives and strong mutual statements of support by all partners, as well as success in joint legislative initiatives.

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Partnerships in Practice: The Fine Line Between Success and Failure

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Natural resource agencies continue to face the challenge of solving complex environmental problems with declining budgets and a smaller work force. Building public and private partnerships has become an effective way to pool limited resources to address such problems. Often the basic elements or processes used to form partnerships are crucial to determining their ultimate success or failure (Nelson et al. 1993).

Two projects involving U.S. Fish and Wildlife Service (FWS) programs in Montana will be examined to illustrate some of the important components that were used to build an effective partnership in one case, while avoiding some of the potential pitfalls that led to failure in another. The Blackfoot Challenge Project is an example of a highly successful partnership between private landowners, local businesses, nongovernmental organizations, and state and federal agencies working cooperatively to protect and restore the Blackfoot River Valley in western Montana. The success of this effort boils down to a bottom-up process or "community-based approach" that was used to form the partnership.

Conversely, the Frontlanders Project, an attempt to develop a similar effort along some 2 million acres of the Rocky Mountain Front in northcentral Montana, failed when a top-down or "agency-driven" approach was employed. Critical elements that made the difference between success and failure included identifying common ground and key players, community involvement, building trust through tangible accomplishments, and organizing a grassroots structure and communication network.

Blackfoot Challenge Project

The Blackfoot River Valley is a 1.5-million acre watershed that extends from the top of the Continental Divide westward for some 132 miles. The geologic, hydrologic and topographic features of the drainage combine to produce a mosaic of habitat types. Prairie grasslands, sagebrush steppe, coniferous forest and extensive wetland and riparian areas contain more than 600 species of vascular plants, including six rare plant communities and the Howell's gumweed (*Grindelia howellii*), a globally threatened species found nowhere else on earth (Lesica 1994).

The habitat diversity of the watershed supports a wide variety of fish and wildlife species. Wetland complexes provide important breeding habitat for 21 species of waterfowl and numerous other water birds. Bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), grizzly bears (*Ursis horribilis*) and 10 candidate species (for possible listing under the Endangered Species Act), such as the bull trout, are found here.

Despite the pristine beauty depicted in the movie, "A River Runs Through It," the Blackfoot Valley has endured a long history of poor mining, logging and livestock grazing practices. The cumulative impact of such land-use activities has degraded water quality in the Blackfoot River, resulting in a declining fishery and reduced angling opportunities (Peters 1990). Today, fragmentation of the landscape into summer homesites, golf courses and other commercial developments poses a much more serious, long-term threat to the area.

Identifying Common Ground and Key Players

With such important resources at risk, it is easy to understand why the U.S. Fish and Wildlife Service wanted to be involved in resolving resource problems in the Blackfoot. Yet much of the degraded and threatened habitat occurs on private land. Local landowners were also worried about the state of the Valley, but for a different reason. Their concerns centered around losing a rural way of life, as large family ranches are split up and sold off for development purposes. Unsustainable land-use practices, subdivisions and commercial development posed a common threat to both wildlife habitat and rural lifestyles, thus giving everyone motivation and ownership in finding solutions to the problem. Increased dialogue between agencies and landowners helped identify key community leaders who were often looked to for advice and assistance in solving local problems or concerns. In 1991, these same local leaders were instrumental in organizing the first community meeting where all the stakeholders were brought together to discuss the future of the Blackfoot.

Community Involvement

During the following year, FWS personnel became more active in the community, attending local meetings and developing personal relationships with the key community leaders "across the kitchen table." Numerous discussions took place at Trixi's Restaurant and Bar in Ovando, Montana, which serves as the social hub for many landowners in the watershed. Community meetings were held to identify local resource concerns, priorities and opportunities to work together. All of this required a significant, up front commitment of agency staff time and resources with no guarantee that the project would be successful.

Building Trust through Tangible Accomplishments

During this time, FWS staff were also busy working with local landowners to deliver on-the-ground projects. Under the FWS Partners for Wildlife (PFW) program, funding and technical assistance were provided to improve fish and wildlife habitat on private lands. Initial projects were small, involved low risk and had a high probability of success, such as installing artificial nesting structures for Canada geese (*Branta canadensis*). As landowner trust of the FWS grew, larger and more complex projects were completed, including restoring wetlands, streams and riparian areas, developing grazing systems, and implementing other stewardship practices that improve water quality and complement landowners' agricultural operations.

Ultimately, these successful short-term projects opened up opportunities to work with landowners to protect important habitat on private land with perpetual conservation easements. In addition, easements allow landowners to continue their traditional agricultural lifestyles and help maintain the rural character of the area. Most important, FWS staff had the flexibility to use a variety of innovative tools to solve local resource problems.

Establishing a Grassroots Organization and Communication Network

As projects and potential partners grew, the need for a more coordinated strategy was identified. The Blackfoot Challenge organization was formed and guided by a diverse steering committee to represent all the interests in the watershed. Its mission is to "coordinate efforts that will enhance, conserve and protect the natural resources and rural lifestyle of the Blackfoot River Valley for present and future generations." In 1994, the group hired an executive director and became a 501(c)(3) nonprofit organization.

The Blackfoot Challenge continues to serve as an information clearinghouse for land-management activities in the drainage. Monthly steering committee meetings, fax/electronic mail linkage and quarterly newsletters sent to some 400 local residents provide an important communication network between partners. In addition, the organization sponsors educational workshops and tours throughout the year to encourage local involvement and ownership in resolving resource problems in the watershed. Active participants in the partnership have grown to include more than 100 private landowners and representatives from 27 state, federal and non-governmental organizations.

To date, the accomplishments are impressive. More than $5 million have been combined to restore and enhance more than 1,500 acres of wetlands, 200 miles of streams and 15,000 acres of native grasslands. More importantly, nearly 45,000 acres of private land have been protected with perpetual conservation easements. All of this accomplished, without controversy, through a diverse, community-based partnership.

Frontlander's Project

With a successful partnership underway in the Blackfoot, FWS staff began looking for similar opportunities elsewhere in the state. The Rocky Mountain Front seemed appropriate, a mix of public and private land that lies adjacent to Glacier National Park and the Bob Marshall Wilderness Area, and is considered to be nationally significant in terms of wildlife habitat. Here too, residential subdivision and commercial development pose a serious threat to the area's unique resources and rural lifestyle.

In 1994, representatives from FWS, Montana Department of Fish, Wildlife and Parks, and the Nature Conservancy sponsored a series of meetings to identify resource threats and potential opportunities to work together along the Front. Initial response to the idea was positive but several key players (who were considered to be "opponents" to such ideas) were left out of the early planning stages. Excluding some of the stakeholders from the public involvement process created rumors of a hidden agenda or government plot to regulate and control traditional land uses (livestock grazing, farming, logging, etc.). Despite this, a fragile consensus group called the Frontlanders formed and participants agreed to work cooperatively on threats to the area's wildlife habitat and agricultural land base.

A vocal minority remained opposed to any efforts that included assistance from government agencies or conservation organizations. FWS staff were not actively involved in the local community and hadn't completed any projects with private landowners in the area. Lack of trust between landowners and FWS personnel fueled local anxieties over other issues including endangered species recovery and loss of private property rights.

Subsequently, a spin-off group called Montanans for Private Property Rights (MPPR) formed and began advocating the need to preserve rural lifestyles without the help of government agencies or outside influences. This made it difficult for the project to move forward, since much of Rocky Mountain Front is a mix of public and private ownership. Ultimately, MPPR managed to stifle the effort, leaving members of the Frontlanders group frustrated and unsure of how to proceed.

What Went Wrong?

Hindsight is always 20-20, but several subtle but fundamental mistakes were made in the Frontlanders Project. Most of these involved the *process* that was used to form the partnership rather than any specific problem or resource issue. Critical elements responsible for the failure included:

(1) Top-down or "agency-driven" approach—the initial meeting was sponsored by agency representatives and quickly became perceived as a "government project." A better strategy would have been to let key community leaders organize the effort and encourage more local input and ownership in the process.

(2) Excluding your opponents—inviting only the supporters to the initial meeting created suspicion of a hidden agenda and led to the formation of a rival group that generated additional conflict and controversy. Involving your opponents from the onset must be viewed as an opportunity and not an obstacle. Ultimately they will add diversity and strength to the partnership.

(3) Moving too fast—pushing the process too fast resulted in a lack of trust between partners. Partnerships require patience and a significant investment of time and resources. FWS should have completed a series of projects on-the-ground to establish trust and credibility with local landowners. More "coffee-shop" discussions were needed before launching forward with a formal partnership proposal.

Conclusion

From a field manager's perspective, building partnerships is more art than science. Like grandma's homemade bread, each partnership is unique, often messy to make and doesn't follow any cookbook recipe or format. Traditional agency paradigms, such as an 8 to 5 work schedule, tying every staff hour or resource dollar to a specific accomplishment and "controlling" the public, don't mix well with the partnering process.

Personalities can also make or break a partnership. Agency staff must be able to understand the perspectives of other partners in order to develop two-way trust. We may disagree with others on certain issues, but we need to set aside those differences and focus on the common ground.

In my opinion, natural resource agencies will never solve some of the complex fish and wildlife related problems facing us through a top-down, regulatory approach. Ultimately, it's going to take a change in human behavior. Clinical psychologists agree that "effectual (or personal) experiences" are much more effective at changing human behavior than informational programs. Partnerships promote these effectual experiences—public and private partners working hand in hand to solve local problems. These efforts not only improve habitat, but also help make measurable strides in changing human behavior. I sometimes think this may be more important than the acre of habitat or mile of stream we restore.

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Traditional Knowledge: Don't Leave the Future Without It

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Traditional Knowledge is an essential grasp, an understanding and reverence that indigenous people have with ecosystems. This is an astute and strategic orientation based on observations and interactions with the natural world. This knowledge is empirical—closely based on observations, interactions and systematic feedback while incorporating spiritual systems. It is often expressed in spiritual and cultural terms and rules, providing not only description and reverence for natural resources but an ethical system for human behavior for sustaining ecosystems, including humans, for generations that will follow. It is community-based and culturally centered wisdom held by individuals who represent the understanding of long-term ecosystem fluctuations and functions across the cultural landscape. It stresses that humans depend on ecosystems and human actions must reflect this dependency.

Traditional Knowledge—Western Science

Traditional Knowledge is oriented much differently than Western Science. Traditional Knowledge is generally transmitted orally and experientially, and not written. It is learned through hands-on experience and not taught in abstracted context. It is holistic, nonlinear and not reductionist in approach. It is qualitative and in the intuitive thinking mode, and not quantitative or in the analytical thinking mode. Instead of relying on explicit hypotheses, theories and laws, it relies on spiritual, cumulative and collective knowledge that is interpreted annually. Traditional Knowledge tries to understand systems as whole and not isolate the interacting parts. Observed ecosystem changes and human actions are evaluated in the perspective of the whole ecosystem and its importance (Clark 1997, Jorgensen 1995, Merculieff personal communication: 1977).

Like Western Science, Traditional Knowledge provides an additional body of knowledge and another way to instill conservation ethics into others. It teaches conservation and ecosystem management. As Traditional Knowledge keepers continue to point out, you pay particular attention to things when those things keep you alive.

Some Key Tenants of Traditional Knowledge

All living and nonliving things on earth are interconnected in a vast symbiotic relationship (Sherman no date). All elements of earth and all life forms have a spirit similar to that of humans; humans and all life forms depend on mother earth for survival (Federation of Saskatchewan Indian Nations 1992).

Native Elders, with their multigenerational insight and cultural wisdom handed down from the ancients, will tell you that if you watch and listen closely, you will hear the heartbeat of Mother Earth; she will share her knowledge, her history and her bounty. However, she will also share her heartache and wrath with equal measure. Survival is a spirit of mutual good. Disrespect of any natural resource will afflict all natural resources. The web of life and ownership of what land provides are completely opposite. From the Tlingit culture point of view, Mother Earth depicts us all as equal in her garden, which is the foundation by which Natives contemplate brotherhood with plant, rock and wildlife in common endorsement to live on Earth. In complete and wholesome measure, Native Americans possess the science of respect for and commitment to live in harmony with Mother Earth and the web of life and to pass it on to future generations. Native Americans have enjoyed this relationship for eons and built a society with successful cohabitation with plant, rock and wildlife.

We Need Traditional Knowledge

Threats to our Environment

During 1950 to 1990, the human global population more than doubled, from 2.5 billion to 5.3 billion. More than 1 billion will be added in the 1990s (Raven 1990). There is no overall accepted strategy to sustain the global ecosystem. Almost every square inch of the globe is affected by human activities. Natural habitats and countless species are being lost. Solutions will require far more than reactionary technological fixes, more environmentally friendly development or relying solely on Western Science. Social/economic systems and controls will be required that firmly institutionalize respect for the land and protect the biological diversity that supports all of us. "The fate of humanity is bound to that of the diverse ecosystems that are the bedrock of human economies" (O'Neal et al. 1995: 217). Tainter (1996: 10) states: "...in the long term, sustainable land use and management must be based on social and political institutions that are themselves sustainable."

Human Dependency on Biological Diversity

World plant and animal species, biological communities, and genetic resources form the foundation for human societies (Balick et al. 1996, Montgomery and Pollack 1996, Tainter 1996, World Resources Institute 1992, Raven 1990, Wilson 1988). They play critical direct roles in human spiritual, cultural, religious and family systems for human survival. Raven (1990: 773) states: "[human] Sustainability and preservation of biological diversity are two sides of the same coin." According to World Health Organization estimates, some 80 percent of people living in developing countries rely on harvested plants for some part of their primary health care (Balick et al. 1996). In Alaska, about one-third of the residents depend on wild meat to keep them alive.

Provides Specific Information

Traditional Knowledge of an area, ecosystem or species can be very valuable. The indigenous people's intricate webs of knowledge form a "...vast intellectual legacy, born of intimacy with the natural world" (Nelson 1993: 104). Berkes et al. (1994) and Merculieff (no date) give many good examples. In many critical natural resource management situations we don't have time to wait for research. We recognize that science does not provide direction for decisions. Traditional Knowledge can help provide understanding now. There are many situations where results of "western" scientific studies already were well known by indigenous people and where community-based Traditional Knowledge can make a great difference. Local knowledge of Hudson Bay eider abundance, distribution, behavior and sustainability held by the Inuit provided managers with baseline information and strategies for conserving and developing a commercial harvest of eiderdown (McDonald and Fleming 1993, Nakashima 1993). The Alaska Eskimo Whaling Commission (AEWC) was created after the International Whaling Commission imposed a total ban on bowhead whaling. The AEWC first mounted a court challenge to prevent the ban from taking effect, then concentrated on filling the information gap between the Western Science understanding of bowhead whale population levels and the knowledge already held by Native whalers. The AEWC did this through fostering scientific research which independently corroborated the whalers' observations and understandings (Brelsford and McFarland 1996). In 1991, scientific documentation showed an 83-percent decline in four key seabird species in the Pribilof Islands of Alaska. The Pribilof Aleuts had made those determinations more than a decade earlier, but managers chose not to lend credence to Aleut Traditional Knowledge (Merculieff no date). A major university spent $300,000 to determine if halibut forage off the sea bottom in the Alaskan Aluetians. Resident Aluets already knew that halibut do this, and specifically when and under what conditions—something not addressed by the university study (Merculieff no date).

It is well written how Traditional Knowledge provides information on ethnomedicine and medicinal resources of forests, particularly tropical forests, as well as agricultural knowledge and biological diversity. The Exxon Valdez Oil Spill Trustee Council (1996: 1) recognized the importance of Traditional Knowledge: "As astute observers of the natural world and its repositories of knowledge on the long term changes in their biophysical environment, practitioners of traditional ecological knowledge (TEK) can provide western biologists and ecologists with systematic and analytical observations that cover many years."

Protects Human Rights

We cannot have human rights without protection and support for cultures. We cannot have indigenous people's cultures without Traditional Knowledge. Traditional Knowledge provides strong kin-based social safety nets for families and family cultural values, and teaches environmental and conservation values and ethics. Rejecting or marginalizing Traditional Knowledge and excluding indigenous people from their heritage or from helping to determine their future denigrates human rights. Indigenous people often are excluded from discussions that profoundly affect their lives. Gadgil et al. (1993) discuss ways to include indigenous people and protect their rights.

Merculieff (no date) describes countless and subtle ways in which native cultures are diminished by not acknowledging Traditional Knowledge and experiences that define cultures and how persons in those cultures understand themselves. If the teachings of indigenous elders are rejected or ignored in the society where young indigenous people must make their future, traditional wisdom is lost through punitive enforcement. Thus, cultural and human rights are not honored. Indigenous youth often are caught between teachings and values of their elders and laws from "outside." Spring waterfowl hunting in the North American Arctic and fur seal pup harvest on the Pribiloffs are examples. Should indigenous youth be treated as "criminals" or should harvest be "legalized" and youth be required to be accountable for their actions and active players in conservation?

Human rights are eroded in other ways. Destructive biodiversity prospecting occurs (Reid et al. 1993). Alcorn (1993: 426) stated: "In the real world, conservation of forests and justice for biodiversity cannot be achieved until conservationists incorporate other people into their own moral universe and share indigenous people's goals of justice and recognition of human rights." These are important ethical and human rights questions.

Strengthens Cultural Diversity

Cultural diversity strengthens human society. Most Alaska Native cultures express strong family, environmental, ethical and moral values, based on cultural traditions passed on by Traditional Knowledge. These are virtues that the human society would be wise to conserve, strengthen and encourage. Ben Stevens (personal communication: 1996), an Athabascan from Arctic Village, Alaska, said: "You don't disrespect that which keeps you alive." Salina Everson (personal communication: 1996), a Tlingit elder, said: "The Traditional Knowledge of our elders kept our natural resources from being depleted."

Strengthens Biological Diversity

Human cultural diversity should be considered part of our global biodiversity. Since humans are part of ecosystems, human diversity should be considered part of biodiversity. Gadgil et al. (1993) state that ecosystem resiliency probably is the most critical ecosystem property to sustain and that long-term human experiences in ecosystems most likely are of vital importance. Berkes et al. (1994) state that Traditional Knowledge will help design more effective conservation of biological diversity. We agree. Like genetic or species diversity, diverse human cultures represent potential solutions for human survival in diverse environments and preparedness for changing conditions. Merculieff (personal communication: 1997) stated that nature teaches us that diversity is an essential component of survival and that the world drift toward monoculture is a threat to human survival. He referred to singular languages, economies and learning. Will our highly technological and convenience-based lifestyle with little connection with nature get us in the end? If we spread this lifestyle to all the world, how prepared are future generations to face major environmental change? In that scramble, will biological diversity be sacrificed?

Apanguluk Charlie Kairaiuak (Kairaiuak no date: 2), a Yupik Inuit Eskimo from Alaska, states: "For thousands of years, they [indigenous people] have maintained a spiritual relationship with all living things and have always shown respect and honor to them. It is because of this communal relationship that Native people have developed a management and regulatory system specifically designed to ensure that all of the resources they use are harvested in a way such that the strength of those resources is always enhanced."

We began comparing the messages between Traditional Knowledge and teachings of recognized great American conservationists. How familiar Traditional Knowledge sounds to the great writings of Leopold (1949), Carson (1962), Humphrey (1976), Udall (1972), Thomas (1986) and Thomas et al. (1993). Yet, only indigenous cultures have proven that they can live this ethic over thousands of years. Indigenous people, through their Traditional Knowledge or Treaty rights, or through their committment to conservation can be very powerful conservation partners.

Call for Leadership

The United States must provide more leadership in protecting the environment and cultural diversity. Like it or not, we perform poorly at home, and we are viewed as an example to the world (Chafee 1996). The United States finances development projects through the Agency for International Development, the Export-Import Bank of The United States, and the Overseas Profit and Investment Corporation. We believe these activities are important. However, protection for the environment must be assured. We now know that it is more important than once thought (Carnegie Endowment National Commission 1992, Christopher 1996a, 1996b, World Resources Institute 1992, World Bank 1995). Developing nations are struggling and creating environmental damage (Christopher 1996a, 1996b). Former Secretary of State Warren Christopher's (1996a) policy on the environment is a critical leadership initiative in world environmental protection. Recognizing that America's national economic and security interests are inextricably linked to the quality of the Earth's environment, the policy calls for U.S. leadership to support sustainable development in developing nations to help establish political stability, stronger trading partners and reduced reliance on foreign assistance, and to prevent humanitarian catastrophes, and help conserve biological diversity. Traditional Knowledge and collaboration with indigenous people can and must be part of America's foreign policy. Senator Sam Nunn said: "There is a new and different threat to our national security emerging—the destruction of our environments" (Bidlack 1996: 3). We are particularly struck by what has happened in Siberia and the Russian Far East (Romoli 1995, Garelik 1996, Newell and Wilson 1996).

Urgency

There is great urgency to accept and respect Traditional Knowledge. Elders are dying and with them Traditional Knowledge. Weatherford (1988: 254) tells of the sad death of the last member of a tribe in the South American tropical rainforest: "When she died a treasure of information went with her...." Nelson (1993) discusses how western education and cultural changes have steadily eroded this knowledge. When we lose indigenous cultures in their natural environments, we will lose a rich legacy and powerful potential force to strengthen society's will to protect what it must. Meffee (1992: 350) concludes: "Humankind has adopted an arrogant and ultimately a self-defeating attitude toward nature that places technological mastery over nature at the forefront of our approach to many environmental problems." He describes the "...flawed attempt to recover Pacific salmonid fisheries..." through dependence on hatcheries. With the urgency of the issues and threats to cultures and our environment, we need the wisdom of indigenous people in decision making and problem solving.

Accept Each Other

We are all brothers and sisters under the sun. We must join together and not let Traditional Knowledge slip away. Weatherford (1988: 255) concludes his book, "Columbus arrived in the New World in 1492, but America [Traditional Knowledge] has yet to be discovered." We agree!

Indigenous and nonindigenous people must work together and focus on our shared environment. We need to apply Traditional Knowledge to broader societal environmental issues and strengthen human understanding of the web of life and social systems that respect the environment, and live as if Mother Earth mattered. Are Traditional Knowledge and associated human rights part of our safety net for securing the future of humans? Social forces threaten Traditional Knowledge, helping to break the string of learning from elders and teaching environmental values to the young. All human societies, including ours, are dependent on the quality of our environment and societal will to protect it (Carnegie Endowment National Commission 1992, Christopher 1996a, 1996b). We must have democracies to protect the environment. Open governments are a must. To have democracies, we must involve and share leadership with local and indigenous people.

For many socioeconomic issues involving natural resources, we will need to combine Traditional Knowledge with Western Science. We must extend a hand to each other and join forces. Our land ethics and hearts are in the same place. When we value Traditional Knowledge, it empowers indigenous people resulting in a better environment (Jorgensen 1995).

Accept Traditional Knowledge

"A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community; it is wrong when it tends otherwise" (Leopold 1949: 224-225). Leopold stresses that land ethics reflect our ecological consciences and individual convictions to preserve the health of the land, and that the human individual is a member of a community of interdependent parts. Leopold (1949: 209) further states "Obligations have no meaning without conscience, and the problem we face is the extension of the social conscience from people to land." Sounds like "Mother Earth" to us! This land ethic changes the role of humans from conqueror of the land community to plain members of it. Respect for fellow community members and the community as a whole is essential. Yet, the traditional "western" perspective has tended to reduce biological diversity through simplification, fragmentation, selective destruction and consideration of only the short-term perspective (Franklin 1993, Norse 1986, Harris 1984, Cairns and Lackey 1992, Wilcove 1987).

A strong land ethic also requires respect for Traditional Knowledge. A land ethic that demonstrates respect for the experience and knowledge of indigenous people is at the root of sustainable development. Maurice Iwu from Nigeria stated that the only way we can leave sufficient natural resources for our children's children is to go back and learn from cultures that used natural resources sustainably (Davis and Ebbe 1993). Iwu states that African indigenous people had symbolic and ritualistic ways of doing this, but: "The symbolism involved in this should not prevent Western Science from understanding the actual significance of the protective mechanism" (Davis and Ebbe 1993:). Nelson (1993: 36) stated that it is essential that we learn from traditional societies, especially those whose livelihood depends on the harvest of a wild environment: "These people have accumulated bodies of knowledge much like our own sciences and this gives us vital insights about responsible membership in the community of life, insights founded on a wisdom we have long forgotten and now are beginning to re-discover." Berkes et al. (1994: 287) state, "...there is good reason to believe that the ethics of truly sustainable development will need to borrow much from the world views of some traditional societies." If Traditional Knowledge was not scientific, indigenous people would not have preserved the ecosystems for thousands of years (Davis and Ebbe 1993).

We conclude that Western Science and Traditional Knowledge have much to learn from each other and gain collectively; we have so much to lose if we don't join together. Threats to the environment and cultures don't give us much time. Acceptance of Traditional Knowledge is prerequisite for obtaining critical conservation partnerships. Indigenous people will share Traditional Knowledge if they feel the information is respected and sharing it will benefit them. The relationships developed from this can lead to critical collaboration. This is vitally important to world conservation of biological diversity and security of nations. We agree with Alcorn (1993: 425), "...the modern [conservation] approach is too narrow and that conservationists [must] have two goals: to stabilize the traditional conservation ethic wherever it still exists, and improve the modern conservation ethic" About 80 percent of the African elephants in Kenya live outside protective parks. The Kenya Wildlife Service manages elephants in collaboration with rural Kenyans, including sharing revenues from elephant management with them (J.Waithaka personal communication: 1996).

Personal Responsibility to Take Action

Alcorn (1993: 426) states, "Until we recognize the authority of indigenous peoples as equals at the discussion table, we cannot join in partnerships with them." If they don't join in, we lose their gift of Traditional Knowledge. We must break down the barriers and ask others to do the same. We ask that Traditional Knowledge not be labeled as *anecdotal*. We are dismayed at how frequently it is. Rejecting or discrediting Traditional Knowledge is wrong and does not serve society. Those who reject or discredit Traditional Knowledge because of treaty rights or other legal disputes must stop and consider those issues separately. We must not let these actions take the dignity and benefits of Traditional Knowledge away from us.

We must all gain the understanding of those who don't accept the fact that sustainable economies depend on sustained environments. Nabhan (1995: 481) states: "Unless we can further engage a diversity of people in the conservation of biodiversity, the epitaph of our movement will read: cause of death: an uncommon strain of reductionism complicated by an attack of elitism, even though there were ready cures."

Progress is Being Made

The Canadian Northwest Territories' (NWT) government recognizes that Traditional Knowledge is a valid and essential source of information about the natural environment, natural resources and uses, and the relationship of people to the land and to each other (Davis 1993). Their government is using Traditional Knowledge in their decisions and actions.

Many tribes are showing the way. The Menominee Forest Management Program earned a Sustainable Development Award from the U.S. Vice President's Council on Sustainable Development (Landis 1992). The Minneapolis Area Waterfowl Management Task Force's *Circle of Flight* program (Bureau of Indian Affairs 1996) continues to be a national tribal model for wetland conservation.

The United Nations *Earth Summit—Agenda 21 Program of Action* (United Nations 1993: 9) Principle number one is: "Human beings are at the centre of concerns for sustainable development...they are entitled to a healthy and productive life in harmony with nature." The action plan also contains: (1) "Indigenous people have developed over many generations of holistic traditional *scientific* knowledge of their lands, natural resources, and environment"; and (2) "...indigenous people and their communities shall enjoy the full measure of human rights and fundamental freedoms without hindrance or discrimination."

The Arctic Environmental Protection Strategy (Eight National Governments 1991) was developed to protect the Arctic flora and fauna. It states that both "scientific" and Traditional Knowledge have been pointing to the danger signals of environmental damage. It recognizes that Traditional Knowledge has value and credibility, and that there are benefits to sharing this information. It further recommends creation of forums and other ways to share and use Traditional Knowledge and encourages comanagement partnerships between indigenous people and others. Brelsford and McFarland (1996) describe successful comanagement and Traditional Knowledge partnerships between indigenous people and governments. World Bank policy now is to protect indigenous people from harm of development projects (Davis 1993).

Government leaders in Alaska are committing to use of Traditional Knowledge and collaborating with indigenous people. The State's Federal Subsistence Board seeks and uses Traditional Knowledge in its decision making. The Forest Service Alaska Region established a Core Group for applying Traditional Knowledge to management of national forests (Janik 1996). The Exxon Valdez Oil Spill Trustee Council (1996) established protocols for including indigenous people's knowledge in the Exxon Valdez Oil Spill restoration process.

Conclusions

Traditional Knowledge is valid and necessary. It contains comprehensive, detailed, insightful, proven wisdom about species, ecosystems and sustaining human respect for the environment. We must not reject or marginalize it or its keepers. Currently they are threatened. Government entities should move swiftly to incorporate Traditional Knowledge into their decision making and collaborative stewardship. It will strengthen government and society. We find no compelling argument otherwise. Traditional Knowledge and its keepers can be two of the most influential future conservation forces this world will have. Let's not leave the future without them.

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Beyond Conservation Rhetoric: Bridging the Gap Between Science, Policy, Planning and Getting the Job Done On the Ground

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Over the past decade or so, conservation has seen a major shift in philosophy and emphasis as we have gradually moved from a tradition that focused largely on individual species (threatened and endangered as well as game) and a few selected habitats, to one that attempts to encompass larger expanses of the landscape. The terms used to characterize these broader conservation horizons are numerous and include such things as watersheds, ecosystems, bioregions and ecoregions. By adding the words "planning" or "management" to the above terms, we begin to give names to the many processes being applied across these landscapes, along with others, such as biodiversity planning, habitat conservation planning, multi-species planning, natural communities conservation planning, coordinated resource planning, sustainable development and more. While this changing emphasis has at times provided its own set of controversies, its momentum continues to grow in this country and elsewhere. As the primary component of "biodiversity conservation" and "ecosystem management," landscape-level planning provides much of the focus for current conservation action and debate.

Across the country, efforts are underway at almost all conceivable levels to plan for and implement regional, statewide and, in several cases, multistate conservation programs. What many of these efforts are revealing is that, in spite of everyone's best efforts, the science that drives these processes remains largely imperfect and sometimes inaccessible, and the planning phase is extremely time consuming and costly. And now for the bad news; the planning is the easy part! How to actually implement these programs—i.e., how to effectively achieve landscape-level conservation on the ground and maintain it over the long-term—remains largely a mystery. And, until the mystery is solved, until we have "real world" working successes to build on, our current terms and processes will remain more rhetoric than reality.

Only one national biodiversity oriented program that we are aware of has attempted to take a comprehensive look at the complex set of issues associated with implementing broad landscape-level conservation planning. This is the National Gap Analysis Program (GAP), a landscape-scale assessment of selected elements of the nation's biological heritage. At the heart of GAP is a computer-based Geographic Information System (GIS) that layers data showing land cover types, predicts the distribution of terrestrial vertebrate animals as surrogates for biodiversity, and overlays land ownership and management status. The data base can be used to identify "gaps" in the nation's system of conservation lands; hence the name, "Gap Analysis."

In 1995, we completed an assessment for the GAP Program, aimed at identifying the critical implementation needs for GAP to help it achieve its greatest potential as a tool for conserving the nation's biological diversity. The premise that we worked from was that in order for GAP to have the greatest conservation impact, it must become an integral part of organized, comprehensive planning efforts at a variety of implementation levels. Our assessment was based largely on input from a nationwide survey that involved more than 400 individuals, along with a series of focused workshops and interviews involving dozens of additional scientists, land managers, conservation interests and policy makers from around the country. Through this process, a number of critical focus areas were developed and discussed. These include application of data to land conservation planning, policy needs, institutional structure, education and training, information transfer, and human dimensions. Each of these areas is discussed below.

Maybe one of the most important things that we came to understand during this effort is that the issues we originally intended to address for Gap Analysis specifically are, in reality, much broader than GAP. They are common to all efforts aimed at comprehensive landscape-level conservation, and combined, they form a basic template for effective conservation planning and implementation. So, this paper is not about Gap Analysis. Rather, it is about the processes and factors that are destined to play a critical role in virtually all attempts to develop and implement scientifically sound, landscape-level programs.

Application of Data to Land Conservation Planning

There is little argument over the fact that sound conservation at any level must be science based. However, science- and research-based programs eventually must reach a critical juncture; a point where they can remain essentially as "science" and have a maybe important but limited impact on conservation or move beyond their research-based underpinnings into an arena of interdisciplinary and interagency coordination and cooperation. It is on this latter playing field that conservation is best served. Good science will lead to better conservation if the information it generates can answer the questions that many nonscientists that have to make planning, policy and financial decisions ask. From the scientific community, this means committing expertise and resources to communicate effectively with a broader audience—an audience that scientists generally do not serve. It means meeting people where they are and presenting them with information they can understand and use. Many scientists do not view their role as that of a "bridge" between necessary research and the on-the-ground application. Perhaps Everett Rogers, in his book *Diffusion of Innovations* (1983:) said it best: "When public funds have been used to sponsor research, financial support is an unrealized public investment until the innovation is adopted by users....Scientists tend to be cautious when it comes time to translate scientific findings into practice." The real tragedy here is that it is conservation, the very reason that these same scientists claim they are carrying out their research, that is the primary loser due to this attitude.

Policy Needs

In its report, *Ecosystem Management: Additional Actions Needed to Adequately Test a Promising Approach*, the General Accounting Office (GAO 1994) found that in taking steps to implement ecosystem management, "...the federal government will have to make difficult policy decisions about how it can best fulfill its stewardship responsibilities." The report went on to point out that "...although ecosystem management will require collaboration and consensus-building among federal and nonfederal parties within most ecosystems, incentives, authorities, interests and limitations embedded in the larger national land and natural resource framework—many beyond the ability of the federal land management agencies individually or collectively to control or affect—constrain these parties' efforts to work together effectively."

In effect, what this means is that the current institutional structure in this country—along with its supporting laws, regulations and policies—make it extemely difficult for efficient, broad-based landscape-level conservation planning and management to occur. Despite this, a growing national interest, and we might even say urgency, has arisen, both in the public and private sectors to move rapidly forward in this direction. Clearly, there is a need for enlightened policy direction in this arena. Successful implementation of comprehensive conservation programs in general will depend largely on the evaluation and restructuring of existing programs and policies at both the state and federal levels. Their success, however, also depends heavily on policies and decisions that are made where the rubber meets the road—on-the-ground, by local government agencies and private landowners and interest groups.

Local agencies have significant control over how and where activities proceed within their jurisdictions. With continued economic growth and development key to their long-term survival, they can be strong, proactive partners or major deterrents to developing and implementing comprehensive conservation strategies. For these strategies to be successful, local agencies should adopt policies in support of regional conservation planning efforts. They need to be invited to participate as full planning partners in efforts that expand beyond their jurisdictional boundaries. Such involvement can be greatly facilitated through cooperative planning and outreach programs on the part of state and federal agencies that provide ready access to data sets valued by these local agencies.

In our assessment, we made the point that the ultimate success of landscape-level conservation planning efforts will depend on the support and ownership of private-sector interests. This has a number of policy implications. Across the nation, individual and corporate landowners must become involved in implementing conservation strategies. At the corporate level, this will be accomplished most effectively if landowners are included in the planning process. It will require that such landowners come to the table as proactive planning partners rather than adversaries. Corporate policies that support and promote cooperative efforts will greatly facilitate private-sector participation and serve as positive models for others to follow.

Like many agencies, conservation groups are often steeped in tradition. Many are focused on narrow agendas rather than on what is really needed over the long term to conserve biological diversity. Developing and implementing effective landscape-level conservation strategies will be greatly facilitated if these organizations adopt policies that are aimed at issues broader than the protection of individual species or relatively small, specific sites.

Institutional Structure

We have previously referred to the challenges associated with institutional structure. Unfortunately, no institution exists whose mission is to facilitate landscape-level planning. Although most resource agencies now acknowledge the need to manage ecosystems in addition to individual elements, widespread agreement has yet to be reached concerning how that might be accomplished. Although significant progress has been made, many agencies continue to pursue ecosystem management naively and unrealistically within their own traditional boundaries.

Institutions will undoubtedly change over time to accommodate a more holistic approach to conservation. Change, however, is never immediate or smooth; a transitional period will occur in which new ways of doing business are attempted. Some will succeed and some will fail, but all will provide important lessons to those who participate. An adaptive management approach is useful to apply to cooperative planning and conservation programs—try new things, evaluate them, make corrections as necessary and, eventually, a new consensus will emerge that represents new values and strategies.

One thing that is certain is that managing land to conserve biological diversity requires taking a somewhat different approach than is commonly used in managing a single species or site, or in maximizing the production of a certain commodity. To manage landscapes for long-term ecological and economic sustainability requires a more holistic, interdisciplinary approach. Such an approach demands that a number of important linkages be formalized and supported institutionally before traditional barriers can be broken down. In our assessment, we characterize some of the more significant of these in terms of (1) academic linkages between the fields of ecology, social science and economics; (2) linking research to application; (3) finding common ground; (4) linking data at different scales; and (5) linking agencies for cross-boundary conservation.

Education and Training

New and developing programs in support of landscape-level planning provide sophisticated new approaches to resource management. These programs, however, most often do not include a specific strategy for sharing these new techniques and information with broader audiences. If data are to be effectively incorporated into land-management decisions, the public must be made aware of resource management problems and become more engaged in developing commonly acceptable solutions. This process differs significantly from the traditional approach in which "experts" make the decision, then offer a plan to the public for comment. A higher level of ecological literacy is necessary before people are likely to place a high priority on the protection of natural resources, especially if personal sacrifice is required. The key to achieving this literacy is through the establishment of outreach programs that target specific audiences, rather than a more typical, generalized approach. Information generated by these programs must be useful in helping people understand different options and participate in the search for solutions.

Information Transfer

While it may have several connotations, we use the term "information transfer" to describe the communications networks and products generated as part of the growing number of technically complex programs associated with landscape-level planning. If, for example, a goal is to integrate electronic data effectively with an extensive hierarchy of data sets, as it is for the Gap Analysis Program, the ideal system for distributing data must be developed within a much larger context. Elaborate systems normally will not be established for any single effort, nor should they be. However, some standard products should be developed. Also, ways of accessing data should be established that are carefully planned and meet the unique needs of primary users.

Many systems exist for distributing resource information. Some are more effective than others. Some serve certain audiences well and ignore others. We believe that wherever possible, it makes more sense to take advantage of systems already in place than to invent new ones. Where deficiencies exist, programs should be integrated with other programs having similar data development and distribution needs. This prevents unnecessary confusion, duplication of effort and competition for limited resources.

Human Dimensions

When we began our assessment, we did not identify or intend to develop a human dimensions component. Through the process, however, it became vividly clear to us that this may be the most important and most ignored factor in all of conservation. The result was that we held several workshops on this topic alone. The bottom line is that, in reality, ecological considerations are seldom the dominant factor in major land allocation decisions. Socioeconomic concerns are prominent in the minds of most decision makers. To the extent that a landscape-level planning strategy can synthesize information on a variety of factors—including ecological concerns and human needs, values, development patterns, land prices, etc.—the final product will be strengthened and chances of its implementation will be improved.

The point here is that it is critically important to supplement the ecological information with some basic data concerning other factors. The benefits of taking these additional steps are significant. By involving more stakeholders in the process, the chances of shared decision making are improved. By using common information, people have specifics—not just ideology—to form discussions about options. If the process works, land developers, resource extractors, recreationists, conservationists and the policy makers who attempt to balance competing interests will have a better idea where the best places are to concentrate their activities. Peter Brussard, Co-Director of the Nevada Biodiversity Initiative at the University of Nevada, Reno, and a highly respected conservation biologist, said it well in his response to our questionnaire:

"Biodiversity conservation will not be accomplished unless sociological, economic, and political factors are addressed. Working groups, consisting of all relevant agency personnel and potentially affected parties will have to sit down with each other and arrive at goals that are mutually acceptable. Science can provide information and analysis, but little more."

Summary and Conclusions

In the space allowed, we have attempted to give you a cross section of some of the more important aspects of landscape-level conservation. What we have presented is only a small portion of the information we collected and synthesized for our assessment. There is much, much more. We realize that on the surface, attempting to deal with all of the complexities of conservation at the landscape level can appear overwhelming. There is a tendency to want to pull the covers over our heads and go back to the more straightforward methods of the past. But those methods will not take us where we need to go. The good news is that around the country there are new innovative efforts being explored and developed; in California, Oregon, Michigan, Missouri, Tennessee and elsewhere. Of these programs, perhaps the Oregon Biodiversity Project has developed further, faster than any other effort in the country. There are positive and negative lessons to be learned from all of these efforts. Because of space limitations, we are unable to provide summaries of these programs in this paper, but they are available.

When all else is said and done, the reality remains that conserving the nation's biological diversity over the long term will require comprehensive and cooperative planning and implementation commitments between the private sector and all levels of local, state and federal government. On the ground, these commitments will become real conservation largely through the planning and regulatory responsibilities of local and state governments, working cooperatively with federal agencies and private interests. The role of science-based programs in this arena will ultimately depend on the philosophy and vision of those responsible for their development and application, on their ability to develop partnerships formed around a mutual interest in comprehensive conservation planning, and on their ability to serve as an effective "bridge" between the technology associated with developing and applying them, and the planning and policy decisions that will determine their success on the ground. Successful implementation will only be achieved through the efforts of creative people sharing responsibilities and working together toward a common vision.

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Special Session 4. *The Changing Face of Eastern Forests*

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Opening Statement

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The theme of the 62nd North American Wildlife and Natural Resources Conference is "Finding Common Ground in Uncommon Times." It is hard to imagine a more appropriate session in concert with that theme than "The Changing Face of Eastern Forests." Forest management, especially public forest management, has been a highly contentious issue in recent years. This contentiousness reaches from individual public forests all the way to the halls of Congress.

In the early 1970s, controversy erupted over clearcutting on Monongahela National Forest in West Virginia. Results of that flap included passage of the Forest and Rangeland Renewable Resources Planning Act of 1974, the Federal Land Policy and Management Act of 1976 and the National Forest Management Act of 1976. Subsequently, the USDA Forest Service substantially reduced timber harvests on eastern national forests. This led, directly or indirectly, to accelerated timber harvests on federal lands in the Pacific Northwest, where the local culture and economies were more receptive to timber harvest. As you all know, the accelerated timber harvest in the Northwest led to conflicts with conservation of threatened and endangered species, and thus to the President's Northwest Forest Plan. As harvest in the Northwest was scaled back, harvest of southern forests has now exceeded growth for several years. Since our demands for fiber and forest products continue to grow, and apparently will continue to grow for the foreseeable future, the Appalachian and northeastern forests are once again coming under increased pressure. A handful of new mills have been planned in West Virginia, and the public once again is up in arms over management of eastern national forests. It feels like we've been here before, and we're right back where we were 25 years ago.

Last year, I was privileged to participate in the 7th American Forest Congress here in Washington, D.C. More than 1,400 people participated, and substantial areas of agreement were achieved regarding a vision for the future of our forests. There were also substantial areas of disagreement. Translating that vision into principles, policies and practices that embody "common ground" is a challenge that still faces us.

It became apparent that the 10 participants at my table at the Forest Congress were attempting to reach consensus while holding widely disparate assumptions about the current status and trends of our forests and forest wildlife. It reminded me of the old parable of the three blind men describing an elephant, one holding the tail, one the leg and one the trunk.

Like the blind men, each of us discerns only part of the whole. This lesson was brought home to me more than 20 years ago. As a young graduate student hoping to become the world's next great ruffed grouse researcher, I was privileged to spend a day in the field in central New York State on a wildlife management area that was being managed for ruffed grouse. With me that day were two legendary men, Gardiner Bump, senior author of the 950-page book on the New York ruffed grouse study, and Gordon Gullion, who had been studying ruffed grouse for nearly 20 years in northern Minnesota. These two men knew more about ruffed grouse than anyone in the world. Between them, they practically invented ruffed grouse. Neither of these men could be described as timid, and to my amazement, they disagreed with each other all day long, sometimes heatedly, regarding grouse management. Reflecting afterward, I concluded that it is unwise to argue with anyone on his home ground. Each was dead certain he was right and the other was wrong. In fact, both were right, but only in the context of their own study sites. Each had spent a lifetime seeing only part of the whole. Northern Minnesota and New York State differ markedly in climate, snowfall, tree species composition, and the abundance and types of grouse predators. Extrapolating results from one location to another leads us all to false perceptions.

We, too, are often like the blind men describing the elephant. We forget that we have done our learning in a particular ecosystem context, and that what is true in one context is very likely not true in another. We need to constantly remind ourselves that what we know to be true in our own backyard may not be true elsewhere. I have dubbed this "Woehr's Law," which states that "the probability that what is found to be true at Site A is also true at Site B is inversely proportional to the distance between them."

This brings me to the point of differences of opinion. It is vitally important that we do frequent reality checks to find out if we are seeing the whole or just a part. We can all benefit by hearing out the other guy's views, and the basis for them. One of my favorite philosophers, Yogi Berra, reputedly once said "You can learn a lot just by listening." How right he was!

Because there *are* disparate views of the current condition and trends in eastern forests, this session on "The Changing Face of Eastern Forests" is very timely. We are fortunate to have with us scientists who can tell us the facts, at least as science knows them at this time. In this session, we are honored to have papers by some of the most knowledgeable people in the country regarding our eastern forests. What they tell us may contain some surprises, but we hope to learn the best available information on the current status and trends of our eastern forests and their wildlife. We hope this will make it easier to achieve consensus on forest management, to “Find Common Ground in Uncommon Times.”

If some of what we hear today differs from your current concept of the status and trends in eastern forests, remember that different contexts produce different outcomes. One of my favorite scientists, Stephen Jay Gould (1980: 243) of Harvard, wrote:

> “Science contains few outright fools. Errors usually have their good reasons once we penetrate their context properly and avoid judgment according to our current perception of ‘truth.’ They are usually more enlightening than embarrassing, for they are signs of changing contexts. The best thinkers have the imagination to create organizing visions, and they are sufficiently adventurous (or egotistical) to float them in a complex world that can never answer ‘yes’ in all detail. The study of inspired error should not engender a homily about the sin of pride; it should lead us to a recognition that the capacity for great insight and great error are opposite sides of the same coin—and the currency of both is brilliance.”

Those “errors” are as likely to be *our* errors of perception as someone else’s. As you listen to our speakers, I urge you to keep an open mind and try to identify where your perceptions, formed in the context of your own experiences, may differ from the “best available scientific information” as presented here today. So let’s welcome all our speakers and express our gratitude for their willingness to pull together the data to describe for us the status and trends of eastern forests.

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Today's Eastern Forests: What Have 350 Years of European Settlement Wrought?

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Forested habitat in the eastern United States has evolved in response to a complex mix of natural and human-induced processes. The character of eastern forests has direct ties to the abundance or scarcity of forest-dependent wildlife species as well as species that thrive in adjacent land types, such as riparian areas or pasture. Information on forestland is especially important for species such as ovenbird (*Seiurus aurocapillus*) or martin (*Martes americana*) that depend totally on forest habitat. Within forested ecosystems are intricate relationships between wildlife species and forest composition, stage of stand development, tract size, and degree of interspersion with other land types (Hobson et al. 1993).

We summarize land-use history since European settlement, discuss recent trends in forest conditions, and describe the location and condition of oak forest habitat. Information on forest development prior to the implementation of systematic forest inventories is from the literature. More recent trend data and information on habitat assessment are derived from regional forest-inventory data collected by the USDA Forest Service's Forest Inventory and Analysis (FIA) units.

Land-Use History

Presettlement Forests

There are uncertainties associated with any description of presettlement forests because of conflicting information about the extent of forests and the impact of Native Americans on forest condition. Also, the common notion that settlement occurred at a discrete point in time is an oversimplification. Rather, colonization began slowly and then accelerated gradually, beginning in the Northeast during the 1600s and progressing westward and southward through the early 1800s. Concurrent with this general movement, colonization spread from all major Atlantic and Gulf ports, primarily along water courses. The impact of Native Americans resulted from clearing for habitation, land cultivation and defense. Native Americans used fire to aid in clearing land to establish habitat for preferred game species (i.e., grassland), as a tool for hunting, and to free the forest of underbrush (Williams 1989). These activities usually were limited to areas surrounding communities, often floodplains and coastal areas, and well-established trade routes. Over time, these activities likely had a significant impact on forest composition, though the degree of this impact is difficult to quantify.

Population Expansion and Land Clearing

As colonization proceeded, the human population of the eastern United States increased slowly until the mid-1800s. As the population expanded, forests were cleared for cropland to satisfy increased demand for food. Earlier, timbering was concentrated on softwood species that could be accessed by water and horse. The first comprehensive report on North American forests was issued in 1884. At that time, much of the white pine in New England, New York and Pennsylvania had been removed (Sargent 1884). Sargent described vast quantities of softwood available in the South, particularly the Gulf States, as well as large stocks of hardwood timber in the Appalachian Mountains.

As the population continued to expand, so did demand for wood to build houses, provide fuel, build railroads, supply mining props, produce chemicals for tanning and support other industries. The advent of rail transportation made vast tracts accessible. In 1909, R.S. Kellog estimated the area of eastern forest at 370 million acres (150 million ha) compared with an estimate of "original" forests of 650 million acres (263 million ha) (Kellog 1909). By 1920, large-scale harvesting of eastern forests had slowed considerably. However, areas that had been cleared of merchantable timber experienced severe ecological shock (Clawson 1979). Softwood stands in the northern and central United States were nearly exhausted by 1920 and the South was losing its lead position as a supplier of softwoods. The only large reservoirs of virgin hardwood timber were in the Lake States, the southern Appalachians and the lower Mississippi Valley (USDA Forest Service 1920). The impact of these trends on wildlife probably was substantial, though there are few official records on wildlife populations from the period. MacCleery (1992) hypothesized that many wildlife species that are abundant today, such as white-tailed deer (*Odocoileus virginianus)*, wild turkey (*Meleagris gallopavo*), black bear (*Ursus americanus*) and beaver (*Castor canadensis*), likely would have been placed on an endangered species list had one existed at the time.

Farmland Abandonment and Forest Regrowth

The history of eastern forests since the turn of the century has been one of regrowth and resiliency. By the 1920s, the long-term loss of forestland had nearly halted and the area of cropland had been stabilized (MacCleery 1992). During the 1930s and 1940s, the area in cropland began to decrease across the East as agricultural land was reverting to forest. Economic pressure, depleted soils on marginal cropland, mechanization of farm machinery and the rise of eastern cities contributed to the overall loss of agricultural land. In the 1930s, the USDA Forest Service began conducting forest inventories to track the extent and condition of the nation's forests. Most inventories conducted since then have documented the steady expansion of and improvement in eastern forests. The demise of American chestnut (*Castanea dentata*) was one of the major changes that occurred during the period of forest regrowth. First documented in 1904, the chestnut blight disease caused by a fungus (*Endothia parasitica*) spread over the entire range of American chestnut, virtually eliminating mature trees from the landscape (Harlow et al. 1979). This was an important loss for wildlife species that depend on chestnuts for food. Chestnut was replaced by oaks and other species. This period of forest regrowth was one of recuperation for wildlife species that suffered during the time of forest clearing, particularly "habitat generalists" that were able to adapt to the changing condition of the forest (MacCleery 1992). The composition, structure and location of today's eastern forest habitat resulted from the ongoing struggle between man and the forest (Figure 1).

Resource Overview

The analysis of forest resources and wildlife in the eastern United States is divided by major region and subregion. The Northcentral region includes the Lake States (Michigan, Minnesota and Wisconsin) and Central States (Illinois, Indiana, Iowa and Missouri). The Northeastern region is made up of the New England States (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island and Vermont) and Mid-Atlantic States (Delaware, Maryland, New Jersey, New York, Ohio, Pennsylvania and West Virginia). The Southern region is divided into the Atlantic States (Florida, Georgia, Kentucky, North Carolina, South Carolina and Virginia) and Gulf States (Alabama, Arkansas, Louisiana, Mississippi, eastern Oklahoma, Tennessee and eastern Texas). Inferences about changes in wildlife habitat are made by analyzing broad trends in composition and structure of eastern forests using FIA's variables related to forest-type group and tree-size class. Forest-type groups include a mix of related specific forest types. For example, the white pine/red pine/hemlock (*Pinus strobus*, *P. resinosa*, *Tsuga canadensis*) group includes the white pine, red pine, white pine/hemlock, hemlock and jack pine (*Pinus banksiana*) types. FIA sample locations are assigned to a tree-size class based on the majority of sample trees. Tree-size class is used as a rough surrogate for stand age and stage of stand development (successional stage), i.e., sapling-seedling (young successional stands), poletimber (mid-successional) and sawtimber (mid- to late successional). The use of the term late successional is somewhat misleading as stands in the 60- to 80-year range may be of sawtimber size, but still are young with respect to life expectancy. Forest types are also related to successional stage, as pioneer species merge with later successional species and stands convert to other types.

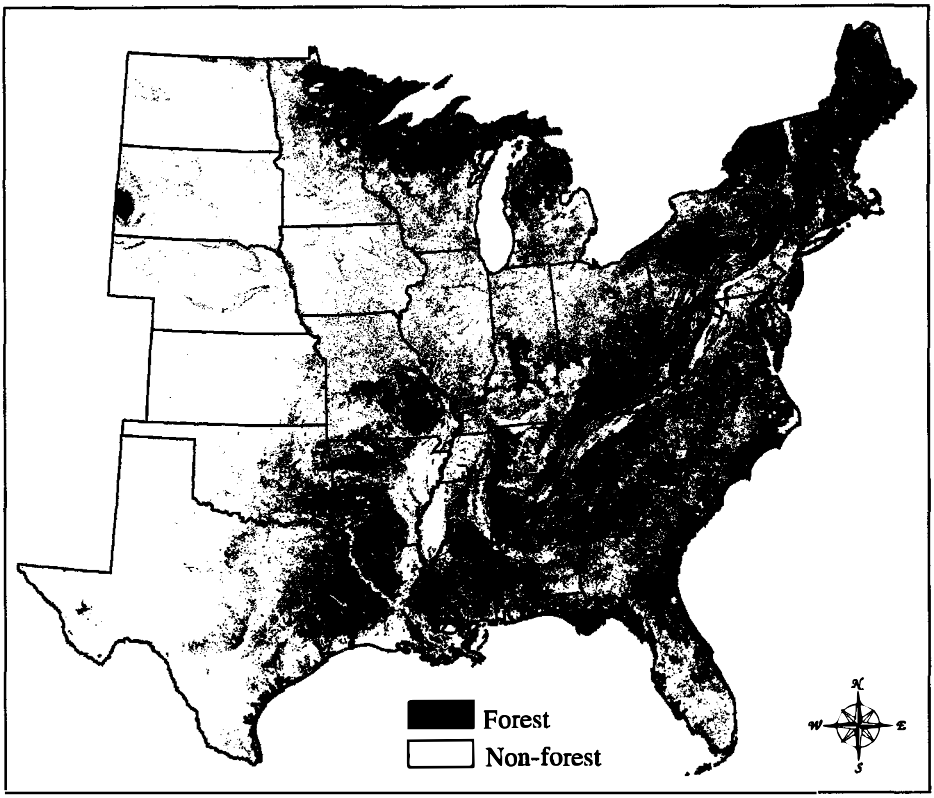

Figure 1. Location of forested habitat in the eastern United States, 1992 (Powell et al. 1993).

Northcentral Region

Lake States. The Lake States subregion provides an ecologically important transition between boreal forests to the north, and central hardwood forests and tall grass prairies to the south and west. The Lake States tend to be less populated than other subregions and contain large tracts of undisturbed forest. Overall, the area of forestland in the Lake States has been increasing slightly, but there is little opportunity for future increases in forestland due to increasing pressure to convert to urban, industrial and other land uses. Within the forestland base, there is a trend toward decreases in area of forest types that represent early successional stages, (e.g., jack pine, aspen/ birch [*Populus grandidentata* or *P. tremuloides*, *Betula* spp.], balsam poplar [*Populus balsamifera*]); and increases in mid- to late successional groups (e.g., red pine [*Pinus* *resinosa*], elm/ash/cottonwood [*Ulmus* spp., *Fraxinus* spp., *Populus deltoides* or *P. trichocarpa*], oak/hickory [*Quercus* spp., *Carya* spp.], and northern hardwoods, primarily maple [*Acer* spp.], beech [*Fagus grandifolia*] and birch [*Betula* spp]).

A major trend in the Lake States has been toward older, more mature forests (Schmidt et al. 1996). Current inventories indicate that 2 percent of the forests in this subregion (1,150,000 acres: 465,400 ha) are more than 120 years old. This was an increase of 44 percent since the previous inventories. The area of forest between 80 and 120 years of age also increased, by 42 percent, and now totals 6,700,000 acres (2,711,000 ha). Lake States' forests are aging primarily because harvesting has had a minimal impact and natural disturbances have been infrequent and of low intensity. Also, the predominant cutting technique for mid- to late successional forests is "selective" harvesting, which does little to change successional stage compared with practices such as clearcutting. Selective cutting removes several of the most valuable trees from a stand, leaving a significant residual stand of mature trees. Early successional forests (e.g., jack pine and aspen/birch) often are harvested by clearcutting, which removes the dominant overstory and tends to maintain these types in early successional stages. Certain wildlife species depend on the interspersion of old and young forest stands. Examples include gray wolf (*Canis lupus*), which is associated with interspersed stands, and ruffed grouse (*Bonasa umbellus*), which is associated with early successional stands.

There is a strong demand for wood from this subregion's softwood forest-type groups, white pine/red pine/hemlock and spruce/fir (*Picea* spp. and *Abies balsamea*). Harvesting and management are more frequent in pine forests because of the value of that resource. Species such as Kirtland's warbler (*Dendroica kirtlandii*) prefer young stands of jack pine. In the absence of harvesting, jack pine stands often are converted to other forest types. Large tracts of undisturbed forest preferred by some wildlife species are found in the Boundary Waters Canoe Area of Minnesota and the Porcupine Mountains of Michigan.

Spruce/fir forests of the Lake States are increasing. These forests are dominated by swamp conifers—black spruce (*Picea mariana*), northern-white cedar (*Thuja occidentalis*), tamarack (*Larix laricina*) and balsam fir. Swamp conifers generally are associated with lower stocking levels, growth rates and disturbance than other forest types in the Lake States. Most are located on poor sites preferred for uses other than agriculture or home building, so these tend to be owned publicly. Swamp forests are important for some wildlife species, such as moose (*Alces alces*). Mature stands of northern-white cedar provide ideal winter cover for deer in the Lake States (Doepker and Ozoga 1990) and their juxtaposition with wetlands makes them an important component of the upland/wetland interface.

Aspen/birch is commonly a transient forest-type group in the Lake States. Between 1935 and 1955, the total area of aspen/birch stands changed little, yet hundreds of thousands of acres of land were shifting between this and other forest-type groups. The area of aspen/birch peaked by the 1960s and has decreased as aspen is being replaced by more shade-tolerant species (e.g., maple and beech). This decrease has important implications for ruffed grouse, Minnesota's most abundant game bird, which prefers aspen/birch stands (Gullion 1984) . The current demand for aspen by industry is high, so future management may be directed toward sustaining this type.

Northern hardwoods forests are mixed with the other types but predominate along the southern tier of the Lake States. Representative of late successional forests, northern hardwoods account for 40 percent of total timberland with an average age of more than 80 years, but only 26 percent of all timberland (Schmidt et al. 1996). Because the forests are concentrated on nonindustrial private lands, northern hardwoods suffer most from fragmentation. This has an adverse impact on Neotropical migratory landbirds that depend on large tracts of undisturbed stands for nesting.

Central States. The oak/hickory type, a major mast producer, predominates in the Central States, accounting for more than 65 percent of the timberland in this subregion. Numerous wildlife species are associated with these forests, including white-tailed deer, turkey and gray squirrel (*Sciurus carolinensis*as), as well as many Neotropical migratory landbirds (Thompson et al. 1996). Although oak/hickory forests have remained stable in area, there is concern that a general lack of oak regeneration following harvest will result in gradual, long-term declines in oak abundance (USDA Forest Service 1993).

The elm/ash/cottonwood forest type, although far less common than oak/hickory, is important because it is the major riparian type of the Central States. Elm/ash/cottonwood is found linearly along water courses, providing food and cover for wetland wildlife and other species that use the riparian zone for movement. Trends in the elm/ash/cottonwood type generally follow those in the Northcentral region, i.e., gradual maturing, increases in tree size and higher stocking.

The eastern redcedar (*Juniperus virginiana*) forest type (including pure stands and redcedar/hardwood) has been increasing dramatically in the Central States (Schmidt and Leatherberry 1995). Between the most recent inventories, eastern redcedar increased by 113 percent, from 2,100,000 to 4,500,000 acres (850,000-1,821,000 ha). Most of the new redcedar stands are from abandoned pasture, which reduces both pasture habitat and the area of young deciduous species with which redcedar competes. Invasion by redcedar on sites that previously supported pasture and grasslands has negatively affected wildlife species associated with grasslands.

Northeastern Region

New England States. New England contains the highest proportion of forestland in the United States. Maine, New Hampshire and Vermont are 90, 84 and 75 percent forested, respectively. This subregion is dominated by the northern hardwoods, white pine/red pine/hemlock and spruce/fir groups. The latter is most common to the north.

Except for Maine, inventories of other New England States date to the early 1980s, making it difficult to detect recent trends. Because the predominant cutting method is selective harvest, species that use young successional forests probably are becoming more scarce. Anecdotal evidence suggests that harvest activity has centered on white pine and northern red oak (*Quercus rubra*). Species that would be affected adversely by decreases in white pine could include long-eared owl (*Asio otus*) and pine warbler (*Dendroica pinus*). The loss of northern red oak would adversely affect many species that depend on acorns for food. In Connecticut, Massachusetts and Rhode Island, the most significant trend in coming years is expected to be fragmentation of forestland.

Oak/hickory is the most common forest-type group in southern New England. Highly populated areas along the coast should continue to increase and expand inland, resulting in an overall decrease in oak/hickory forests along with increased fragmentation.

The 1995 FIA inventory of Maine has revealed tremendous change due to impacts from spruce budworm (*Choristoneura fumiferana*), salvage harvesting and expanded markets for the state's timber. Despite considerable change, the total area of timberland remained relatively stable, decreasing by 1 percent between recent inventories. However, most of the change has occurred within the state's two predominant forest-type groups. There was a 16-percent increase in the area of northern hardwoods and a 20-percent decrease in spruce/fir timberland. Most of this change centered around a 39-percent increase in sapling-seedling stands and a 22-percent decrease in poletimber stands. The area of sawtimber stands increased by 11 percent. Much of the increase in sapling-seedling stands resulted from conversion of spruce/fir stands to northern hardwoods, white pine/red pine/hemlock and aspen/birch following disturbance. Most of the increase was in young stands of northern hardwoods which, in turn, increased habitat for bird species such as the northern saw-whet owl (*Aegolius acadicus*), willow flycatcher (*Empidonax traillii*), mourning warbler (*Oporornis philadelphia*) and northern flicker (*Colaptes auratus*) (DeGraaf et al. 1992). Also, general increases in young brushy stands are expanding habitat for a variety of birds, eastern cottontail (*Syvilagus floridanus*) and other small mammals, as well as predators such as red fox (*Vulpes vulpes*) and assorted raptors. With the extent of budworm damage, increases in populations that feed on dead spruce and fir trees, such as black-backed woodpecker (*Picoides arcticus*) and red-breasted nuthatch (*Sitta canadensis*), are likely occurring. The decrease in spruce/fir forest also has ramifications for spruce grouse (*Dendragapus canadensis*), ruby-crowned kinglet (*Regulus calendula*), Canada warbler (*Wilsonia canadensis*) and other species associated with this type. Red maple (*Acer rubrum*) increased in volume by 24 percent and has replaced balsam fir as the second highest volume species in Maine. In areas where red maple has occupied sites previously supporting spruce or fir, increases in species such as song sparrow (*Melospiza melodia*) and common grackle (*Quiscalus quiscula*) can occur. Populations of habitat generalists, such as moose and white-tailed deer, probably will remain stable, as wintering areas for deer in Maine are reserved from cutting.

Mid-Atlantic States. The principal forest-type groups in the Mid-Atlantic States are northern hardwoods and oak/hickory. Northern hardwoods dominate New York and the northern tier of Pennsylvania, with spruce/fir, white pine/red pine/hemlock and aspen/birch interspersed. Oak/hickory is the most common group throughout most of Pennsylvania, Maryland, southeastern Ohio and West Virginia. Forests of New Jersey, Delaware and coastal Maryland more resemble southern Coastal Plain forests with pitch pine (*Pinus rigida*) replacing loblolly pine (*P. taeda*) to the north. As in other areas of the East, the forestland base is stable due to offsetting forces of clearing for alternative use and abandonment of agricultural land. New sources of forestland are becoming scarce, and forest areas likely will begin to decrease in areas adjacent to urban and suburban expansion. Large tracts of unbroken forest are common in the rural and mountainous areas of this subregion. As a result, populations of black bear are relatively high.

Harvesting of northern hardwoods currently is limited and tends to remove only select trees. For example, although 32 percent of New York's forest had evidence of tree removal, only 1 percent of the cutting could be classified as clearcut harvests sufficient to move stands to an early successional state (removal of at least 80 percent of a stand's total basal area) (McWilliams et al. 1996). Cutting has removed select species in the larger diameter classes, which bodes ill for Neotropical migratory landbirds and small mammals that prefer young stands. Species that thrive in areas with forest/nonforest edge, e.g., the least flycatcher (*Empidonax minimus*), probably will concentrate in the urban/rural interface where forest fragmentation is most likely.

Trends in northern hardwood forests are toward denser forests containing larger size stems—or increases in mid- and late successional forest. Species associated with such conditions include sharp-shinned hawk (*Accipiter striatus*), northern goshawk (*Accipiter gentillis*), barred owl (*Strix varia*), pileated woodpecker (*Dryocopus pileatus*) and northern flying squirrel (*Glaucomys sabrinus*) (DeGraaf et al. 1992).

Harvest activity in oak/hickory forests of the Mid-Atlantic States is similar to that in New York. About 30 percent of Pennsylvania's timberland had evidence of tree removal, but only 2 percent could be classified as clearcut harvests (Gansner et al. 1993a). As in New York, cutting was concentrated in larger trees of select species. Some areas of West Virginia and southeastern Ohio could see expanded harvest in the future due to increased demand for timber from mill expansion.

The gypsy moth (*Lymantria dispar*) has caused significant mortality in oak forests in areas where outbreaks reached epidemic levels. Chestnut oak (*Quercus prinus*) and white oak (*Q. alba*) have been affected more than other species (Gansner et al 1993b). Most of the mortality has been in smaller, poorer quality trees; snag trees have increased substantially. In especially hard-hit areas such as central Pennsylvania, the entire overstory is killed and young stands of black cherry (*Prunus serotina*), red maple, sweet birch (*Betula lenta*) and other species have replaced oak. McWilliams et al. (1995) found that 92 percent of mixed-oak stands in Pennsylvania were adequately stocked with woody species following major disturbance, but that oak stocking was far below levels occurring before disturbance (including harvesting). Only 16 percent of the stands studied had adequate stocking of oak.

Pennsylvania's populations of white-tailed deer often exceed 20 per square mile, so their effect on the forest understory has been significant. Preferred browse species, such as the oaks and raspberry (*Rubus* spp.), have declined in abundance. Ferns, grasses and other unpalatable competing vegetation have proliferated. Excessive browsing by deer has reduced the density and diversity of woody understory species (Tilghman 1989), as well as the abundance and species richness of songbirds that nest in the intermediate canopy (DeCalesta 1994).

Southern Region

Atlantic States. Forest composition of the Southern States follows general physiographic boundaries of the coastal plain, piedmont and mountains. Harvesting and management regimes differ among major forest types, with active management most pronounced on the more productive sites. As in other regions, total area of forestland is stable, with losses offset by reversions to forest and planting of nonforestland. It is likely that the area of forest will decrease as human populations increase.

From an economic standpoint, pine forests have proven to be the most valuable in the subregion. These forests are concentrated most heavily on the coastal plain but are common in the piedmont. In the more productive areas, the coastal plain has supported a "fourth" forest since large-scale clearing of the late 1800s and early 1900s. As management has intensified, there have been significant changes in the composition, structure and function of the pine ecosystem.

The original pine forests contained a natural mix of shortleaf pine (*Pinus echinata*), slash pine *(P. elliottii*), longleaf pine (*P. palustris*), loblolly pine, Virginia pine (*P. virginiana*) and deciduous species that sorted itself over the landscape with species proliferating on sites suited to their individual preferences. Harvesting and management have altered this natural mosaic significantly. The conversion from natural stands to plantations has proceeded to the point where 47 percent of the total pine forest in the Atlantic States is from planting or seeding (pine forests represent 40 percent of the total timberland base). Early planting experiments included loblolly, slash and shortleaf pine, but managers soon identified loblolly as a preferred species because of its rapid juvenile growth and ability to occupy a range of sites.

Some researchers maintain that wildlife associated with large unbroken tracts, older trees and species other than loblolly will suffer from conversion to pine plantations. Others believe that the interspersion of forests in different stages of stand development (edge) and an abundance of young stands containing a diverse mix of species (mast-producing trees, shrubs, berry, forbs and grasses) will benefit songbirds, small mammals, deer and wild turkey. Bobwhite quail (*Colinus virginianus*) thrive in just the sort of habitat produced by interspersed clearcuts of differing age.

Plantation management has reduced the abundance of longleaf pine forests estimated at one time to occupy 60 million acres (24.3 million ha) (Kelly and Bechtold 1990). Longleaf forests covered only 3.2 million acres (1.3 million ha) by 1993. Longleaf is still found throughout much of its original range except in southeastern Virginia and northeastern North Carolina. Without efforts to maintain or restore longleaf pine, reductions will continue as sites are harvested and planted to other species or are lost to other land uses. The reduction in longleaf pine has serious ramifications for red-cockaded woodpecker (*Picoides borealis*), which requires older pine stands for nesting. Although nesting cavities are found in all southern pine species, red-cockaded woodpeckers prefer mature longleaf and slash pine stands (Lennartz et al. 1983).

The piedmont lies to the west of the Atlantic coastal plain. In the early 1900s, the piedmont was a burgeoning agricultural area, having been cleared in the mid-1800s because of its highly productive soils (Barrett 1980). In the 1930s and 1940s, large-scale abandonment of cropland due to soil erosion/depletion and economic hardships resulted in a major reversion to forest. Management of piedmont pine forests, primarily loblolly/shortleaf, has been similar to pine management of the coastal plain. Stands of oak/pine often have been "managed" for pine only. Later removal of merchantable pine and a subsequent lack of pine regeneration have converted many stands to hardwood species. Management of today's pine and oak/pine forests is generally based on economics, with intensive management on the more productive sites. Management of the piedmont's oak/hickory forests has followed that of oak/hickory in the southern Appalachian Mountains to the west.

Oak/hickory is the dominant forest-type group in the southern Appalachian Mountains. These forests contain perhaps the most diverse mix of deciduous species in the eastern United States. This area contains many late successional and relatively rare communities with threatened and endangered species (Dobson et al. 1997). Rare communities appear to be declining in area and quality in the southern Appalachians (USDA Forest Service 1996), which also are characterized by large forest tracts and publicly owned forests favored by black bear (Rudis and Tansey 1995). Maintaining current conditions for the long term will be difficult as population expansion, tourism and associated development affect habitat that now is secluded. The primary management goal has been the production of hardwood sawlogs; selective cutting remains the most common practice in the southern Appalachians.

Gulf States. It is common for analysts to discuss forests of the Gulf States as though their composition and management were simply an extension of those of Atlantic States. There are some obvious parallels, but also some important differences. For example, the Gulf States contain only a small area of piedmont in eastern Alabama. Features of the Gulf coastal plain are similar to the Atlantic coastal plain along the southern tier of the Gulf States, but to the north, the hilly coastal plain has a rolling topography and a greater concentration of oak/pine forests. Also, patterns of farmland abandonment were not as severe across the Gulf coastal plain, and management trends have lagged slightly behind those of the Atlantic States. Still, in the more productive pine regions of the Gulf coastal plain, intensive plantation management is common and is having significant impacts on composition and stage of stand development. Pine management is intensive in southwestern Alabama, southern Mississippi, the corridor adjacent to the Tombigbee Waterway along the Alabama/Mississippi border, southwestern Louisiana, southwestern Arkansas, southeastern Oklahoma and southeastern Texas. Currently, 29 percent of Gulf States' timberland is in pine and 42 percent of the pine forest is of artificial origin. The conversion of longleaf/slash pine forests is a concern, but the Gulf States contain less of the original range of that type. However, conversion to loblolly pine is causing a sharp decrease in the prevalence of shortleaf pine. For example, the volume of shortleaf pine in Alabama decreased by 73 percent from 1972 to 1990 (McWilliams 1992).

Another distinguishing feature of the Gulf coastal plain is the Mississippi alluvial plain that bisects the region. Most of the bottomland hardwood forests of the Mississippi alluvial plain were cleared and converted to cotton, sorghum, soybeans and other crops. Losses were most rapid in the 1940s and from the 1960s to the early 1970s (Sternitzke 1976). Recent inventories indicate that the area has stabilized, though fragmentation has occurred and the mix of bottomland hardwood community types has changed (Rudis in press). The current mix is toward wetter, such as cypress/water tupelo (*Taxodium* spp., *Nyssa aquatica*) and early successional, such as hackberry/

elm/ash (*Celtis* spp., *Ulmus* spp. and *Fraxinus* spp.) forests, and away from late successional types, such as the oaks that are typically found on drier bottomland sites.

The decline of black bear has been attributed to regional fragmentation of forests of the lower Mississippi alluvial plain (Rudis and Tansey 1995). Wildlife species that depend on mature trees and large forest fragments, e.g., the cerulean warbler (*Dendroica cerulea*), also are at a disadvantage. Species that are associated with bottomland hardwood species, e.g., the Prothonotary warbler (*Protonotaria citrea*), have been affected by the loss of forest area. Selective cutting is common and land is largely in private ownership. Although the recovery of the region's fauna is uncertain, incentive programs for reforestation of private land, such as planting select high-value oak species, show promise of supporting both economic and selected long-term wildlife production values.

The Ouachita Mountains of Arkansas and eastern Oklahoma are another important feature of the Gulf States. Unique to the Ouachitas is a large proportion of shortleaf pine and oak/pine community types, and national forestland. Concern over intensive management in the 1980s resulted in a reformulation of national forest management policy. The current focus of managers and researchers is on ecosystem sustainability. This strategy includes promoting old-growth forest conditions, retaining oak/pine and other indigenous forest types, and adapting silvicultural tools to enhance the mix of resources produced, including habitat for wildlife.

The Gulf States also encompass a significant area of southern Appalachian forests in Tennessee and northern Alabama. Here, the oak/hickory forests share many of the trends and issues of southern Appalachian forests of the Atlantic and Mid-Atlantic States. The sustainability of hardwood forests in the area is of increasing concern due to greater demand for hardwood pulpwood and chips. How this issue is resolved could affect forests with proximity to transport via the Tennessee River and the Tombigbee Waterway.

Oak Habitat—Current Location and Condition

The importance of oak for mast production and as habitat for wildlife cannot be overstated. In fact, concerns related to oak regeneration (USDA Forest Service 1993), effects of gypsy moth and oak decline (Millers et al. 1989) have made it necessary to examine all aspects of oak habitat in the East. We applied spatial statistical techniques to FIA's Eastwide DataBase (Hansen et al. 1992) to explore relationships between oak density and tree-size class. Indicator kriging was applied to the data with a 10-kilometer cell size and 10-kilometer search radius (see Isaaks and Srivastava 1989 for a discussion of geostatistics).

Figure 2 shows the distribution of timberland with at least 25 percent of total basal area in oak species based on kriging. The map contrasts the more typical abundance maps that show regions with high or low inventory volumes. Figure 2 shows the high density of oak in the Ozark Plateau of Missouri and northern Arkansas. Other areas with high oak densities are the Central Lowlands of Minnesota and Wisconsin, the Appalachian Mountains from central Pennsylvania to northern Alabama, the Nashville Basin of Tennessee, and western Florida.

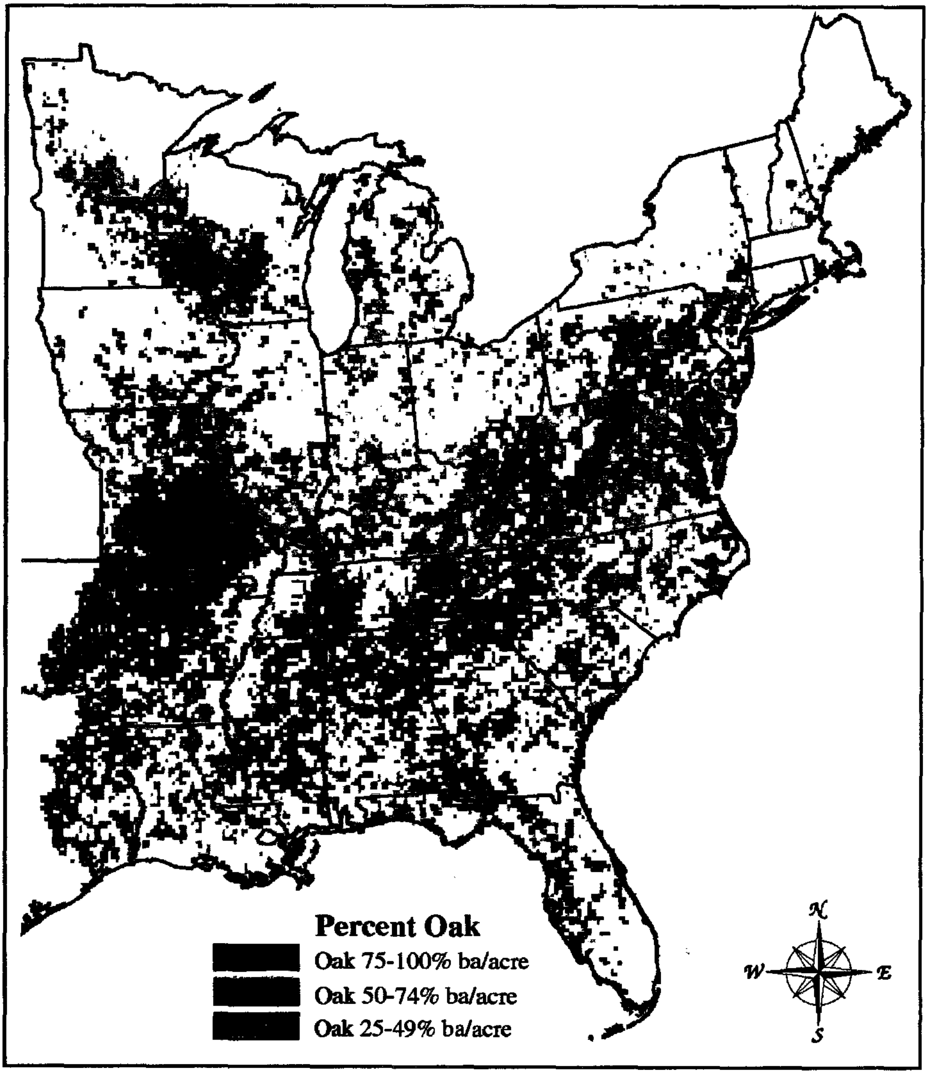

Figure 2. Estimated oak occupancy on timberland with at least 25 percent of total basal area in oak species, eastern U.S. (available data excludes Connecticut, Massachusetts and Rhode Island).

The interspersion of early, mid- and late successional stands using FIA's tree-size variable as a surrogate is depicted in Figure 3. The map shows sample locations with at least 50 percent of their total basal area made up of oak species. Most of these relatively pure oak stands are in the sawtimber tree-size class (late successional). The

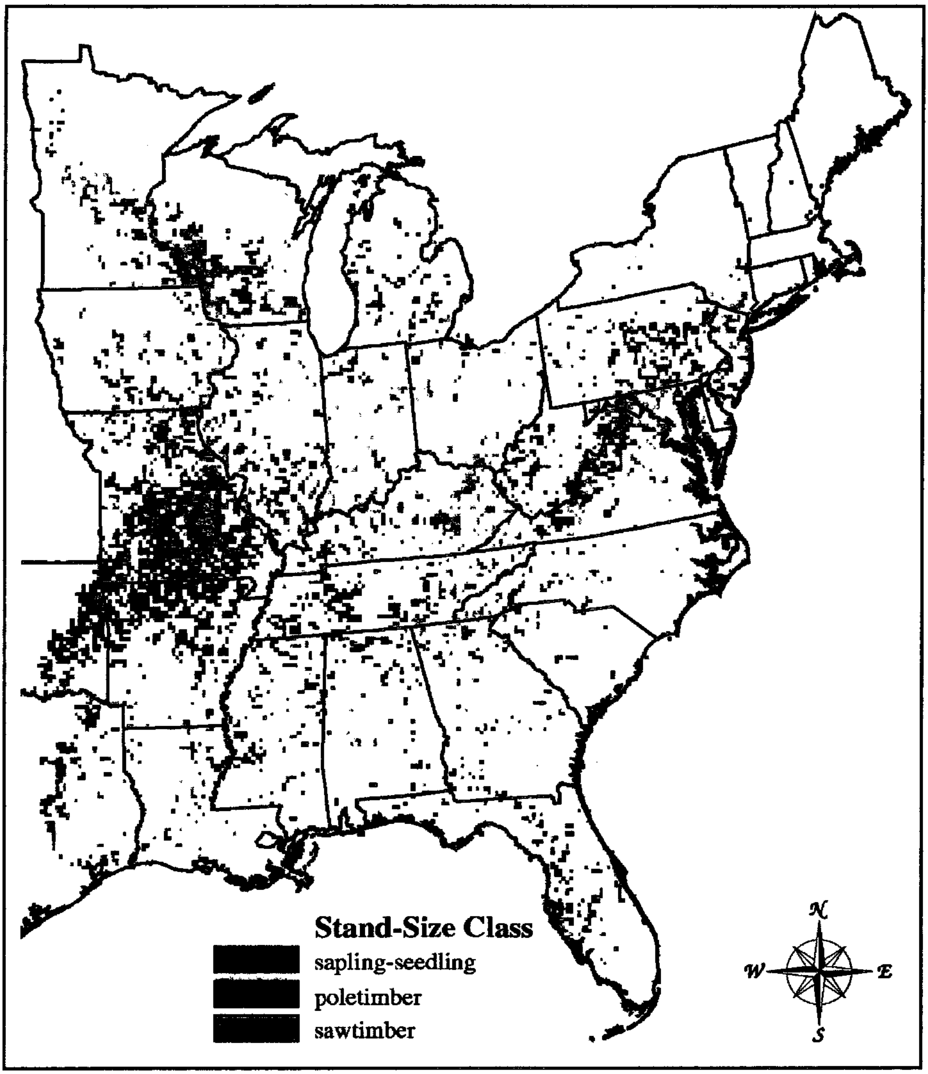

Figure 3. Distribution of timberland with at least 50 percent of total basal area in oak species by tree-size class, eastern U.S. (available data excludes Connecticut, Massachusetts and Rhode Island).

distribution of oak-dominated timberland in the East (excluding Connecticut, Massachusetts and Rhode Island) is 19 percent sapling-seedling, 29 percent poletimber and 52 percent sawtimber. There is a good mix of successional stages in Missouri and Arkansas. Young oak stands are rare in most of the rest of the East.

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Wildlife, Values and the Eastern Forest

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Throughout the 20th century, wildlife management has prided itself on its scientific foundations; when wildlife problems arise, we seek their answers largely in scientific research, whether that research be in basic biology, ecological analyses or public opinion polls. Yet, if controversy is any indication, this strategy has been less than fully successful; few issues are as hotly debated as the role of animals in our society. Are animals here to provide benefits to humans, or are they possessed of certain rights that people must respect? Should leghold traps be banned? What can be done about the increasing number of automobile collisions with deer (*Odocoileus virginianus*) and moose (*Alces alces*)? Are deer beautiful creatures that should never be hunted or pests that are invading the suburbs? Should certain groups of Americans be allowed to violate fish and game laws or be given priority access to resources? Should we encourage people to stop feeding the birds because it promotes the transmission of avian diseases? How much weight should we give to the opinions of metropolitan populations (as opposed to rural populations) about issues such as reintroducing wolves into the Adirondacks or New Hampshire? The list of such questions is vast, and the interest groups they involve are seemingly endless. What they have in common, however, is that they are questions, not of fact, but of values. While values traditionally are excluded from scientific analysis, they have a long history of intellectual discussion and debate. Too often, people end a discussion by saying, "Well, that's a value judgment!" as if there were nothing further to say about it. To make progress dealing with the kinds of questions raised above, we must address this important concept and the role that it plays in public policy formation. In this paper, we explore the concept of value and the different kinds of values as they apply to wildlife, concluding with a framework for incorporating values into management decisions.

The Varying Concepts of Value

Value has been a central concept in the human dimensions of wildlife since the field's inception (Fulton et al. 1996). Unfortunately, the term is ambiguous because it is used in so many different ways (Brown 1984, More et al. in press). When we speak of wildlife values, what do we mean: the role or roles that wildlife plays in maintaining ecosystems; the economic value of hunting at site x; or the aesthetic value of various avian species? To avoid miscommunication, one must understand the categories these questions represent and the different lines of reasoning about values that exist.

The concept of value has a distinguished intellectual history. The ancient Greeks first identified the two strands of argument that underlie our present-day understanding: the subjective and the objective (Figure 1). The subjectivist position asserts that value is a human concept that implies the notion of a valuer—someone for whom a particular object or event is good or bad, beautiful or ugly. Thus, Protagoras, the great Sophist, asserted that "Man is the measure of all things." Plato, by contrast, argued for an objectivist theory in which value was eternal and existed independently of humans. The Platonist Greeks, for example, did not believe that "beauty was in the eye of the beholder" (a subjectivist interpretation that arose following the Enlightenment); but, rather, that beauty was an objective matter of form, line and proportion—an attribute of the object, not the perceiver (Averill et al. 1997). For the most part, discussions of wildlife values today lie firmly within the subjectivist tradition. There is, however, a trace of the objectivist line to be found in the concept of intrinsic value—the idea that an individual animal or species has an inherent worth that is independent of humans.

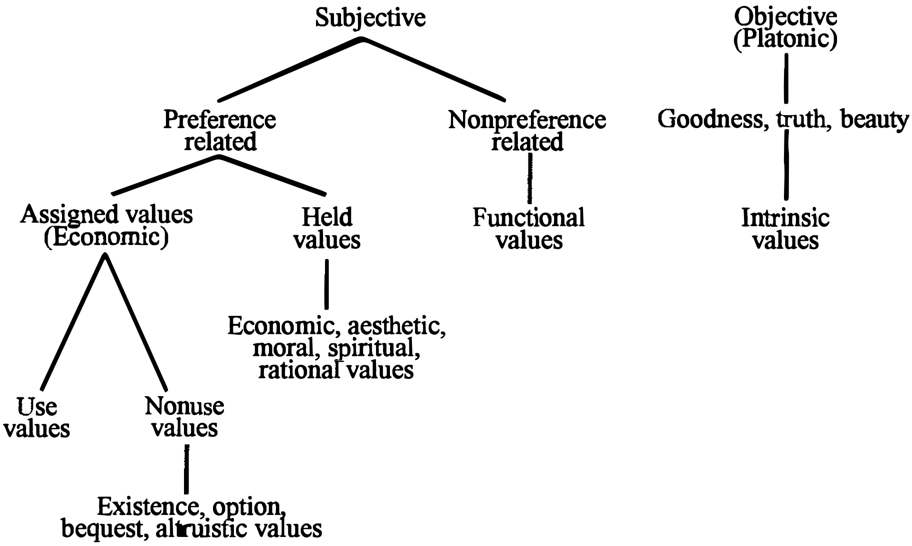

Figure 1. Categories of value.

Subjectivist (or human) values can be divided into preference-related and nonpreference-related values (Brown 1984). Nonpreference-related values concern the function something serves—to use Brown's example, nitrogen is valuable in corn production. In nonpreferential usage, wildlife values concern the functions of wildlife either biologically or socially. Biological values might, for example, concern a species' niche or position in a food chain; the statement: "Wolves (*Canus lupus*) are valuable in regulating ungulate populations" is an example. Socially, we might speak of wildlife having recreational, educational or aesthetic values.

These "functional" values are relatively clear. By contrast, preference-related uses of the term "value" are more complex and must be distinguished. Here "value" is used in an evaluative sense: good or bad, beautiful or ugly, honest or dishonest, like or dislike. The statement, "I hate snakes!" is clearly much more preference based than the preceding statement about wolves; it specifies a clear preferential relationship between the individual and the object.

Assigned values represent one major category of preference-based values. Assigned values are derived from a consistent standard of comparison across various tangibles. Most economic values are assigned. For example, if the value of a white-tailed deer harvested at a particular site is $x, its value is assigned by the market using a standard of comparison with other marketed goods and services.

Most of the values with which economists deal are, in fact, market assigned. Usually, however, wildlife, along with other resources such as wilderness, clean air, etc., is not traded on the open market, so market-assigned values are unavailable. This frustrates economists who would like to have such values available to make explicit tradeoffs between wildlife and other resources. To assign value to these nonmarket resources, economists have developed methods including travel cost, hedonic pricing and contingent valuation. Perhaps the most commonly used of these techniques for valuing wildlife is the contingent valuation method in which markets are simulated by asking people what they would be willing to pay for species X under different sets of conditions (contingencies). This enables economists to determine how much people are willing to pay for two broad categories of values: use values, in which the benefits of the resource (in this case species X) accrue directly to users, and external values that accrue to both users and nonusers. Use values include activities such as hunting, fishing, wildlife observation and photography. External values include existence, option, bequest and altruism. Existence value is defined as a willingness to pay to preserve the existence of a species, even though the person does not use the species currently and plans no future use. Option value is a payment to ensure the continued existence of a species so that the individual, who may or may not be a current user, preserves the option of future use. Bequest value is a payment made because the individual wishes to leave a bequest or endowment (in the form of the species) for future generations. Altruism is a payment to ensure that the resource is available for the use of other contemporaries.

While numerous studies have used contingent valuation, only a few have examined wildlife in eastern forests, and most of these have concerned rare or endangered species (see review by Stevens et al. 1994b). What contingent valuation studies have done, however, is establish the dominant paradigm for wildlife valuation efforts; it should be possible to take any species and ask questions about its use and nonuse values. Yet, there have been growing doubts about the appropriateness of this paradigm when applied to wildlife. When people express a willingness to pay to preserve a particular species, they often are making ethical decisions rather than economic ones, and ethical decisions do not necessarily fit well within the context of economic decision making (Bergstrom and Reilling in press, Sagoff 1996, Stevens et al. 1991a, 1991b, Stevens et al. 1994a).

Sagoff (1996), for example, distinguishes between economic decision making based on a utilitarian welfare framework, and Kantian decision making emphasizing deliberative democracy. He argues that economists are too quick to assume that markets fail; it may be that there is no market price for many of the 600,000 plus species of Coleoptera, not because the market has failed, but because there is no known use to which these species can be put. Payments that people are willing to make to preserve such a species may reflect their desire to "do the right thing" rather than the amount that species contributes to their welfare. In consequence, the use of the resulting assigned values in benefit/cost analysis is dubious at best (Stevens et al. 1991a). Under the Kantian system, by contrast, we might agree as a society, through our various deliberative and political mechanisms, that we have an ethical responsibility to save a species even in the absence of any economic value. This is essentially what we have done in the Endangered Species Act.

Many assigned values reflect relatively superficial preferences that can be easily changed: your preference for a particular candy bar or variety of coffee, for example. Other values, such as honesty or loyalty, are much more enduring and are deeply embedded in a person's personality structure. Brown (1984) refers to such values as "held values." Held values are the principles that govern our commerce with the world; as such, they represent the deeply held convictions within which the more superficial values are nested. They are actually the standards by which we make judgments. Is a particular avian species beautiful? The answer depends on our values—the criteria we use to decide.

Linking Held Values to Wildlife

There have been numerous attempts to classify these basic or "terminal" values (cf. Rokeach 1973), but there probably is no single definitive list. For our purposes, they can be divided into five broad groups (More et al. in press): economic values, aesthetic values, moral values, spiritual values and rational values. Economic values are the standards we use to judge goods and services, aesthetic values are standards for appreciation, moral values are standards for judging conduct, spiritual values provide standards for judging meaning, and rational values are standards for judging truth. As noted, each group can be subdivided into increasingly specific (and more malleable) values; moral values, for example, include honesty and loyalty, while aesthetic values contain preferences for forms, colors and the like.

Economic Values

Wildlife has economic value because it can be instrumental in fulfilling human needs (Sagoff 1996). These needs may include nutrition, recreation and education, among others, and may result in consumptive or nonconsumptive uses of wildlife, or some combination of the two. Such uses reflect the functional values discussed above, and provide the basis for both market and nonmarket valuation efforts. But the individual also has held economic values (criteria) that guide his or her efforts in decision making. These are a bit like rules for the consumer: always buy something on sale, or prefer quality at any price. When applied to wildlife, such standards may lead to preferences for individual species; often hunters, for example, may choose between species or even between individual animals on the basis of such principles. These choices, when considered in the aggregate, provide the basis for economic value.

Aesthetic Values

Aesthetic criteria provide standards for appreciation. The current view—that beauty is a subjective experience "in the eye of the beholder"—is only about 300 years old. Prior to that, in the period generally termed classical, beauty was very much an attribute of the object. There were four classical criteria for judging an object beautiful: measure, proportion, vitality and context. Measure referred to anything that could be measured—length, swiftness, etc.—while proportion concerned the harmonious relations among measures. Vitality is a bit like animation—a living animal is generally considered more beautiful than a stuffed one, even though the stuffed one may have better proportion. Context specifies the object's "meaning," and contextualists believe that the total context, including historical, scientific or other knowledge, contributes directly to appreciation. In this sense, the aesthetic appreciation of a particular animal depends at least as much on a person's knowledge of its habits and habitats as on preferences for color, size and form.

The shift from classicism to modernism (with its corresponding change from objective to subjective experience) created a new set of aesthetic criteria. These new criteria include pleasure (enjoyment), absorption (concentration), detachment (a contemplative attitude) and challenge (innovation and mastery). These are characteristics of aesthetic experiences rather than aesthetic objects. We can imagine the experience of watching a beaver at sunset fulfilling each of these criteria—depending on the person involved, the experience might be enjoyable and absorbing, and it might well promote contemplation and challenge the individual to learn more about beaver.

In addition to the shift in criteria, the change from classicism to modernism also broadened the category of the aesthetic. Under classicism, the aesthetic focused primarily on the traditional concept of beauty. Under modernism, by contrast, it broadened to include the grotesque as well as the sublime. Nature, indeed, includes much that, while it may not qualify as traditionally beautiful or pretty, is certainly fascinating. Predator/prey relationships may be an example: one of John James Audubon's most famous prints shows a black snake (*Coluber c. constrictor*) attacking a nest of brown thrashers (*Toxostoma rufum*). Although the painting's subject is grotesque and even threatening, it certainly grips our attention.

The source of wildlife's aesthetic appeal can be biological, social and/or psychological. The close attention we give to reptiles such as snakes may, for example, have its origin in our biological heritage (Wilson 1996). Similarly, our own biologically based needs for nurturing and attachment may be the reason that we enjoy watching wildlife mothers and their young. Socially, the history and traditions of the group also contribute to preferences: the bald eagle (*Haliaetus leucocephalus*) has a meaning for Americans that it may lack for other cultures. And, psychologically, each of us has a unique, idiosyncratic history of relationships with animals that contributes to preference formation.

Moral Values

Moral values are the standards we use to judge conduct. Most wildlife management decisions and policies have human consequences in that they involve a set of stakeholders who are potential winners and losers. Should Native Americans have priority access to wildlife resources? Should hunting be encouraged or banned? The moral content of these and similar questions concerns issues such as the fairness of the decision making process or equity in the distribution of costs and benefits. There is much in this area that research can help to clarify, particularly in terms of processes and factors to be considered, but the responsibility for a decision's moral component ultimately is the decision maker's.

A second aspect of moral values associated with wildlife concerns whether wildlife has rights and, if so, just what these rights might entail. To some, the very idea seems ridiculous; animals are here for our use and that's it! Most of us, however, would probably be willing to accord animals at least some minimal rights—the right not to be treated with undue cruelty, for example. This is clearly recognized in the Animal Welfare Act. But what other rights might they have? Partridge (1986) points out that animals do not have the right to vote or freedom of worship. They lack these rights not because we humans are tyrants who refuse to grant them, but because they presumably lack the ability to worship or make political choices. Clearly, then, the issue of animal rights is closely related to the issue of animal capacities. It is worth noting that animal capacities vary along the phylogenetic scale; as we descend the scale, people gradually lose faith that there is any consciousness there to be harmed (Dennett 1991).

The third aspect of moral values related to wildlife concerns the increasingly common notion that wildlife has intrinsic value—an inherent worth that is independent of human concerns. To understand this concept, we need to return to our original objective/subjective dichotomy. Under the subjectivist heading, most economists tend to treat intrinsic values under the general heading of existence value—the pleasure people derive from knowing that a particular species of wildlife exists even if they plan no actual use of it (cf. Krutilla 1967). However, existence value is subjective because it emphasizes the pleasure people derive. Alternatively, Sagoff (1996) proposes a noneconomic form of intrinsic value based in the "deontological" decision-making framework of the 18th century German philosopher, Immanuel Kant. Under this framework, a species may have no known benefits or costs for people (i.e., no economic value), but we may, as a society, make an ethical decision to preserve it anyway. Sagoff argues that it is actually this reasoning that underlies the Endangered Species Act. This framework, too, keeps intrinsic value as a thoroughly subjectivist human value.

What most people mean by intrinsic value, however, is probably something closer to the objectivist line of reasoning—that wildlife has an inherent value that is *completely* independent of *any* human concerns. This is a difficult line of reasoning for many people to accept; it requires one to argue that "if all sentient life on earth was destroyed, it would still be a good thing if the Frick Collection survives" (Nagel 1986:

153). This sounds odd—how can it possibly matter that a collection of paintings survives if there are no people around to appreciate it? Yet, this is exactly what is being claimed for wildlife. The argument can seem more plausible in a different context, however. For example, most religious values are essentially objectivist; we are quite used to the argument that God exists as an eternal force for good in the universe that is quite independent of humans. Overall, it is probably impossible to resolve differences between the objectivist and subjectivist lines of reasoning about values. What is important is that wildlife managers understand the distinctions between them so that they can understand the nature of the various claims that people make about wildlife.

Spiritual Values

Spiritual values provide standards for judging meaning. "Spiritual," in this context, does not refer to any particular set of religious principles; indeed, even nonreligious people tend to construct an overarching world view within which they interpret the events and circumstances of their lives (Peck 1978). Used in this context, then, spiritual values provide the framework within which the other values are interpreted.

Research on spiritual values in natural resources is only just beginning. Most of the world's religions specify particular sets of relationships between people and animals, and the prescribed relations with animals may be very different across the religions (Kaza 1996). Particular species may play important roles in the spiritual symbology of particular cultures, as they do in many indigenous North American tribal cultures. For mainstream North American culture, however, what probably matters most is the concept of "nature" as a whole. Pantheism—the doctrine of identifying the deity with the various forces and workings of nature—has affected Americans powerfully since the writings of the Concord transcendentalists, particularly Emerson and Thoreau. Although the Catholic Church officially considers pantheism a heresy, we suspect that it continues to exert a strong pull on many Americans and that pantheism may well be an underlying factor in many of the intensely felt conflicts over wildlife issues that we are currently experiencing.

Rational Values

Rational values link values with decision making: rational decisions are considered good, while irrational decisions are bad. When a decision is considered rational, no further explanation is usually necessary. On this basis, then, we need to understand the values that we use to judge rationality, that is, the standards by which we judge truth. Some of these values emphasize logic: a decision should be objective (impartial), internally consistent, and conform to the rules of inductive and deductive inference (i.e., take account of base rates, causal relations, etc.). Other norms are attitudinal: a willingness to test underlying assumptions and not be unreasonably critical or overly committed to a particular position. Finally, decisions must meet practical criteria: the goals must be attainable and the methods used to achieve them must be appropriate.

In sum, then, values provide critical links between individual people and the objective facts of the world around us; they represent the standards that people use to make evaluative judgments. The next section explores the role of these values in the context of contemporary wildlife management.

Wildlife Values, Goals, Constraints and Opportunities for Natural Resource Management

Translating wildlife values into management plans and actions is a major management challenge. The previous section described a classification scheme for wildlife values. The following section provides tools and rationales for applying this classification scheme in natural resource management. First, we describe an analytical framework for identifying areas of potential conflict and consensus based on an understanding of ecological processes and stakeholder analysis.[1] Second, we discuss the rationale for applying this framework in natural resource management decisions. Ultimately, we propose that this type of analysis is critical for understanding the linkages between wildlife values and natural resource management in the northeastern United States, where diverse land uses, property ownerships and human populations represent a mosaic of interests and needs.

Translating Values into an Analytical Framework for Natural Resource Management Decisions

Wildlife values may be understood more commonly by natural resource managers as goals, constraints and opportunities for management. For instance, some values associated with deer hunting represent management goals. Additionally, a person's values related to whether deer should be fed during an especially hard winter are, in essence, constraints or opportunities to the management of the deer population in order to achieve specific goals. The point with any example, however, is that the wildlife values that various stakeholders express about a wildlife management issue can be translated into either a goal, an opportunity or a constraint. In this case, there are potential conflicts or compatibilities between stakeholders' wildlife values and understanding of ecological processes, and there are potential conflicts or compatibilities between wildlife values themselves.

[1]The term "stakeholder" is used here to connote both private landowners and the general public—the "owners" of public lands. Oliver and Twery (in review) distinguish between decision makers and stakeholders by noting that "decision makers" may be thought of as "policy makers" or "managers" at different organizational levels. People with interests in the decision(s) are the "stakeholders." In representative democratic organizations, stakeholders are often represented by decision makers. In participatory decision making, multiple stakeholders develop a consensus set of management goals and alternative policies from which decision makers choose. The line between stakeholders and decision makers becomes blurred when stakeholders also assert the right (authority) to select alternative policy or management alternatives.

Conflict and Compatibility between Values and Ecological Processes

Forest management decisions exist within the context of what is (1) socially acceptable, (2) economically feasible, and (3) ecologically possible (Firey 1960). Within this context, our understanding of ecological systems has changed dramatically over the past 20 years and with an increasing realization that:

(1) ecological systems are never closed or self-contained;
(2) ecological systems are not self-regulating;
(3) stable point equilibria are rare, although some systems of sufficient size and duration may exhibit stable frequency distributions of states;
(4) ecological change is rarely deterministic, ecological systems are stochastic and future conditions have varying levels of probability; and
(5) disturbances are common in ecological systems, though some disturbances are not frequent on the scale of human lifetimes (adapted from Pickett and Ostfeld [1995: 267]).

This change in ecological understanding has fundamentally altered what natural resource managers consider to be ecologically possible. Further, it represents a potential source of conflict or compatibility for addressing wildlife values of different stakeholders. Thus, natural resource managers need to systematically analyze the compatibility of various wildlife values (goals, constraints and opportunities) with the ecological systems that they manage. For instance, the fact that ecological systems are never closed or self-contained represents an ecological conflict for wildlife managers trying to achieve the goals of the Endangered Species Act. If a wildlife manager cannot sufficiently influence the resources that are critical to an endangered species over its entire home range, as well as protect it from external disturbances, how can the species be protected? Further, if stable point equilibria are rare in ecological systems, then a zero tolerance for the extinction of species conflicts with the fact that species have gone extinct in the past and will continue to go extinct in the future. This is especially relevant in the context of major disturbances, since ecological phenomena, such as hurricanes, floods, fires, earthquakes and volcanoes, may dramatically change a landscape, destroying the entire habitat of a species. In this case, is it possible for wildlife managers to reverse profound ecological changes in order to meet certain wildlife values?

Social Conflict and Compatibility between Values

Natural resource managers are often perplexed by the conflicts between wildlife values of different stakeholders, as well as the wildlife values inherent in federal, state and local laws and customs. An analytical framework for translating wildlife values into goals can be based on the use of matrices through a series of steps. First, managers can work with stakeholders to translate wildlife values into management goals, constraints and opportunities statements: for example, no species' extinction, large deer populations, no poisonous snakes, no trapping.

Once a set of wildlife values based on laws, customs and stakeholders has been translated into a list of goal, constraint and opportunity statements, mangers can work with stakeholders to convert this list into a matrix and identify potential areas of conflict and compatibility between goals (e.g., Figure 2). From this matrix, managers and stakeholders can identify conflicting goals and work to prioritize and build consensus for which goals are more important than others (Starfield 1994).

CATEGORY	GOAL	Forest regeneration	Dispersal of lyme disease	Hunting	Wildlife observation	Photography	Existence	Option	Bequest	Altruism	Nutrition	Recreation	Education	Beauty
Functional	Forest regeneration		+	−	−	−	✔	✔	✔	✔	+	−	−	−
Functional	Dispersal of lyme disease	+		−	−	−	✔	✔	✔	✔	+	−	−	−
Use	Hunting	−	−		+	+	+	+	+	+	+	+	+	+
Use	Wildlife observation	−	−	+		+	+	+	+	+	+	+	+	+
Use	Photography	−	−	+	+		+	+	+	+	+	+	+	+
Non-Use	Existence	✔	✔	+	+	+		+	+	+	+	+	+	+
Non-Use	Option	✔	✔	+	+	+	+		+	+	+	+	+	+
Non-Use	Bequest	✔	✔	+	+	+	+	+		+	+	+	+	+
Non-Use	Altruism	✔	✔	+	+	+	+	+	+		+	+	+	+
Economic	Nutrition	+	+	+	+	+	+	+	+	+		+	+	+
Economic	Recreation	−	−	+	+	+	+	+	+	+	+		+	+
Economic	Education	−	−	+	+	+	+	+	+	+	+	+		+
Aesthetic	Beauty	−	−	+	+	+	+	+	+	+	+	+	+	

+ Compatible with or complement each other. ✔ Some effort required to do both or more information is needed. — Requires two separate areas or incompatible.

Figure 2. Compatibility and conflict between goals for deer management.

Next, managers and stakeholders create a second matrix in which wildlife values—as management constraints and opportunities—are listed along one axis, and alternative management strategies to achieve management goals from matrix 1 (Figure 2) are arranged along the second axis (e.g., Figure 3). A similar approach is used; managers and stakeholders identify potential conflicts and compatibilities between management constraints and opportunities and management alternatives. Then they can identify conflicting alternatives and work to prioritize and build consensus for which goals are relatively more important.

MANAGEMENT ALTERNATIVES / MGMT. CONSTRAINTS	Moral: No killing	Moral: Killing	Spiritual: No killing	Spiritual: Killing	Rational
Harvesting	–	+	–	+	+
Culling	–	+	–	+	+
Reintroduction of predators	+	✔	+	✔	✔
Contraception	+	+	+	+	✔
Repellants	+	+	+	+	✔
Clear cuts and patches	✔	+	✔	+	+
Fencing	+	+	+	+	✔
Vegetation selection	✔	+	✔	+	✔
Feeding	✔	+	✔	+	✔

+ Compatible with or complement each other.

✔ Some effort required to do both or more information is needed.

– Requires two separate areas or incompatible.

Figure 3. Compatibility and conflict between management alternatives and management constraints for deer management.

Applying the Analytical Framework in Forest Management Decisions

There are several advantages to using such a structured, systematic analysis. First, this analytical approach helps to make values explicit, reducing potential misunderstandings and increasing the likelihood of successfully addressing client desires. Second, such an approach can build understanding and consensus between stakeholders. In most planning processes, for instance, conflicts are usually between stakeholders, and the decision makers are often caught in the middle. Thus, this approach can be used as a tool to avoid conflicts between stakeholders before they occur or minimize conflict by seeking potential areas of agreement or opportunities for compromise. Finally, this analytical framework helps to promote a sense of fairness that can be used to foster the legitimacy and acceptance of natural resource decisions; in other words, the decision-making process has tried to account for each stakeholder's interests. This final point is particularly crucial to public participation planning processes associated with public lands. In this case, we suggest that there are several critical components to the decision-making process that are facilitated through the use of this analytical framework. This analytical framework can be used by managers to:

(1) make the decision-making process transparent;
(2) achieve clarity among decision makers and stakeholders;
(3) identify and guide the collection of relevant information for analysis;
(4) create win-win situations or at least reasonable compromises;
(5) document how decisions are made; and
(6) communicate the decision-making process, analysis and choices.

Thus, decision makers and stakeholders can use this analytical framework to translate and improve the incorporation of wildlife values into natural resource management.

Conclusions

The array of wildlife values can seem endless and perplexing to managers caught in the midst of intensely felt disputes. In this paper, we have attempted to classify them and illuminate the historical strands of argument that underlie them. All such classification schemes have their shortcomings, however, and many of the values we discuss are related to one another. For example, a truth may be aesthetically pleasing, or aesthetic values may be suborned to moral ends. Nevertheless, the classification scheme provides a useful heuristic device for understanding this complex and confusing area.

It is necessary to go beyond simple understanding, however, and convert these values into a systematic, structured, analytical framework for natural resource decision making. The benefits of such an approach extend beyond incorporating wildlife values into natural resource management and include the enhancement of the decision-making process as a whole, particularly in the case of public participation models. Ultimately, we propose that such a framework is critical in the northeastern United States where diverse land uses, property ownership and human populations represent a mosaic of interests and needs.

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Changes in Eastern Forests: Chestnut is Gone, Are the Oaks Far Behind?

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Oak (*Quercus* sp.) cover types dominate much of the eastern deciduous forest (Clark 1993), a position they have maintained for 6,000 to 9,000 years (Lorimer 1993). Despite their past and present abundance, oaks are not replacing themselves on many sites, and there is a widespread perception that oak may decline dramatically (Abrams and Nowacki 1992, Clark 1993).

We review the evidence suggesting that the status of oak is changing, and describe the critical role of oak in sustaining eastern wildlife communities. We also describe the agents responsible for the decline and mortality of mature oak, and for regeneration failures. Finally, we examine the implications of these potential changes for managing eastern forest ecosystems.

The Changing Status of Oak

Eastern forests have been changing gradually since the end of the last glaciation in response to climate change. At the time of European settlement, oaks were dominant or common associates in all but the most northern portions of the eastern forest. The most common and widespread tree genera were *Quercus*, *Fagus*, *Acer*, *Tilia*, *Carya*, *Fraxinus*, *Ulmus*, *Betula*, *Liriodendron* and *Castanea* (Braun 1950). These genera moved northward at varying rates during the 10,000 years since the last glaciation, creating a shifting pattern of forest cover types on the landscape (Davis 1976).

Pollen records reveal that the routes and rates of migration differed among tree species, with average rates of movement for individual species ranging from 100 to 400 meters per year (Howe and Smallwood 1982). By 6,000 to 9,000 years ago, oak, pine and mixed hardwoods occupied much of the eastern forest, and oaks have dominated the central hardwood region for more than 6,000 years (Lorimer 1993).

The rate of ecological change has accelerated since European settlement. Widespread deforestation and agriculture over the last 200 years, exclusion of fire throughout much of the 20th century, and introduction of exotic pathogens and insects have reorganized most eastern forest communities. Exotic pathogens have caused the most rapid and irreversible changes. For example, the range of American chestnut (*Castanea dentata*) had been expanding slowly across eastern North America for about 8,000 years (Davis 1976). Within 50 years of its introduction in 1904, chestnut blight fungus (*Cryphonectria parasitica*) had eliminated chestnut as a dominant species throughout its 200 million-acre range (Brewer 1995). American elm (*Ulmus americana*) and American beech (*Fagus grandifolia*), which were common in presettlement forests, also have been greatly reduced in importance as canopy trees due to introduced insects and pathogens (Bey 1990, Tubbs and Houston 1990).

The response of oak to postsettlement disturbance has been variable, depending on species, physiographic region, landform within region and history of disturbance. A comparison of present and presettlement forests shows that oaks have increased (Palik and Pregitzer 1992), decreased (Schneider 1996) or maintained overall abundance of the genus, while proportions of individual species have changed (Abrams and McCay 1996) depending on location. Postsettlement increases in oak were common along the margins of the eastern forest where exclusion of fire led to the formation of oak forests in former prairie and savannah communities, and increases in oak in southern pine forests (Abrams 1992, Lorimer 1993). Changes in the central portions of the eastern forest were more complex. Northern red oak (*Quercus rubra*) tended to increase on mesic sites in many physiographic regions, while white oak (*Quercus alba*) often declined in abundance (Abrams and McCay 1996, Abrams and Ruffner 1995). Despite site-to-site variation, the following patterns emerge. Oaks were self-perpetuating and dominant over much of the eastern forest for the past 6,000 to 9,000 years and maintained or increased their dominance in the first two centuries following European settlement. During the 20th century, oaks have failed to recruit into the overstory on many mesic and dry-mesic sites, whose understories usually are dominated by seedlings and saplings of more shade-tolerant species (Fralish et al. 1991). Logging has often accelerated the replacement of oak with later successional species (Abrams and Nowacki 1992); on both disturbed and undisturbed sites, the failure of oak to regenerate coincides with the onset of fire protection (Abrams et al. 1995, Fralish et al. 1991).

Oaks and Wildlife

Acorn production propels a complex web of ecological connections between oaks and wildlife. The abundance of acorns directly affects the regeneration of oak and the abundance of mast-consuming species, and indirectly affects the predators and parasites of mast consumers and invertebrate defoliators of oak (Elkinton et al. 1996, Ostfeld et al. 1996). We are just beginning to understand the complexity of acorn/wildlife interactions and the opposing evolutionary forces that have led to their development. However, it is now evident that oaks and acorns play a fundamental role in the organization and dynamics of eastern wildlife communities, and that these relationships have been developing for millennia.

Acorns and other seeds represent the most valuable and energy-rich plant food available in the dormant season (Robbins 1993). Once oak forests reach seed-bearing age, the supply of seeds usually exceeds that of browse and forage (Liscinsky 1984). The annual acorn crop often exceeds 100 kilograms per hectare and can be as large as 800 kilograms per hectare in good seed years (Christisen and Kearby 1984, McShea and Schwede 1993). Where acorns and browse have been measured on the same sites, mean annual acorn production has been 3 to 10 times greater than browse production (Rogers et al. 1990, Segelquist and Green 1968). On these sites, acorns accounted for more than 80 percent of the total seed crop. It is only in years of complete mast failure that forage abundance exceeds that of mast.

Seeds have been largely ignored in studies of energy and nutrient dynamics of forest ecosystems, despite their essential role in regeneration and their value to wildlife (Kimmins 1996:92). Litter fall is a major pathway for energy and nutrient cycling in forests. Most studies have measured leafy and woody litter, and estimates of litterfall, exclusive of seeds, range from 2.9 to 5.0 metric tons per hectare per year for eastern oak forest types (Bray and Gorham 1964, Grace 1986). The limited data available suggest that acorn crops may range from less than 1 to nearly 20 percent of the total annual litter fall, and account for 2 to 5 percent in most years (Christisen and Kearby 1984, McShea and Schwede 1993, Nielson 1977). Leaves and woody litter fuel the nutrient cycles in the upper soil horizons, and are particularly important in the nutrition of the plant community; the smaller, more digestible and energy-rich seed component has an equally important role in the energy dynamics of the wildlife community. Leaf and woody litter fall is relatively constant from year to year, whereas seed fall varies considerably.

The functional link between acorns and wildlife apparently is a product of the dispersal and colonization mechanisms of oak. Most animals that eat acorns are simply seed predators. A few, notably blue jays (*Cyanocitta cristata*) and squirrels (*Sciurus* spp.), are symbionts, dispersing acorns over long distances and storing them at sites where chances for germination and survival are enhanced (Barnett 1977, Bosemma 1979, Johnson and Webb 1989). Despite large annual loss of seed to vertebrate and invertebrate consumers, oaks have achieved dominance over broad areas. In North America, oaks were among the most rapid migrants as forest vegetation moved northward following the last glaciation (Davis 1976). Thus, animal-dispersal mechanisms evolved by oaks have been as successful as wind-dispersal strategies evolved in lighter seeded species. In fact, in temperate deciduous forests, about 60 percent of the tree species and most shrubs and vines with fleshy fruits are dispersed by vertebrates (Howe and Smallwood 1982). Production of abundant seed by oaks and other nut-producing species can be viewed as the ecological cost of dispersing these large seeds.

Oak has increased in importance for eastern wildlife during the past century as American chestnut and American beech have declined. Chestnut apparently was the most prolific nut-producing tree (Brewer 1995) and beech the most widely distributed in the eastern forest (Braun 1950). Four of the 10 most characteristic and wide-ranging genera (*Quercus, Fagus, Carya* and *Castanea*) in this forest produced nut crops; this seed fall was an important evolutionary force shaping today's wildlife community. These forests supported the passenger pigeon (*Ectopistes migratorius*), formerly one of the world's most abundant birds (Bucher 1992). Pigeons fed primarily on beech nuts and acorns and to a lesser extent on chestnuts (Schorger 1955). The flocks nested in early spring, and successful breeding was dependent on locating abundant mast crops that had persisted over winter. John J. Audubon estimated the pigeon population at 1.1 billion and their daily mast consumption at 8.7 million bushels (about 307,000 m^3/day) (Schorger 1955). The consumption figures cannot be verified, but considering the long list of mast-consuming species in eastern forests, an enormous mast crop must have been necessary to support pigeon populations (Bucher 1992).

Mature Oak Decline and Mortality

Oak decline and mortality, major factors in the demise of oak forests, are initiated by predisposing abiotic and biotic stressors, often culminating in lethal attacks by opportunistic organisms (Houston 1987, Wargo 1977, 1996). Trees decline and die in response to stresses that weaken and then render them susceptible to attack by organisms that they otherwise resist. There have been episodes of oak decline in the East since at least the turn of the century (Houston 1987). Increases in such episodes reflect the increase in abundance of oak since settlement, as well as an increase in the susceptibility of oak to both biotic and abiotic environmental stressors related to or associated with its abundance and age.

In the northeastern United States, insect defoliation has been the major inciting factor in oak decline (Houston 1987, Millers et al. 1989). The gypsy moth (*Lymantria dispar*) has been cited most often for its role in oak mortality, with reports dating from the early 1900s through the 1990s (Fosbroke et al. 1991). The gypsy moth was introduced into Massachusetts in 1869, and for about 100 years its damaging effects were confined to New England and New York. In the late 1960s, this insect began spreading south and west into the major oak forests of the East, causing significant mortality of oak species. Several other native defoliators have played a role in oak decline, but their population levels and area of infestation have not approached that of the gypsy moth (Millers et al. 1989).

Drought has been implicated as the primary factor in oak decline in the southeastern, southern and midwestern United States (Houston 1987). Associated with oak decline since the early 1900s, drought has been especially severe in the Southeast and Midwest since the early 1970s (Tainter et al. 1983). Mortality from drought has been greater within the red oak subgenus (*Erythrobalanus*) than the white oak subgenus (*Leucobalanus*). Mortality is reported to be highest on xeric sites on ridges or upper slopes with southern and western aspects characterized as having rocky shallow soils

(Starkey et al. 1989). Red oak and chestnut oak (*Quercus prinus*) commonly replaced chestnut following mortality due to chestnut blight (Keever 1953), particularly on upper slopes where chestnut once was dominant (Stephenson 1986). Although drought is a major factor in oak decline in the Southern and Midwest, defoliation will play an increasingly important role as the gypsy moth becomes more widely distributed in these regions (Starkey et al. 1989).

Opportunistic Secondary Organisms

Secondary-action organisms are ubiquitous in most oak ecosystems, acting as ecosystem roguers of weakened trees; it is probably impossible and perhaps unwise to attempt to eliminate them from the forest. As roguers, they play a unique role in ecosystem response to stress. Eliminating weakened, marginally productive trees provides growing space on and allows light to reach the forest floor. Some secondary organisms, such as *Armillaria* species, also act as scavengers, decaying the dead tissue and releasing nutrients for use by adjacent trees or new germinants.

Armillaria spp. are mushroom-producing fungi that cause root disease. The principal role of *Armillaria* in eastern oak forests is as a secondary pathogen that attacks trees weakened by biotic or abiotic stressors. The fungus colonizes and kills trees weakened by such stresses as defoliation by insects, frost or leaf fungi, stem cankers, bark and leaf-sucking insects, drought, waterlogging, soil compaction, and air pollution (Wargo and Harrington 1991).

Hypoxylon atropunctatum, a bark canker and sapwood decay fungus, is the major stem- colonizing secondary pathogen. This fungus infects healthy oak tissue latently and thus is positioned to colonize rapidly and kill bark and sapwood tissue altered by stress (Fenn et al. 1991). *Hypoxylon* canker occurs more commonly on trees of the red oak group and may reflect this group's greater susceptibility to stress from drought and more frequent colonization by the fungus.

The twolined chestnut borer (*Agrilus bilineatus*) is the principal opportunistic insect in oak forests. This borer usually is found in low populations in oak forests throughout eastern North America, where it infests branches and trunks of weakened oaks (Wargo 1977). However, borer populations can increase quickly to epizootic levels and cause widespread oak mortality following periods of drought or insect defoliation. Two to three years of successive borer attack usually are required to kill the above-ground portion of an oak tree. Attack usually is initiated in the branches and proceeds downward along the trunk in subsequent years. *Armillaria* and the twolined chestnut borer often attack concurrently (Wargo 1977).

Interactions with Atmospheric Deposition

A weak but consistent association between the frequency of some secondary insects and atmospheric deposition has been observed. In Pennsylvania, the incidence of twolined chestnut borer galleries was higher on white oaks at the high end of a sulfate deposition gradient than on white oaks in lower deposition areas (Nash et al. 1992). In

Indiana and Ohio, the incidence of chestnut borer on dead white oak was correlated with more acidic conditions in the upper 50 centimeters of mineral soil (Haack 1996). Densities of borers (*Cerambycidae* and *Cossidae*) that infest living oak trees also increased as acidity increased (Haack 1996).

Consequences of Oak Decline and Mortality

Stress-initiated oak decline is leading to decreases of oak in eastern forests because other tree species are released when oak mortality occurs. In New England and Pennsylvania, gypsy moth defoliation has altered the overstory species composition of mixed-oak and oak/hickory forests. In southern New England, changes in overstory species composition in response to gypsy moth defoliation have been reported in mixed-oak stands where scarlet oak (*Quercus coccinea*) has replaced white oak (Brown et al. 1979). In four unmanaged mixed-hardwood stands in southcentral Connecticut, oaks account for about 55 percent of the basal area of canopy species; this proportion has fluctuated only slightly since 1957 despite multiple defoliations by gypsy moth (Stephens and Ward 1992). In Pennsylvania's oak/hickory forests, which generally have greater oak stocking, overstory mortality associated with gypsy moth defoliation resulted in a 3-percent decrease in oak growing-stock volume between 1978 and 1989, while the volume of red maple increased by 37 percent (Widman 1994).

Changes in understory composition and regeneration in response to defoliation vary across the Northeast and are dependent on forest composition, site characteristics and disturbances. In Rhode Island and Connecticut, studies of regeneration composition following gypsy moth defoliation indicate that oak seedlings, saplings and stump sprouts remain a major component of regenerating vegetation on oak stands of poor to medium quality (Sewall and Brown 1995). The future composition of these stands likely will not change even though red maple saplings were more numerous than oak saplings in all stands. Other regeneration research in 60- to 80-year-old even-aged mixed stands with unknown defoliation histories indicates that although red oak was the principal overstory species, it represented a small proportion of the regeneration in southern New England (Kittredge and Ashton 1990).

In the Allegheny Mountain region of Pennsylvania, regeneration in stands defoliated by gypsy moth was dominated by red maple (90 percent of all woody stems), and in the Ridge and Valley region, red maple stems accounted for 49 percent and birch 29 percent of the regeneration inventoried following defoliation (Allen and Bowersox 1989). Also in the Allegheny Mountain region of Pennsylvania, tallies of both pre- and post-defoliation regeneration revealed significant reductions in red oak, white oak and chestnut oak, and increases in red maple and black birch regeneration (Hix et al. 1991). However, plots from the Ridge and Valley region of western Maryland showed increased chestnut oak and northern red oak, decreased white oak, and large increases in red maple and black cherry regeneration following gypsy moth defoliation (Hix et al. 1991).

While red maple, birch and other species are increasing in abundance and may replace oak on many sites, there appears to be no prospect of another hard-mast species replacing oaks. American beech, although present in many parts of this region, seldom occupies sites favored by oaks and seems unlikely as a replacement species. In addition, beech is affected by beech bark disease, a complex caused by feeding of the beech scale insect (*Cryptococcus fagisuga*) on the outer living bark, followed by invasion and killing of bark tissues by several species of fungi of the genus *Nectria* (Houston 1994). Likewise, butternut (*Juglans cinerea*) has never been a major component of oak stands and it is being attacked throughout its range by a canker disease caused by the fungus *Sirococcus clavigignenti-juglandacearum*, that can eventually girdle and kill the tree (Ostry et al. 1994). Hickories are commonly associated with oaks even though their ability to replace oaks apparently is limited. Hickories have not replaced oaks after heavy gypsy moth defoliation (Allen and Bowersox 1989, Hix et al. 1991, Sewall and Brown 1995). And, drought and outbreaks of the hickory bark beetle (*Scolytus quadrispinosus*) may cause heavy mortality of overstory hickories of all species (McCarthy 1995). Black cherry, usually a minor component in oak stands, has not been a common replacement species for gypsy moth-killed oaks.

Susceptibility and Vulnerability of Stands

Changes in oak dominance will be a function of the susceptibility of stands to stress and their vulnerability to the effects of stress. Stands that are most susceptible to a stressor may not be the most vulnerable to its effects. For example, stands in the northeastern United States that are susceptible to gypsy moth defoliation (i.e., experience frequent defoliation) often show relatively low mortality following defoliation episodes (Valentine and Houston 1984). Such stands typically are on sites where stress from water shortage is frequent. Trees in such stands probably are more tolerant of and thus less adversely affected by these stresses and, in turn, are less adversely affected by defoliation than their counterparts in less-stressed mesic stands. These mesic stands are less susceptible to defoliation but are more vulnerable when defoliation does occur, and mortality often is high in such stands (Valentine and Houston 1984). The same is true for drought susceptibility and vulnerability. Sites that are susceptible to drought tend to support species that are tolerant of water shortages, and may be less vulnerable to the effects of drought stress (Starkey et al. 1989). The vulnerability of stands depends on oak species composition, tree age, site conditions, and the aggressiveness and abundance of the agents of mortality.

Regeneration of Oak

Oak regeneration failures have been widespread on mesic and above-average sites only for the last 50 years or so; oak regeneration is successful on drier or below-average sites (Lorimer 1993). The natural disturbance patterns that perpetuated precolonial oak forests are not fully understood, but fire seems to have been the common denominator in maintaining oak forests on upland sites (Abrams 1992). The use of fire to regenerate oak has produced mixed results, and prescribed burning has not been developed into an effective tool for regenerating oak (Van Lear and Watt 1993). Recent studies suggest that severe disturbance may be important in maintaining the function of oak ecosystems, and that fire absent an accompanying canopy disturbance may not benefit oak regeneration (Ashton and Larson 1996, Moser et al. 1996).

The conditions necessary for the successful regeneration of oak are well known, but we do not know how to create those conditions for all site and stand conditions (Sander and Graney 1993). The immediate causes for the failure of oak to regenerate include lack of adequate seed sources or seed production due to oak decline and mortality, unfavorable weather and insect damage; lack of viable seed due to insect and mammal predation; lack of acorn germination or seedling establishment due to heavy litter layers, insect damage and desiccation; and low survival and growth of seedlings due to animal damage, heavy shade and competition (Gottschalk 1983). Many of these factors can be eliminated by management as long as stand conditions are monitored regularly and resources are available for implementing specific treatments.

Regional Factors Influencing Survival and Growth of Seedlings

The failure of oak forests to replace themselves naturally and regenerate after timber harvest generally is associated with the failure of seedlings to grow and survive after germination. Many specific causes of mortality have been identified, but the ultimate cause for the failure of oak seedlings to thrive seems related to interactions among shade, understory competition, fire and browsing by white-tailed deer (*Odocoileus virginianus*).

Excessive Shade and Competition

Oaks have a seedling growth strategy that favors root growth over shoot growth. Seedlings develop a strong taproot and can resprout following shoot dieback, allowing them to persist for many years. However, most oaks are intermediate in shade tolerance so when shade becomes too heavy, they cannot maintain a positive carbon balance and die at a higher rate than more-tolerant species such as red maple (Hodges and Gardiner 1993). The dense shade can be from extensive herbaceous cover, which often results from excessive deer browsing that eliminates the woody understory. Another common problem related to shade is the development of mid- and lower canopy layers of tolerant woody species (Lorimer 1993). These understories produce such dense shade that few oak seedlings can survive; those that do survive do not grow (Johnson 1993).

Shade is more commonly a limiting factor on mesic than on dry sites. Mesic sites support denser understories of shade-tolerant species than dry-mesic or xeric sites; thus, oaks regenerate better on dry, poorer quality sites because these sites tend to have higher light levels. Also, oaks generally are better adapted to low resource levels on these sites, having evolved a stress-tolerant strategy with respect to drought (Abrams 1990, Hodges and Gardiner 1993). As a result, oaks are in a better competitive position on these sites than on mesic sites.

The development of shade-tolerant understories on mesic sites may be related to the control of fires in the eastern forest over the last 50 years (Abrams 1992, Lorimer

1993). The effects of fire are twofold: first, oak seedlings survive fire better than those of most other species, and second, by eliminating tolerant understories, fire ensured that levels of light were sufficient for oak regeneration to grow to large size. These effects were most dramatic on mesic sites. On xeric sites, drought and other stresses maintained favorable conditions for oaks with or without fire.

Deer

Browsing by white-tailed deer populations that exceed 30 per square mile has eliminated seedlings and caused regeneration failures of many woody species, including oaks (Marquis and Brenneman 1981). While these failures have been largely local events, the increase in deer populations throughout most of the Northeast and Midwest is creating adverse impacts on a larger scale than previously experienced.

Managing for Success

Successful regeneration of oak requires a series of treatments that establish seedlings, grow them to large size in the understory and promote their development after overstory removal. When large advance regeneration is adequate, as often is the case on dry sites, only a harvest cut is needed to regenerate the stand (Sander and Graney 1993). Where there are large numbers of small advance regeneration, which usually is the case on mesic sites after good acorn crops, the tolerant understory must be removed to allow the oak seedlings to grow (Loftis 1993). Treatments to remove understory include herbicides, prescribed fire and cutting (Van Lear and Watt 1993). Once the oak seedlings are large enough to compete, they can be released by a harvest cut. Mesic sites that do not have large numbers of small advanced seedlings are even more difficult to regenerate. A shelterwood cut to remove primarily the tolerant understory can provide good conditions for seedling establishment. However, seedling establishment depends on good seed crops, so this treatment should be timed to a period during or immediately after a good seed crop. The sequence of events described earlier then can be followed. Although these techniques might seem simple or easy, they are neither, and they are expensive and must be conducted over 10 to 20 years. As such, they will not be used on most private land.

Areas that are the most difficult to regenerate have an inadequate seed source due to past cutting or oak decline and mortality. Artificial regeneration is the only recourse on these sites, but 40 years of research have failed to develop successful, economically efficient methods (Pope 1993). Recent advances may solve the problem, the most important of which has been the development of an underplanting technique for reintroducing or enriching the composition of regeneration with oak species in shelterwood cuts (Johnson et al. 1986). Another major advance has been the development of large, high-quality nursery seedlings that will compete with other vegetation (Pope 1993). Artificial techniques are much more expensive and difficult to apply than natural regeneration techniques.

Conclusions

During the past 6,000 to 9,000 thousand years, oaks have evolved a complex web of ecological connections that permeates the eastern deciduous forest. If current trends continue, there will be widespread replacement of oak as a dominant genus in this forest during the next century. However, the decline of oak is not universal, as this species continues to replace itself in regions such as the Missouri Ozarks and on drier sites throughout the East. But, on mesic sites, oaks generally are being replaced by later successional species. The effect on ecosystem function is potentially profound because mesic sites support more species and are more productive than drier ones.

A decline in the abundance of oaks will alter the organization and function of wildlife communities. Nut production by oaks, hickories, beech and chestnut was an important force in the evolution of eastern faunal communities. The loss of American chestnut probably reduced the carrying capacity of these forests for many wildlife species. The continuing loss of large beech trees to beech bark disease is further reducing habitat quality, leaving oaks as the primary producer of nuts for wildlife in many areas. Acorns are one of the most abundant and important wildlife foods in eastern forests; more than 100 species of birds and mammals feed on acorns. Seeds of the species that are replacing oaks, primarily red maple, sugar maple (*Acer saccharum*), sweet birch (*Betula lenta*) and yellow-poplar, are of considerably less value to wildlife than acorns.

The prognosis for reversing the current trend is not good. Factors that cause mortality of mature oaks are unlikely to change, nor are the cultural practices that inhibit oak regeneration. Economic and social forces discourage management to sustain oaks.

The regeneration of oak forests is a lengthy process. The phase of understory reinitiation that leads to successful regeneration requires a decade or two, longer than the average tenure of private landowners, who control about 70 percent of the eastern forest landscape. There are no economic incentives for these landowners to invest in activities that will not produce benefits for 80 to 100 years.

Technical difficulties also impede managing oak on a sustained basis. Efforts to regenerate oak have been unsuccessful about as often as they have been successful. Silviculturalists are not yet able to offer effective prescriptions for all sites and stand conditions. Although fire has played a dominant role in sustaining oak forests, guidelines for using fire to regenerate oak remain tentative (Van Lear and Watt 1993).

The disturbance regimes that show the most promise for regenerating and sustaining oak ecosystems will be unpopular and expensive to implement. Initiating such practices will require more patience, skill and investment than generally has been applied to the management of eastern hardwoods. Success will entail synchronizing treatments with good seed years, and manipulating both understory and overstory structure for extended periods. The most useful tools will include herbicides, a series of low-intensity fires for 5 to 20 years before overstory harvest, intense fires that destroy ericaceous understories and much of the overstory, a series of shelterwood cuts that includes a final overstory removal, and broadcast burning following overstory removal. Currently, there is little popular support for these activities, even when their beneficial effect on the ecosystem can be demonstrated clearly. Safety factors and concerns related to air quality make it unlikely that fire will be used widely to benefit oaks, especially along the urban/wildland interface of the Northeast and Mid-Atlantic regions. The net result of these factors may be that the genus that dominated a vast ecosystem for thousands of years will be reduced to a minor component within a century.

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Are Forest Songbirds Declining? Status Assessment from the Southern Appalachians and Northeastern Forests

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Reported declines in populations of migratory songbirds in the eastern United States (Robbins et al. 1989, Askins et al. 1990, Hagan and Johnston 1992) have created a great deal of concern among researchers, land managers and conservationists, resulting in the formation of the large bird-conservation consortium, Partners In Flight. Among the causes implicated in these declines are destruction of habitat on tropical wintering grounds, urban development on migratory stopover habitat, and fragmentation and loss of breeding habitat in North America. Much confusion remains, however, concerning which species of birds are declining, the significance of those declines and whether declines are occurring throughout a species' range (e.g., Askins 1993, James et al. 1996, Villard and Maurer 1996).

Although much of the initial concern, especially in the popular press, was for forest-breeding species, especially forest-interior specialists (e.g., Wilcove and Terborgh 1984, Terborgh 1989), most recent analyses concluded that species inhabiting early successional habitats, especially grassland, may be experiencing more consistent declines than are most forest birds in the East (Robbins et al. 1989, Vickery 1992, Askins 1993, Hunter 1995). Given the massive, landscape-level changes in forest cover over much of eastern North America during the past two centuries, it is not surprising that bird populations have shifted and fluctuated accordingly. Fortunately, very few species have been lost from the regional avifauna. From a conservation perspective, potential conflicts exist between local concerns for declining species and the long-term responsibility for conserving entire species throughout their ranges (Rosenberg and Wells in press, Wells and Rosenberg in press). For example, how should land managers balance the needs of early successional species that may be declining locally but are abundant elsewhere, with the needs of common forest birds whose populations are concentrated in the local region (Hunter 1993, 1994)?

In this paper, we summarize the status of forest-breeding and other landbird populations, based on 29 years of data from the Breeding Bird Survey (BBS) in the Southern Appalachians and Northeast regions. These areas support among the highest diversities of breeding Neotropical migratory birds of any region of the U.S. and, therefore, forest managers in these regions have a great responsibility for the long-term conservation of these bird populations (Rosenberg and Wells in press). First, we address two broad questions: (1) what types of bird species (in terms of migratory status and breeding habitat) are exhibiting decreasing, increasing or stable population trends; and (2) what are the geographic patterns of these trends among physiographic areas. We then focus on forest-dependent species that are declining in all or part of their ranges, discussing the geographic pattern of these declines and their implications for forest management and conservation.

Methods

Study Area

The Southern Appalachians and Northeast regions include 13 physiographic areas (Figure 1), following the boundaries used by the U.S. Fish and Wildlife Service for the Breeding Bird Survey (Robbins et al. 1986). (Note that some physiographic area boundaries [e.g. ridge and valley] have been changed recently by Partners In Flight to reflect ecological conditions and bird distributions more accurately.) Several physiographic areas (notably Great Lakes plain and northern spruce/hardwoods) extend outside our primary study area in Canada or the midwestern U.S.

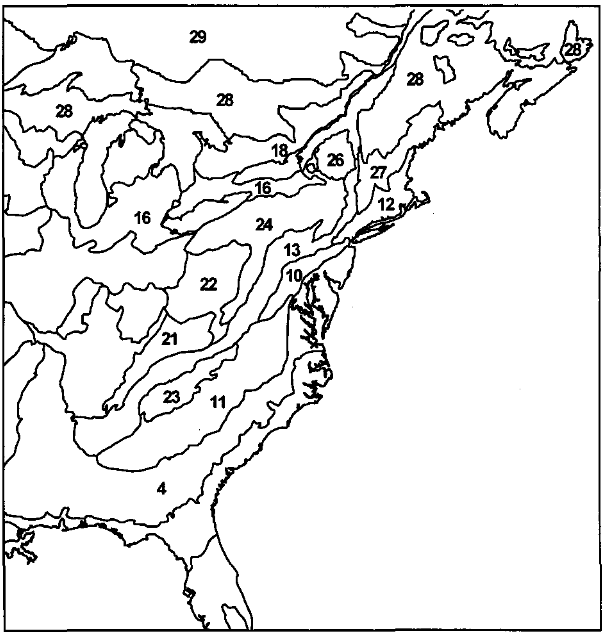

Figure 1. Physiographic areas in the southern Appalachian and Northeast regions. Southern Appalachians: 10 = northern Piedmont; 11 = southern Piedmont; 13 = ridge and valley; 21 = Cumberland Plateau; 22 = Ohio Hills; 23 = Blue Ridge Mts. Northeast: 12 = southern New England; 16 = Great Lakes Plain; 18 = St. Lawrence River Plain; 24 = Allegheny Mts.; 26 = Adirondack Mts.; 27 = northern New England; 28 = northern spruce/hardwoods.

Population Trend Analysis

We examined population trends for all migratory and resident landbird species, excluding game species and raptors. Population trends were based on the North America Breeding Bird Survey (BBS) data base for 1966 to 1994 for each physiographic area, as provided on the BBS World Wide Web site (Sauer et al. 1996). The BBS is an annual survey of birds conducted during the breeding season following specific guidelines and is currently administered by the Biological Resources Division of the U.S. Geological Survey and the Canadian Wildlife Service. The survey consists of randomly located survey routes throughout the continental U.S. and southern Canada. Fifty stops, each 0.8 kilometer (0.5 mile) apart are made along each 39.4-kilometer (24.5 mile) route. At each stop, all birds are recorded that are detected within 0.4 kilometer (0.25 mile) during a three-minute period. The total number of individuals counted along the route is used as an index of relative abundance for each species. Robbins et al. (1986) provide details of the BBS methodology and Sauer and Droege (1990) and Sauer et al. (1994) give an insight into some of the potential biases associated with the survey.

The population trend for a species from 1966 to 1994 was estimated by BBS staff using the route-regression procedure described in Geissler and Sauer (1990), and modified through the use of estimating equations (Link and Sauer 1994), to test the null hypothesis that there was no population change (i.e., change = 0) for the time period 1966 to 1994. Significance was defined as $P < 0.10$. The relative abundance (RA) of each species and the number of routes within each physiographic area were evaluated. RA reflects the number of individuals detected on a route. We considered the sample size to be adequate to evaluate population trends if the species occurred on 14 or more routes within the physiographic area and if the RA value was 1.0 or higher. A species was regarded as "stable" with relation to population trend if the population change was not significant at the $P < 0.10$ level, the RA was at least 1.0, and the species was detected on at least 14 routes in the physiographic area. A species was considered to have an increasing population trend if the change was significantly different from 0 and was positive, the RA was at least 1.0, and the species appeared on at least 14 routes. A declining species was similarly defined but with a population trend value less than 0. The status of a species was considered "unclear" if the RA was less than 1 or the number of routes was less than 14, even if the trend analysis indicated a significant difference (B. Peterjohn personal communication: 1996). This represents a conservative approach in that many species that occur naturally in low population densities, are difficult to detect, or have undergone substantial population declines and do not appear on at least 14 routes with an RA of at least 1.0 will be underrepresented. The above criteria were designed to provide an adequate sample size to enhance reliability of the population trend conclusions.

We segregated population trend data by physiographic area, breeding-habitat group and migratory form. For most species, we accepted the classification of species done by BBS staff (Peterjohn and Sauer 1993) and available at the BBS World Wide Web site. Categories for breeding-habitat groups were grassland, wetland, successional-scrub, forest (including open and closed forest), urban and other (for those species occurring in several habitat groups and not appearing to be primarily seen in any particular group). Temperate (or short-distance) migrant status was assigned to those species breeding in North America and for whom all or most of their populations migrate to other temperate areas north of the Mexico/U.S. border. Neotropical migrants are species whose breeding populations are primarily north of the Mexico/U.S. border and who spend the nonbreeding season in Latin America (including southern Texas) and the West Indies (including southern Florida). A species was deemed a permanent resident if it appears at all times of year throughout its range. Movement of individuals or populations within the range does occur for some permanent resident species.

To test the hypothesis that the number of declining species differed among breeding-habitat or migratory-status groups, we used the log-linear model approach for multiway frequency distributions (Sokal and Rohlf 1981: 747), including physiographic area as a covariable. These tests therefore considered the 13 regions as replicates, and took into account the variability across the regions when testing for differences among the species groups. A significant interaction term (region-by-species group) would indicate that degree of difference between species groups, in terms of number of declining species, was dependent on which region was considered. We performed a separate analysis for breeding-habitat and migratory-status groups.

Geographic Patterns of Declines

Finally, to investigate geographic patterns of population declines for selected forest species, we estimated the percentage of the total population of those species supported in each physiographic area, following the methods of Rosenberg and Wells (1995, in press). With this method, we first estimate the percentage of a species' range occupied in each physiographic area, then multiply these percentage-of-range estimates by the BBS relative abundance estimates for each area, and then divide by the cumulative total to derive the percentage of total population. It is important to note that BBS relative abundances used in this analysis were calculated as the mean abundance over the entire 29-year period. Therefore, for species that have undergone large changes in abundance over this period, our estimates of percentage of population may overestimate "importance" of a given area if current populations are greater than the long-term mean; conversely, we may underestimate true importance if abundances have declined greatly over this period (B. Peterjohn personal communication: 1997). For each species, we plot percentage of population in each area against population trend, to evaluate the importance of regional declines to the species' global population. In this analysis we include, for comparison, data from several eastern physiographic areas that are outside the main study areas.

Results

Overall Pattern of Population Trends

The number of nonraptorial and nongame landbird species recorded on the BBS per physiographic area ranged from a low of 43 in the Blue Ridge Mountains to a high of 130 in the northern spruce/hardwoods (Table 1). In general, larger physiographic areas had more species than smaller areas, although the large physiographic areas also had the largest proportion of species with unclear status (i.e., too uncommon to compute a population trend). Among the species that met our criteria for analysis, the proportion of species with declining trends differed significantly across the 13 physiographic areas (chi-sq. = 21.92, d.f. = 12, p = 0.033). The highest percentages of species that were declining were in the Blue Ridge and Adirondack mountains, whereas the St. Lawrence plain had the smallest percentage of declining species (Table 1). The Blue Ridge Mountains also had the smallest percentage of species with increasing trends; the Great Lakes plain and two Piedmont physiographic areas showed the largest proportion of species that were increasing. On average, the 13 physiographic areas had about the same proportion of species showing stable populations as they had with declining trends.

Table 1. Overall population trends of nonraptorial and nongame landbirds among 13 physiographic areas in the Appalachian and Northeast regions. Number of species in each category are given (percentage of total species for that physiographic area). See Figure 1 for map of areas.

Physiographic area	Increasing	Declining	Stable	Unclear	Total
Northern Piedmont (10)	18 (22.8)	21 (26.6)	17 (21.5)	23 (29.1)	79
Southern Piedmont (11)	19 (23.8)	17 (21.2)	24 (30.0)	20 (25.0)	80
Ridge and valley (13)	16 (14.6)	30 (27.3)	25 (22.7)	39 (35.4)	110
Cumberland Plateau (21)	10 (14.9)	19 (28.4)	35 (52.2)	3 (4.5)	67
Ohio Hills (22)	13 (14.6)	26 (29.2)	27 (30.3)	23 (25.9)	89
Blue Ridge Mountains (23)	2 (4.6)	23 (53.5)	18 (41.9)	0	43
Southern New England (12)	12 (14.0)	29 (33.7)	18 (20.9)	27 (31.4)	86
Great Lakes Plain (16)	22 (25.6)	21 (24.4)	14 (16.3)	29 (33.7)	86
St. Lawrence Plain (18)	14 (15.9)	14 (15.9)	28 (31.8)	32 (36.4)	88
Allegheny Plateau (24)	15 (13.2)	25 (21.9)	24 (21.0)	50 (43.9)	114
Adirondack Mountains (26)	11 (14.1)	28 (35.9)	31 (39.7)	8 (10.3)	78
Northern New England (27)	12 (13.3)	19 (21.1)	37 (41.1)	22 (24.5)	90
Northern spruce/hardwoods (28)	17 (13.1)	36 (27.7)	25 (19.2)	52 (40.0)	130
Mean number of species	13.9	23.7	24.9	25.2	87.7
Mean percentage	15.7	28.2	29.9	26.2	

Population Status in Relation to Breeding Habitat and Migratory Status

We found no significant difference in the distribution of species among breeding habitat or migratory status groups, across the 13 physiographic areas. The difference in proportion of declining species between forested and nonforested (grassland, wetland, shrub and urban) habitats was highly significant, however (chi-sq = 31.13, d.f. = 1, p < 0.001). On average, 26.6 percent of forest species in each area were showing declines, whereas an average of 46 to 70 percent of grassland and successional-shrub species in each area were declining (Table 2). Physiographic areas with relatively high percentages of declines among forest species included the Blue Ridge Mountains, southern New England, northern spruce/hardwoods and Adirondack Mountains.

More than two-thirds of the grassland species were declining in 10 of 13 physiographic areas, whereas declines in successional-shrub species were most prevalent throughout New England, the Adirondack and Blue Ridge mountains, Cumberland Plateau, and ridge and valley areas. Similarly, an average of 37.4 percent of urban-associated species in each area showed declines. The status of the few wetland-associated species varied greatly from region to region (Table 2).

Table 2. Number (percentage) of nonraptorial and nongame landbird species with declining population trends in 13 physiographic areas of the Appalachian and Northeast regions, by breeding habitat and migratory status. Percentages are based on species in each group that met our criteria for calculating trends (see Methods).

Physiographic	Breeding habitat					Migratory form		
area	Forest	Shrub	Grassland	Wetland	Urban	Neotropical	Temperate	Resident
Northern Piedmont (10)	3 (16.6)	6 (37.5)	5 (83.3)	2 (50.0)	5 (45.5)	7 (31.8)	11 (47.8)	3 (27.2)
Southern Piedmont (11)	3 (12.0)	5 (33.3)	1 (33.3)	2 (50.0)	6 (50.0)	5 (17.9)	9 (45.0)	3 (25.0)
Ridge and valley (13)	10 (33.3)	10 (58.8)	3 (75.0)	1 (14.3)	5 (41.7)	15 (44.1)	9 (40.9)	6 (40.0)
Cumberland Plateau (21)	6 (18.8)	8 (50.0)	1 (100.0)	1 (25.0)	3 (30.0)	14 (41.2)	4 (22.2)	1 (8.3)
Ohio Hills (22)	9 (29.0)	8 (50.0)	2 (66.7)	2 (66.7)	4 (33.3)	12 (35.3)	10 (52.6)	4 (30.8)
Blue Ridge Mountains (23)	8 (42.1)	8 (61.5)	1 (100.0)	2 (100.0)	3 (42.9)	11 (61.1)	9 (52.9)	3 (37.5)
Southern New England (12)	10 (43.5)	11 (68.8)	3 (75.0)	2 (50.0)	3 (27.3)	14 (51.9)	13 (61.9)	2 (18.2)
Great Lakes Plain (16)	4 (25.0)	3 (25.0)	8 (80.0)	1 (14.3)	4 (36.4)	6 (26.1)	12 (48.0)	3 (33.3)
St. Lawrence Plain (18)	2 (10.5)	3 (25.0)	5 (71.4)	0	3 (30.0)	3 (10.7)	11 (44.0)	0
Allegheny Plateau (24)	7 (25.9)	5 (35.7)	5 (83.3)	1 (20.0)	6 (54.5)	7 (24.1)	15 (57.7)	3 (33.3)
Adirondack Mountains (26)	13 (35.1)	8 (53.6)	1 (33.3)	3 (50.0)	2 (25.0)	18 (51.4)	9 (31.0)	1 (16.6)
Northern New England (27)	5 (15.6)	9 (60.0)	1 (25.0)	2 (33.3)	2 (20.0)	7 (21.9)	12 (41.4)	0
Northern spruce/ hardwoods (28)	14 (37.8)	6 (40.0)	6 (85.7)	4 (50.0)	5 (50.0)	14 (35.0)	21 (61.8)	1 (25.0)
Mean number of species	7.2	6.7	3.2	1.8	3.9	10.2	11.2	2.3
Mean percentage	26.6	46.1	70.2	40.3	37.4	34.8	46.7	22.7

The proportion of species showing declining trends also differed significantly among the three migratory status groups (chi-sq. = 21.52, d.f. = 2, $p < 0.001$). The lack of a significant interaction between migration status and physiographic area indicated that this trend was consistent across the 13 areas. In general, a lower percentage of resident species than either Neotropical or temperate migrants were declining in each area (Table 2). Areas with the highest percentage of declining Neotropical migrants (more than 50 percent) included the Blue Ridge Mountains, Adirondack Mountains and southern New England. The Blue Ridge Mountains and southern New England also had a relatively high proportion of temperate migrants declining, as did the northern spruce/hardwoods, Allegheny Plateau and Ohio Hills areas.

Geographic Patterns of Declines in Forest Species

A total of 34 species classified as forest breeders exhibited significant long-term declines in at least one physiographic area (Table 3). Of these, 16 declined in only one geographic area. Northern flicker (*Colaptes auratus*) showed the most widespread decline, with significantly negative trends in 11 of the 13 physiographic areas considered. Eastern wood pewee (*Contopus virens*) and wood thrush *(Hylocichla mustelina)*

Table 3. Forest bird species with significantly declining population trends in at least one physiographic area in the southern Appalachians or Northeast regions. Declines are reported as percentage change per year, from 1966 to 1994, based on Breeding Bird Survey trends calculated by Sauer et al. (1996). Physiographic area numbers from Figure 1.

	Physiographic area												
Species	10	11	13	21	22	23	12	16	18	24	26	27	28
Yellow-billed cuckoo			2.4		4.0								
Black-billed cuckoo													2.1
Chuck-wills-widow			3.1										
Northern flicker	1.3	2.9	4.3		3.2	6.6	3.2	3.0	2.2	7.2	4.4	3.2	
Red-headed woodpecker								7.7					
Downy woodpecker			1.1			2.9				2.8			
Eastern kingbird		2.5					2.9	1.6		1.2	2.6		
Great crested flycatcher	2.5				3.8		2.0				3.3		
Eastern wood pewee			3.0	2.3	3.4	7.2				2.7	3.6		2.5
Least flycatcher							3.6			1.2	1.4	2.7	2.3
Acadian flycatcher						3.1							
Tufted titmouse					1.3								
Blue-gray gnatcatcher						2.8							
Ruby-crowned kinglet													1.5
Eastern bluebird					1.8								
Veery									1.2		2.3	0.8	1.9
Swainson's thrush													2.2
Wood thrush		2.3	2.4			4.2	2.1			2.3	3.4		4.3
Warbling vireo					4.4								
Red-eyed vireo												0.9	
Yellow-throated vireo			1.3										
Cerulean warbler				4.7	2.9								
Black-and-white warbler				2.4	5.7	6.8	1.4			3.4	1.5		
American redstart				5.0							3.0		
Louisiana waterthrush				2.0									
Hooded warbler						1.6							
Canada warbler											5.0		2.2
Summer tanager			2.4	4.7									
Scarlet tanager							1.4				2.4		1.3
Rose-breasted grosbeak							2.0				2.9		1.6
Orchard oriole			5.5										
Northern oriole	1.5		2.6				2.8	1.0			3.7		
Purple finch							4.2					3.5	2.8
Evening grosbeak													3.7
Number of declining species	3	3	10	6	9	8	10	4	2	7	13	5	12

each declined in 7 of the 13 areas, and black-and-white warbler declined in 6 areas. Among the physiographic areas, the Adirondack Mountains (Area 26) had the most declining forest species (13 species), followed by the northern spruce/hardwoods with 12 species, and ridge and valley and southern New England with 10 species each. Overall, 22 forest-breeding species declined in at least one area of the southern Appalachian region, and 21 species declined in at least one area in the Northeast.

Several geographic patterns of decline were evident among these species (Figure 2). One pattern is illustrated by the eastern wood pewee and wood thrush, two species with widespread distributions in both the southern Appalachian and Northeast regions. In both these areas, the largest proportions of the total population occur in the Upper Coastal Plain and southern Piedmont physiographic areas, and both species are exhibiting significant declines in nearly every area (Figure 2). The Blue Ridge Mountains stand out as an area of especially steep population declines in both species and, curiously, both species are increasing in the Great Lakes Plain. The primary difference in these species' population status is in the Ohio Hills, where wood thrush populations are increasing and wood pewees are declining. The northern flicker, which also is declining throughout the study areas, has a very large distribution and is showing stable populations in midwestern areas and across the northern forest where a large proportion of the total population occurs.

A second pattern is illustrated by cerulean warbler (*Dendroica cerulea*), in which a large proportion of the total population is concentrated in the southern Appalachian physiographic areas, and many of the steepest declines are in these regions of highest abundance (Figure 2). This species is expanding its range toward the northeast and shows stable or increasing populations at the periphery of the range in the Great Lakes Plain and northern portions of the ridge and valley. The worm-eating warbler (*Helmitheros vermivorus*) shows a very similar pattern, with large and declining populations in the southern Appalachian region and expanding populations in the Northeast; this species was not common enough on BBS routes to be included in our analyses, however.

A third pattern is seen in the veery (*Catharus fuscescens*) and Canada warbler (*Wilsonia canadensis*), in which the bulk of the total population is in the northern spruce/hardwood forest. Both species are declining significantly in this region of greatest abundance, and both species also show very steep declines in the Adirondack Mountains (Figure 2).

A fourth pattern is seen in several species, in which trends are stable or increasing in areas that support the largest populations, and most or all of the declining trends are in areas with very small percentages of the total population. For example, more than 50 percent of all black-and-white warblers (*Mniotilta varia*) breed in the northern spruce/hardwoods and boreal forest regions, where populations are stable or increasing. This species is declining significantly, however, in the Blue Ridge Mountains, ridge and valley, and Ohio Hills physiographic areas, that together support less than 5 percent of the total population. Similarly, the largest declines in American redstart (*Setophaga ruticilla*), scarlet tanager (*Piranga olivacea*), rose-breasted grosbeak

(*Pheucticus ludovicianus*) and northern oriole (*Icterus galbula*) are in areas that support only small proportions of the total populations of these species.

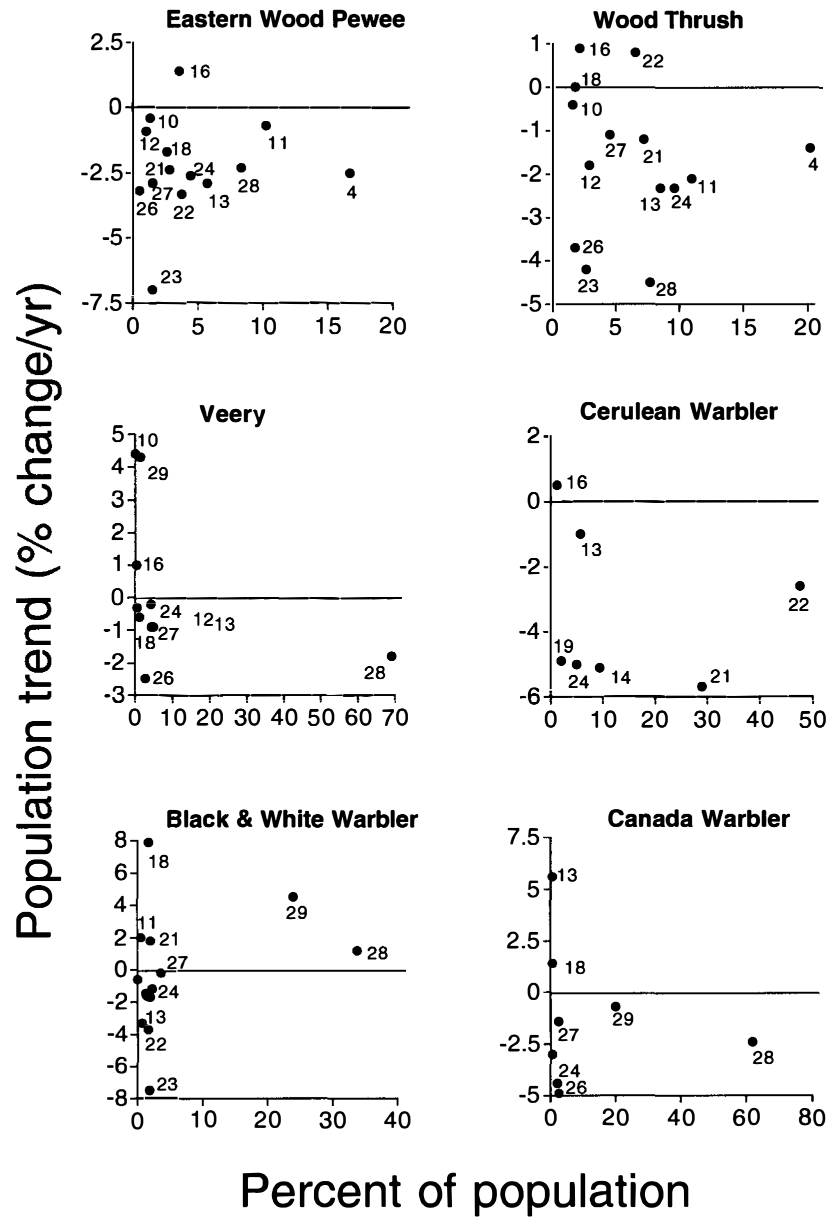

Figure 2. Population trend versus percentage of population by physiographic area for the eastern wood pewee, wood thrush, veery, cerulean warbler, black-and-white warbler, and Canada warbler.

Discussion

Our analyses have confirmed that, in general, bird species associated with wetlands, grasslands and other early successional habitats are suffering greater population declines than forest birds in the southern Appalachian and Northeast regions. This trend is consistent throughout the 13 physiographic areas considered in this study, and it is consistent with other recent summaries of bird population trends in eastern North America (e.g., Askins 1993, Peterjohn and Sauer 1993). Our finding of significantly fewer declines among permanent resident versus migratory species is also consistent with earlier analyses (e.g., Robbins et al. 1989), although the suggestion that temperate migrants may be suffering proportionately more declines than Neotropical migrants is at odds with earlier conclusions. From a conservation perspective, however, the issue is whether declining early successional species deserve high-priority status in these regions, especially if managing for these habitats is at odds with maintaining habitats for forest-breeding species. To address this issue, we must consider: (1) the historical changes in habitat availability in the southern Appalachians and Northeast regions, and (2) the impact that management efforts in these regions will have on global populations of early successional and forest species. Before discussing these issues, however, we must acknowledge the limitations of the BBS data base used in our analyses.

Limitations of the BBS Data Base

Although the BBS provides the only consistent, long-term data on breeding bird populations throughout North America, a great deal of controversy surrounds the methodology used to analyze BBS data and the conclusions that can be drawn from these analyses. Detailed, up-to-date discussions of these problems and limitations are provided by Sauer and Droege (1990), Peterjohn et al. (1995), James et al. (1996) and Thomas (1996). Despite this controversy, results of the various methods prove to be quite similar for species showing marked increases or declines, i.e., the direction of change is usually the same, although the estimated rates of change may differ (B. Peterjohn personal communication: 1997) Because our intent in this paper is to provide a broad picture of the kinds of bird species that may be declining and where these declines might be most prevalent, we believe that our conclusions are not compromised by the controversies associated with analyzing BBS trend data.

One concern that we have with our analysis is that we have excluded species that did not meet our minimum criteria for determining population trend (i.e., species that appeared on fewer than 14 routes per physiographic area, etc.). These species were categorized as having an unclear status and may total up to 44 percent of the species in a given physiographic area (see Table 1). In some cases, these were species that are in low numbers such as the cerulean warbler, worm-eating warbler and whip-poor-will (*Caprimulgus vociferus*), and for which much concern has been expressed. The BBS is limited in its ability to provide us with meaningful trend data on such species. The same applies to species that are difficult to detect either because they are shy, sing softly or infrequently, or are drably colored. The very species that may warrant our greatest concern, therefore, may be inadequately sampled by the BBS. This particular limitation should not bias our overall conclusions, however, because uncommon species are as likely to be associated with early successional habitats (especially wetlands) as with forests.

Historic Changes in Habitat Availability

Details of land-use and vegetation changes in eastern North America may be summarized briefly as follows. Historically, virtually all of the Appalachian and Northeast regions were forested, although successional-scrub habitats were created and maintained by natural disturbance factors, such as fire, insect infestation, grazing by native species, and localized adverse weather features, such as hurricanes, tornados and ice storms. In addition, a compelling argument has been made (Askins 1995) that native grassland and other successional habitats were an integral part of the pre-European landscape, especially on the Atlantic Coastal Plain.

During the late 1800s and early in this century, large-scale clearing of the eastern forests took place for human settlement, agriculture and to provide lumber for the international shipbuilding industry. During this time, many of the small farming operations in the Southeast, with their relatively inefficient practices, inadvertently produced habitat that served as a substitute for successional-scrub habitat that had been depleted by efforts to prevent fire and disease. In recent times, a number of widespread land uses, especially the abandonment of agriculture, tended to favor regeneration of mature forest. In addition, within the agricultural landscape, "old fields" are themselves in decline and are rapidly being replaced by more efficient, larger farming operations.

Initially, these large-scale changes resulted in the tremendous expansion of early successional bird populations throughout eastern North America, including expansions of several species from midwestern regions (e.g., horned lark [*Eremophila alpestris*], brown-headed cowbird [*Molothus ater*]) and expansions into agricultural habitats by populations native to the Northeast (e.g., Henslow's sparrow [*Ammodramus henslowii*]). At the same time, forest bird populations undoubtedly underwent massive retractions and declines, although these are poorly documented. The more recent trends toward regenerating forests and continued reduction in agricultural land uses have resulted in the continued regional declines in early successional bird species seen in the present analysis. Most forest bird populations are undoubtedly larger than they were 100 years ago and, with several notable exceptions (see below), recent declines in forest species are usually local and relatively small in magnitude.

Because of the dynamic nature of land-use and bird-population changes, trend analysis of BBS data from different time periods may yield different results. For example, an earlier analysis found that most physiographic areas had a higher number of declining species from 1978 to 1988 than over the full span of the BBS, 1966 to 1988 (Sauer and Droege 1992). Peterjohn and Sauer (1994) found that woodland species in particular have suffered much greater declines since 1982 than in the earlierperiods of the BBS. Although population trends calculated from subsets of the BBS survey period may reflect short-term land-use changes or even recovery of local populations, they also may be more prone to the confounding influences of climatic fluctuation (e.g., drought), sampling variability or intrinsic population cycles.

Declines in Forest Birds: Should We Be Concerned?

Among the habitat-species groups we considered, the forest-breeding group appears to have the fewest declining bird populations. Even in this breeding-habitat group, however, a substantial proportion of the avifauna is declining. For example, 8 of the 19 forest-breeding species in the Blue Ridge Mountains and 13 of the 44 species in the Adirondack Mountains were declining, and these represented the worst situations for forest birds in the two study areas. Other studies have found a similar concentration of declining populations (both in terms of number of species and magnitudes of declines) in highland physiographic areas such as the Adirondack and Blue Ridge mountains (James et al. 1992, James et al. 1996). Perhaps this trend reflects a bias of sampling along roads in these areas, which is where new development tends to be concentrated (Hunter 1993, 1995). A more elaborate analysis of land-use patterns and changes is needed to assess whether these changes in population trends of forest birds are a reality or merely an artifact of roadside sampling. However, it should be noted that all groups of birds, including those in the successional-scrub and urban breeding habitat groups, have declined in the Blue Ridge Mountains.

From a regional perspective, it is interesting that a higher proportion of forest bird species are declining in physiographic areas that are largely forested, whereas fewer species are declining, and more are increasing, in areas in which forests are sparse or highly fragmented (Great Lakes Plain, northern and southern Piedmont). Hunter (1995) also noted that BBS trend information may appear to contradict the assumption that the amount of forest cover is related to population stability among vulnerable species. It is also possible that in regions with much recent forest regeneration, declines in forest quality are more important than total acres of forest cover. For example, much new forest growth may be the result of even-aged management and fire suppression, leading to dense, closed-canopied forests with little understory development and little horizontal patchiness. Clearly, we need to explore how these trends in avian populations may be influenced by the historical changes, current practices and planned future activities in the various physiographic areas.

Even though forest birds as a group are not in serious trouble, particular species show consistent and troubling declines in all or part of their ranges in the southern Appalachians and Northeast regions. Widespread declines in wood thrush and eastern wood pewee, for example, may be symptomatic of changes in habitat conditions that are not yet affecting (or not detectable) in less-common species. Notably, a majority of forest birds showing consistent, long-term declines are species associated with forest openings (northern flicker, eastern wood pewee), dense shrubby understories (wood thrush, veery, Canada warbler), or are ground-nesters (veery, Canada warbler, black-and-white warbler, worm-eating warbler). These species may respond positively to forest-management practices that stimulate understory development or create canopy openings. Alternatively, the particular set of species that are declining may be subject to threats on the nonbreeding range that are beyond the control of forest managers in our region. Unraveling the causes of population declines is the subject of much ongoing study (e.g., Rappole and McDonald 1994, Sherry and Holmes 1995, 1996, James and McCulloch 1995) and is beyond the scope of this paper. In a few cases, however, such as cerulean warbler, declines are serious enough to warrant immediate conservation concern and management action (Hamel 1992, Hunter 1995, Rosenberg and Wells in press).

To some extent, deciding on the relative "value" of forest versus early successional bird populations is subjective. By considering a global perspective, however, we recognize the overriding importance of mature-forest species in long-term conservation planning based on three lines of reasoning. First is that the Appalachian and northeastern forests support a major portion of the global population for many forest-breeding species (Rosenberg and Wells in press), whereas, with few exceptions (see Askins 1995, Wells and Rosenberg in press), most early successional species have the bulk of their populations outside this region. Second is that current and future land use ensures the maintenance of some early successional habitats throughout the region, although probably never to the extent that existed at the height of forest clearing. Careful management of existing successional habitats (which are often neglected), through sound agricultural practices and protection from urban development, will be very important to the long-term persistence of grassland and shrub-nesting species in this region. Our third line of reasoning evokes the "unequal trading" principle (Dan Brauning personal communication: 1996) that acknowledges that any critical need for early successional habitats in the future can be reconciled easily and quickly, whereas creating mature forest requires much more time.

Recognizing the importance of forest bird populations does not preclude the need to manage these forests, and we are not advocating a policy of no timber harvesting. Indeed, as noted above, many forest bird species may benefit from wisely planned forestry practices that create more open canopies and promote vertical stratification of vegetation. Large-scale fragmentation of forested areas to benefit early successional species, however, is not appropriate from a regional conservation perspective. In the long term, forest managers in our region have a great responsibility for ensuring the health of global populations of a large number of forest bird species. This responsibility must be balanced with more immediate and local conservation concerns, as well as other constraints on long-term forest planning (Rosenberg and Wells in press). The eastern forest region is vast enough to accommodate a range of habitat conditions that support healthy populations of both mature forest-dependent and early successional birds. The current Partners In Flight planning process is considering all these issues in developing conservation strategies for each physiographic area.

Acknowledgments

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Why States Need to Practice Ecosystem Approaches to Management

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Conceptually, ecosystem approaches to management imply manipulation or protection of natural resources on a large geographic scale. Their general purpose is to consider not only specific, politically designated sites such as national forests or parks, but the areas surrounding them as well, in a comprehensive management scheme. For good reason, many of us think of ecosystem management as occurring in, and perhaps most pertinent to, the western United States, where species such as spotted owls (*Strix occidentalis*) and goshawks (*Accipiter gentilis*) are distributed in large part over huge tracts of largely federal land administered by relatively few agencies.

But ecosystem approaches to management apply elsewhere as well. In New England, maps of ecosystems (Westveld et al. 1956, Keys et al. 1995) or species ranges (DeGraaf and Rudis 1986) commonly overlap multiple land ownership or political/jurisdictional (i.e., state) boundaries. One recent application of the ecosystem management concept in New England has been the Gap Analysis Program, a nationwide habitat assessment tool used to identify biodiversity hot spots (e.g., Slaymaker et al. 1996). But the most obvious and long-standing example of ecosystem management by state fish and wildlife agencies is waterfowl management. Treaties and court challenges in the early part of this century established federal supremacy over states in the regulation of migratory waterfowl hunting seasons (Bean 1983, Trefethen 1975); federal hunting regulations were initially applied on a nationwide basis, and later on latitudinal zones extending across the United States (Jahn and Kabat 1984). But by 1929, it was clear that North American waterfowl formed relatively distinct populations that moved north and south along fairly well-defined flyways (Trefethen 1975). In time, formal Flyway Councils and Technical Sections were established, with representation from state, provincial and territorial fish and wildlife agencies, the U.S. Fish and Wildlife Service, and the Canadian Wildlife Service. These entities have collaboratively developed experimental waterfowl seasons and evaluations, research projects, and management techniques that transcend state and provincial boundaries (Addy and Blandin 1984).

There are, however, obvious barriers to ecosystem management. The constitutional authority for federal wildlife regulations is found in three sources: (1) federal treaty-making power, (2) the property clause, and (3) the commerce clause (Bean

1983). Wildlife that do not fall under any of these constitutional umbrellas are covered under what has become known as the "state ownership doctrine." These so-called "resident" wildlife species are considered, for the most part, to be nonmigratory and are managed on a state-by-state basis. Not only are there few incentives for state policymakers to collaborate on management of "resident" wildlife, there are significant barriers. Each state fish and wildlife agency has a unique legal mandate that, in essence, is the basis for an operational philosophy. For example, in the five New England states (exclusive of Maine) that together comprise an area roughly one-fourth that of Montana, there is considerable variation in the philosophical foundation of the legal mandates and the direction of each state's fish and wildlife agency (Musgrave and Stein 1993). There is considerable variation in funding levels and priorities as well. In a sample of three New England States, wildlife program funding in fiscal year 1994 varied from more than $3.5 million to less than $900,000, with Federal Aid funding ranging from 41 to 82 percent of the total (U.S. Fish and Wildlife Service [USFWS] unpublished data). Dollars obligated toward land acquisition varied from less than 1 to 28 percent, while research accounted for 18 to 30 percent of the funding. In addition, there may be specific regulations or policies that restrict or inhibit the ability of state fish and wildlife agencies to contribute funds derived from in-state hunting and fishing license sales for research efforts that do not take place within that state, or to research facilities other than their own land grant university or federal cooperative fish and wildlife research unit.

A consequence of these barriers is that most large mammals that commonly exhibit significant movements across state lines are not thought of in ecosystem terms. Free-ranging species whose dispersal movements or even home ranges cross political boundaries often are not managed cooperatively by states or provinces. Medium- and large-size mammal species whose ranges are still expanding in New England, such as black bears (*Ursus americanus*), fishers (*Martes pennanti*), moose (*Alces alces*) and perhaps even coyotes (*Canis latrans*), all can move across areas with differing management authority and philosophies. The same is true for species that could be present but are extremely rare (cougars [*Felis concolor*]) or species that might be reintroduced (lynx [*Felis lynx*] or wolf [*Canis lupus*]). This potential is a consequence of the small size of states in New England (versus the West), the fact that political and ecological boundaries do not coincide, and the aforementioned legal and philosophical differences.

Ecological Considerations

The geographic scale at which we perceive wildlife has a profound influence on how species are managed. Habitat management for individuals is certainly different than that for populations. On an individual basis, we often try, through research, to identify particular cover types that are "preferred," and then recommend that more of this type be produced. We assume that individuals with home ranges containing lots of the preferred type will reproduce better or live longer, though this is rarely demonstrated. For populations, however, states typically ignore a "habitat" factor that clearly causes population change; that is, adjacent states where, because of longer hunting seasons, chances of dying are much higher during a certain part of the year. The habitat boundaries in these cases are not ecological ones, as might be true for management zones within a state, but political ones.

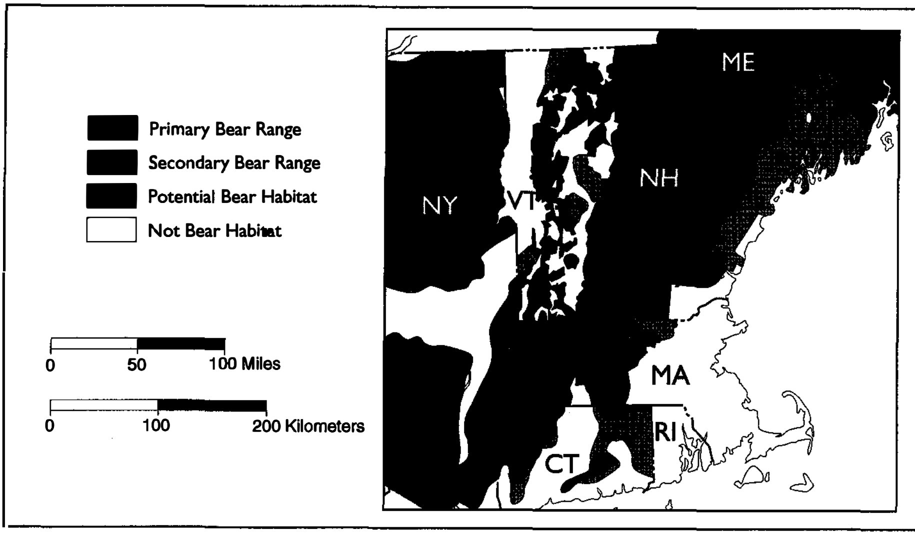

Figure 1. A recent assessment of black bear range in New England, conducted under the auspices of the Eastern Black Bear Workshop. Before the Workshop, biologists independently estimated the geographic extent of occupied (primary and secondary) and unoccupied (potential) bear habitat within their states, and results were compiled into a single map at the Workshop.

Wildlife biologists also tend to view the distribution of wildlife on different scales. In a recent independent state assessment of bear range in New England conducted under the auspices of the Eastern Black Bear Workshop, some states drew general maps with smooth lines outlining large areas, while others were quite specific and detailed in their assessment of occupied range (Figure 1). The consequence was that, at state borders, unbelievable discrepancies in bear distribution were clear.

For some species, the size of their home ranges may have additional consequences for ecosystem management. It is certainly recognized that a number of individuals must have ranges that lay on state boundaries, but the actual size of some ranges may astound managers, and the number of individuals whose ranges extend well into two or more states may be substantially higher than traditionally thought. Although female black bears monitored in western Massachusetts had annual home ranges no larger than 26 square miles (67 km^2), certain males ranged up to 750 square miles (2,000 km^2) covering an area essentially from one state boundary to another (Fuller 1993). Many ranges in that study certainly were much smaller, and between-study variation in both the mean size and variation of home ranges can be substantial as well. This variation only complicates our understanding of how to extrapolate biological data over an ecosystem.

Perhaps a more important biological aspect is that of dispersal. The recently established moose population in Massachusetts, which is currently a major management concern, clearly has New Hampshire as a source (Vecellio et el. 1993). Radio-marked fishers in northcentral Massachusetts dispersed up to 66 miles (107 km) into Vermont and New Hampshire (York 1996) and recently, a black bear marked in western Massachusetts ended up as a nuisance about 75 miles (120 km) away in Rhode Island a year or so later (J. Cardoza, Massachusetts Division of Fish and Wildlife, personal communication: 1995). Aside from the repopulation consequences of dispersing individuals, the genetic exchange that results from such movements is considered an important component of maintaining biological diversity.

Management Considerations

Variation in legal status of species (protected, hunted, unprotected) and regulations (season lengths and bag limits) among adjacent states can present challenges to harvest management and enforcement. There is considerable variability among five New England states for four species whose home ranges or dispersal distances encompass more than one of these states, and where human interstate movement is facilitated by a relatively small geographic area (Table 1). Species in adjacent states may

Table 1. Regulations concerning and harvest of several large mammal species in New England.

Species	State	Season length in weeks: Hunting	Season length in weeks: Trapping	Bag limit	Number harvested in 1996
Black bear	Connecticut	Closed		na[a]	0
	Rhode Island	Closed		na	0
	Massachusetts	2	None	1	56
	New Hampshire	9	None	1	185
	Vermont	11	None	1	274
Coyote	Connecticut	46	25	None	146[b]
	Rhode Island	52	52	None	6[b]
	Massachusetts	13	4	None	153
	New Hampshire	52	52	None	380[b]
	Vermont	52	9	None	163
Fisher	Connecticut	Closed		na	0
	Rhode Island	Closed		na	0
	Massachusetts	3	3	None	226
	New Hampshire	4	4	5	433
	Vermont	2	2	None	103
Moose	Connecticut	Closed		na	0
	Rhode Island	Closed		na	0
	Massachusetts	Closed		na	0
	New Hampshire	>1	na	1	374
	Vermont	<1	na	1	78

[a]Not applicable.

[b]Number of pelts tagged only; other animals may have been harvested and not registered.

be completely protected or experience short harvest seasons; here there is the clear potential for illegal harvest in one state to end up as legal, registered harvest across the border. Along the Massachusetts/Vermont border, for example, the six-day survival rate of black bears radio marked in Massachusetts and apparently venturing into Vermont (where their radio signals ultimately were detected) during the Vermont deer/bear season (not concurrent with the bear season in Massachusetts) was only 0.06 (versus six-day survival rates of >0.86 in Massachusetts during that state's hunting season) (Fuller 1993). It is not hard to imagine that the harvested marked bears actually were shot illegally in Massachusetts and then registered in Vermont shortly thereafter, thus accounting for the unbelievably low survival rate.

Bag limit variations also may affect reported harvest. During the mid-1980s, there was a noticeable increase in the number of fisher pelts tagged within Vermont, where there was no bag limit, after an adjacent state concurrently imposed a reduced bag limit (J. DiStephano personal communication: 1996). This scenario raises questions as to the reliability of some harvest data in assessing status of populations, particularly if methodologies for harvest data collection among adjacent states vary enough to preclude comparison. It also complicates any enforcement efforts because the identification of the harvest location is so difficult.

Research Considerations

Overall, most state natural resource agencies have objectives that are similar (to manage their wildlife resources sustainably), but often their priorities are different because of ecological circumstance (e.g., varied population status of some species) and concerns of constituencies (e.g., antihunting sentiment). However their priorities are determined, it always turns out that there is a lack of resources to do everything that they would like to do. As a consequence, managers often rely on research data from elsewhere to make decisions. This is certainly convenient, but reasonable only to the extent that such data can be extrapolated reliably to the prevailing conditions. Often, study sites are selected for convenience or to meet a political priority and, thus, not intended to be representative of even all locations within a state, much less locations in other states. In addition, studies have particular emphases, and even though the work may have been done on a species of interest, the objectives of the work (food habits versus density estimation) or even the methodology used in the work (track counts versus radiotelemetry) may result in information that is not very useful in other jurisdictions.

Opportunities for Cooperation

It has been common for management agencies to share information and techniques concerning season structure and length, harvests, and political concerns, but only recently have there been concerted efforts to coordinate collection of biological data over larger areas and apply those data in a uniform way. A furbearer working group, and black bear and small carnivore meetings and workshops, have significantly aided in contributing toward ecosystem approaches to management.

The first step in development of an ecosystem approach is for political jurisdictions to share information regarding common trust resources. The Northeast Association of Fish and Wildlife Resource Agencies has established separate technical committees for deer, furbearers, nongame wildlife and wild turkeys (*Meleagris gallopavo*) to advise the state agency directors on management issues common to the 13 states (Maine to Virginia) that comprise its membership. Similar groups exist in the midwestern and southeastern United States, and workshops that focus on bears occur in eastern and western North America. Annual or biannual meetings are held in order to share or coordinate regulatory approaches, management techniques, research efforts or findings, and biological data.

The Northeast Furbearer Resources Technical Committee has adopted a regional approach to assessing and prioritizing research, information and management needs. Using regional Federal Aid in Wildlife Restoration administrative funds, the Committee has addressed specific needs that were of broad concern (Chilleli et al. 1996, Muth et al. 1996, Organ et al. 1996). A subgroup of the Committee, in collaboration with the University of Massachusetts and the Wildlife Conservation Society, participated in a "mesocarnivore" workshop to identify and prioritize research needs for mid-sized carnivores that were of broad interest beyond particular political jurisdictions (Organ et al. 1997).

The ability of an individual state fish and wildlife agency to answer a research question can be enhanced greatly if other states are willing to collaborate. Limitations on number of study areas and duration often render results inapplicable beyond the immediate geographic area and time-frame of the study, and preclude true experimentation. Studies of the same species are sometimes conducted in different states at different times using different approaches (e.g., Crowley et al. 1991, Paragi et al. 1994). The ability to compare results and extrapolate findings beyond the time and place of the studies is hindered because of methodological differences. It is reminiscent of the story of the blind men who are each asked to describe an elephant: one is convinced that he is touching a pillar, another a snake, and yet another a brush with a flexible handle (Braudel 1993). Notable exceptions to this rule have surfaced recently. The Northeast Furbearer Resources Technical Committee commissioned a study to conduct interstate comparisons of river otter (*Lutra canadensis*) biological data and make recommendations on the kinds of data that should be collected and protocol for collection (Chilleli et al. 1996). Adoption of the procedures the authors identified will facilitate interstate comparisons. The Virginia Department of Game and Inland Fisheries and the West Virginia Wildlife Resources Section, with support from the National Wild Turkey Federation and USFWS regional Federal Aid administrative funds, collaborated on a study of the effects of fall hunting on wild turkey hen survival and productivity (Pollack et al. 1996). By working together and pooling resources, they were able to increase statistical power and evaluate the effects of a wider array of management regimes. As a result, the findings have broad application beyond the two states involved. Five states (Kentucky, Maryland, Ohio, Virginia and West Virginia) have recently initiated a cooperative study of the effects of late-season hunting on ruffed grouse (*Bonasa umbellus*) survival and recruitment. With the development of an experimental design encompassing 10 study areas over a broad geographic area, a long-term commitment and the ability to conduct true experimentation through cross-over manipulation of hunting among study areas, this effort may set the standard for future wildlife research.

Recommendations

Increased coordination in efforts to manage species on large scales will result in a more efficient, progressive and fruitful outcome. State fish and wildlife agencies should explore more opportunities to collaborate with their neighbors on shared research and management concerns. The long-term benefits of pooling limited resources will be manifested in cost efficiency and greater problem-solving ability through better science. In order to overcome legal and philosophical obstacles to interstate cooperative efforts, incentives should be developed. For example, Section 6 of the Endangered Species Act of 1973 provides for an increased reimbursement rate (90 versus 75 percent) of federal funds to states that engage in cooperative efforts. Similar incentives should be explored for the Federal Aid in Wildlife and Sport Fish Restoration Programs and the proposed Fish and Wildlife Diversity Enhancement Act, commonly referred to as Teaming With Wildlife. Fish and Wildlife Service regional Federal Aid administrative funds have been used to support research projects that have been identified and prioritized by a majority of states within a given region. These funds have been critical to the success of these studies because the scale and design requirements necessary for good science have made it difficult or impossible for states to finance them without additional support. Thus, this practice should be encouraged.

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Eastern Forestland Owners: Who's Buying What and Why?

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In the eastern United States, most forestland is privately owned (Powell et al. 1993). In general, private forestland is owned by individuals rather than a corporation, partnership, club or undivided estates (Birch 1996). Eastern private forestland owners are likely to be white-collar workers, blue-collar workers or retirees and only a small percentage are farmers. Of all private ownerships, more than half own fewer than 10 acres (4 ha) of forestland and nearly 90 percent own fewer than 50 acres (20 ha). Through parcelization of forested lands, the number of nonindustrial private forestland (NIPF) owners has increased over the past 20 years.

The previous is a glimpse of some of the findings in "Private Forest-land Owners of the United States, 1994," which was a joint effort between the research and the state and private branches of the USDA Forest Service and the National Association of State Foresters. It is the first such study since a national study of private forestland owners in 1978 (Birch et al. 1982). The 1994 study includes information on landowner motivations and management intentions, including timber harvesting behavior not covered by the earlier study. Most of the interest in the past centered on timber resources, but the contribution of private lands to the production of wildlife resources also has been recognized (Roth et al. 1983, Brooks and Birch 1986, 1988). This paper looks at eastern forestland owners: who's buying forestland and why, and what lies ahead in the dawn of the next century.

Data Collection

In 1992, the Forest Service estimated that 33 percent of the total land area of the United States was forestland (736.7 million acres: 298 million ha), and that forest area was essentially unchanged since 1977 (Powell et al. 1993). This paper uses an estimate of 8.8 million owners and 317 million acres (128 million ha) of private forestland in the eastern United States (Figure 1). The 1978 data on private ownership included here were gathered by the USDA Economic Research Service (Birch et al. 1982). The 1994 study was conducted by the Forest Service's Forest Inventory and Analysis projects in cooperation with the National Association of State Foresters and the USDA Natural Resources Conservation Service, in support of the Forest Stewardship Program of the State and Private Forestry branch of the Forest Service. For the 1994 study, questionnaires were mailed to 20,704 owners of 24,016 privately owned forested sample locations in 33 states (Figure 1). Responses from 10,410 ownerships that own 13,172 of these sample plots are included here (Birch 1996). The procedure for estimating the number of private forestland ownerships for this paper are included in the national study.

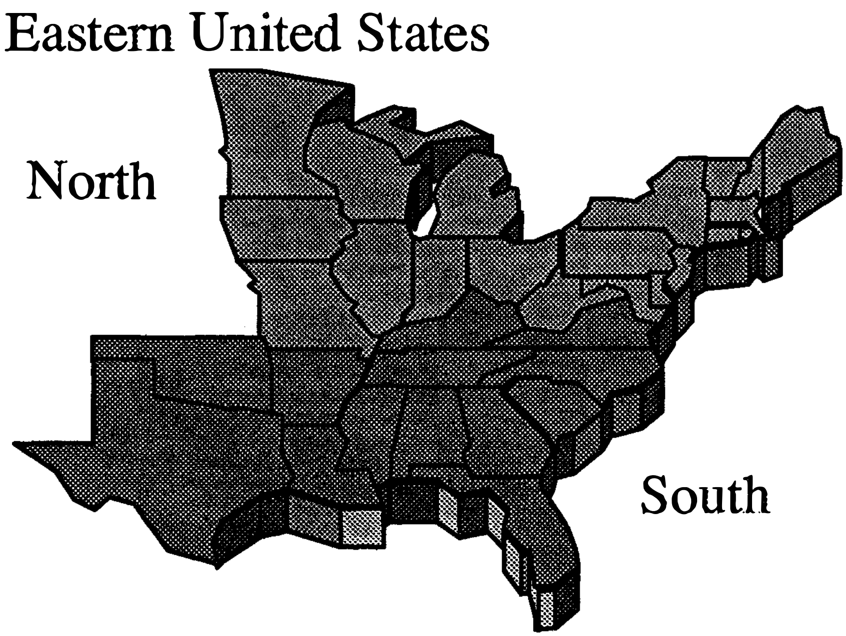

Figure 1. Eastern United States, northern and southern regions.

Private Forest Owners

There are 9.9 million private forestland owners in the United States, an increase of 2.1 million (28 percent) over the 7.8 million estimated in 1978. The North and South have, respectively, 3.9 and 4.9 million private owners with 130 and 188 million acres (52.6 and 76.1 million ha), respectively, of forestland. These owners are diverse in legal organization, personal characteristics, ownership objectives and management experience. About 95 percent of the private forest ownerships in the East are held by individuals, who collectively control 65 percent of the privately owned forestland (Figure 2). Corporations hold 25 percent and the remaining 10 percent is held by partnerships, undivided estates, clubs, associations and Native American tribes.

Ownership Size

The distribution of owners and acres by size class of ownership in the East has changed since 1978 (Figure 3). The number of private owners with fewer than 10 acres of forestland increased from 5.1 to 5.2 million. The acreage in this class increased from 10.1 to 14.6 million acres (4.1-5.9 million ha). The number of ownerships with 10 to 49 acres (4-20 ha) of forest increased from 1.1 million in 1978 to 2.5 million in 1994. The acreage in this class increased from 26.0 to 54.6 million acres (10.5-22.1 million ha). The number of owners with 50 to 99 acres (20-40 ha) of forest increased, as did the acreage owned in this class. Ownerships with more than 100 acres (40 ha) of forestland decreased from 569,000 in 1978 to 558,000 in 1994. The acreage of forestland in this class decreased from 219.3 to 205.5 million acres (88.8-83.2 million ha). There are distinct differences between the North and South.

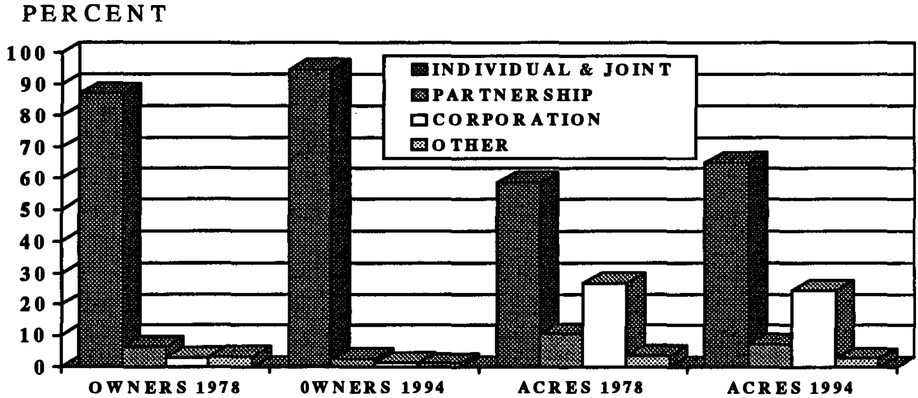

Figure 2. Distribution of private ownerships by form of ownership, eastern United States, 1978 and 1994.

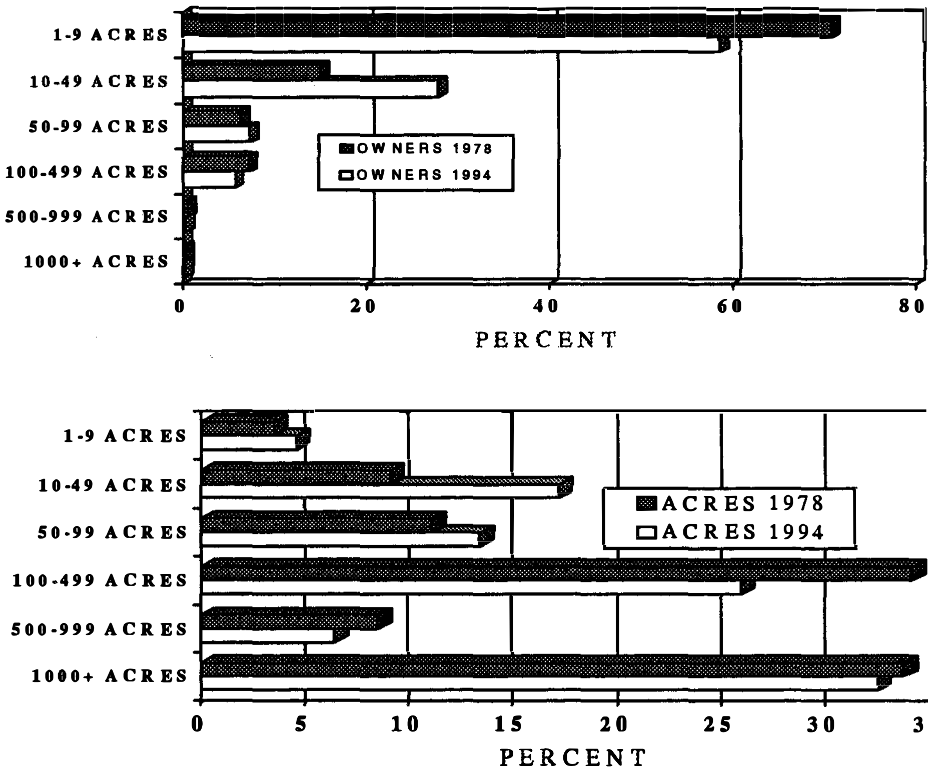

Figure 3. Distribution of private ownerships by size class of ownership, eastern United States, 1978 and 1994.

Forests in the North increased by 14 percent from 1978 to 1994; all of the increases occurred in ownership classes with fewer than 100 acres of forest. The largest increase was in ownerships with 10 to 49 acres, which increased by nearly 16.7 million acres (6.8 million ha). Ownerships with 50 to 99 acres increased by nearly 7.6 million acres (3.1 million ha), and those with fewer than 10 acres increased by 1.7 million acres (0.7 million ha). The area of forest in ownerships with more than 100 acres of forest decreased by 10.5 million acres (4.2 million ha).

Forestland in the South increased by 8 percent; much of this increase was the inclusion in 1994 of oak forests in western parts of Texas and Oklahoma. Forestland in ownerships smaller than 10 acres increased by 2.8 million acres (1.1 million ha). Nearly 12 million acres (4.5 million ha) were added in the 10- to 49-acre size class. Forestland ownerships of 50 to 99 acres increased by 3.1 million acres (1.3 million ha), from 1978 to 1994. Additional forestland in small tracts is coming from land in the 100- to 499-acre (40-202 ha) size class, which decreased by nearly 8 million acres (3.2 million ha), and from ownerships of 500 to 999 acres (202-404 ha), which declined by 1.4 million acres (0.6 million ha). By contrast, there was a net increase of 6 million acres (2.4 million ha) in forestland in ownerships with more than 1,000 acres.

The implications of these changing ownership patterns are significant. The increase in numbers of ownerships alone makes it difficult to communicate habitat management opportunities and activities such as forest stewardship programs. Also, each year there are many new owners resulting from land transfers. The use of mass media communications, especially the electronic media, is essential to convey this information (Birch and Pywell 1986). The reduction in tract size complicates management because forest management becomes less commercially viable. As the forest is subdivided into increasingly smaller parcels, the opportunity to use timber management to support habitat management is also less feasible. Large ownerships can support effective habitat management. By working with several individuals or industries, a manager can influence habitat quality on a large scale. What is lost when working with large ownerships exclusively is the development of a broad-based supportive constituency.

Some bird species depend on extensive forest areas for nesting (Whitcomb et al. 1981). For 38 bird species, many of them Neotropical migrant species, the predicted probability of occurrence increases as the area of contiguous forest increases (Robbins et al. 1989). However, most of the long-term bird census data were collected at sites in small parks, reserves or woodlots that are separated from expanses of forest by cropland or urban/suburban sprawl (Askins et al. 1990). Urban sprawl creates disturbance through road construction and the installation of utility lines, fragments forest cover and increases stocking with nonnative species (Zipperer 1993).

A review of recent studies in the Midwest lists the primary threats to breeding birds as habitat loss and fragmentation, which are closely related (Robinson 1996). Area-sensitive and forest-interior nesting birds are prone to reproductive failure in small, edge-dominated patches. Parasitism by cowbird (*Molothrus ater*) has been identified as the chief cause of this failure, though habitat disturbance by factors such as urbanization may be equally important. Habitat loss also has been severe in floodplain forest, grassland and savanna habitats. Fragmented areas may serve as population sinks for many species whose populations are maintained by the immigration from source populations in large unfragmented areas such as the upper Midwest. Conversely, the lack of natural disturbance in some areas may threaten some of the Midwest's highest priority species.

Data from ownership studies can provide a basis for evaluating forest fragmentation as a factor in the decline of breeding birds. For example, if 50 acres of forestland is assumed to be the norm for the veery (*Catharus fuscescens*) (Robbins et al. 1989), 69 million acres (27.9 million ha) of private forestland in the East would be classified as unsuitable for populations of that species, an increase of 36 million acres (14.6 million ha) of forest from 1978 to 1994. Some species flourish on the urban fringe. A study of population trends of the great horned owl (*Bubo virginianus*) and red-tailed hawk (*Buteo jamaicensis*) in Pennsylvania suggests that these two species have increased near urban land uses (Goodrich and Senner 1988).

Timber Harvesting Behavior

There is widespread experience with timber harvesting in the East and a positive attitude toward cutting timber in the future. About 47 percent of the private owners have harvesting experience (Figure 4). These owners control 77 percent of the private forestland. If forest habitat management is to have an extensive and significant impact, it will have to be associated with forest management for commercial wood products. While many private owners are not motivated primarily by economic gain to manage their forests, the opportunity to improve wildlife habitat through timber management no doubt will motivate some owners.

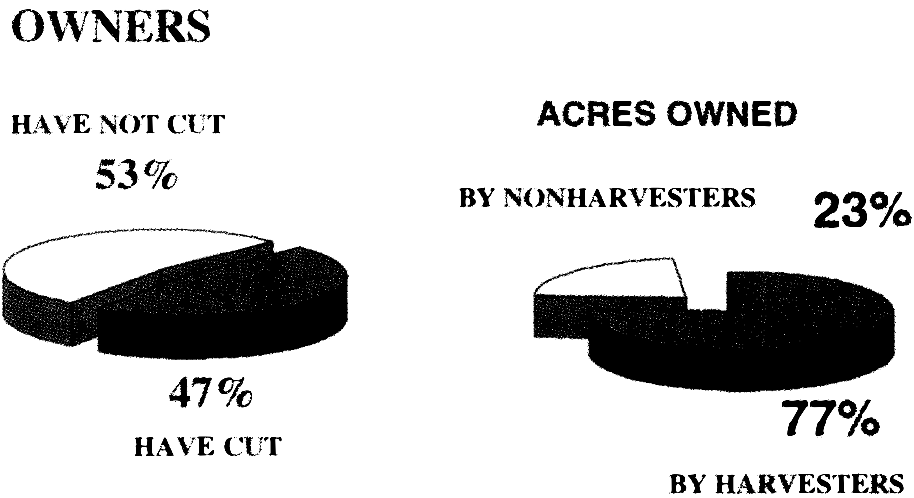

Figure 4. Harvest experience of private ownerships and acres of forestland, eastern United States, 1994.

Intermediate treatments such as thinnings open the forest canopy to allow the development of residual tree crowns. Increasing the crowns of oak, hickory and beech should result in increased mast production (Hassinger et al. 1979). Additionally, thinning of stands allows for the maintenance of an understory of herbaceous plants and shrubs, and tree regeneration. The decline of the shrub layer because of overstocking in the overstory has been listed as a potential factor in the decline of species that nest and forage in this layer. Examples include the American redstart (*Setophaga ruticilla*), Canada warbler (*Wilsonia canadensis*) and hooded warbler (*Wilsonia citrina*) (Askins and Philbrick 1987).

Private forestland owners intending to harvest in the next 10 years account for 32 percent of the owners and 61 percent of the private forestland (Figure 5). Conversely, 34 percent of the owners say they never intend to harvest; they hold only 12 percent of the private forest. The 28 percent of the owners with indefinite harvest plans control 26 percent of the private acreage. The remaining owners did not choose to answer the question on harvest intent. All of this activity is taking place when there is greater demand for products from the forests in the East (Powell et al. 1993).

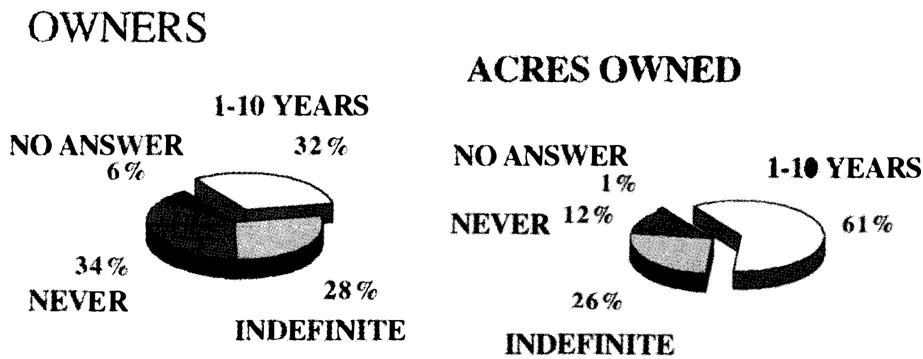

Figure 5. Harvest intentions of private ownerships and acres of forestland owned, eastern United States, 1994.

Land Tenure

The implications of changing land tenure is significant. Nearly 40 percent of the current owners acquired forestland for the first time since 1978 (Figure 6). These owners control 25 percent of the private forest in the East. The group with the largest decrease both in numbers of owners and acreage owned includes individuals who first acquired forestland between 1970 and 1977. By contrast, nearly 10 percent of the owners with more than 25 percent of the acreage acquired forestland before 1950.

The social and economic characteristics of private forestland owners and their objectives must be considered when developing management programs. Retired owners increased both in the proportion of owners and in the proportion of acreage owned (Figure 7). Many of these owners retired in the last decade and were from occupation groups including farmers and blue-collar workers, as opposed to individuals who purchased forestland upon retirement. Also, people are retiring earlier and living longer. Currently, 25 percent of all private ownerships are owned by individuals over 65 years of age. These owners control 26 percent of the private forestland in the East.

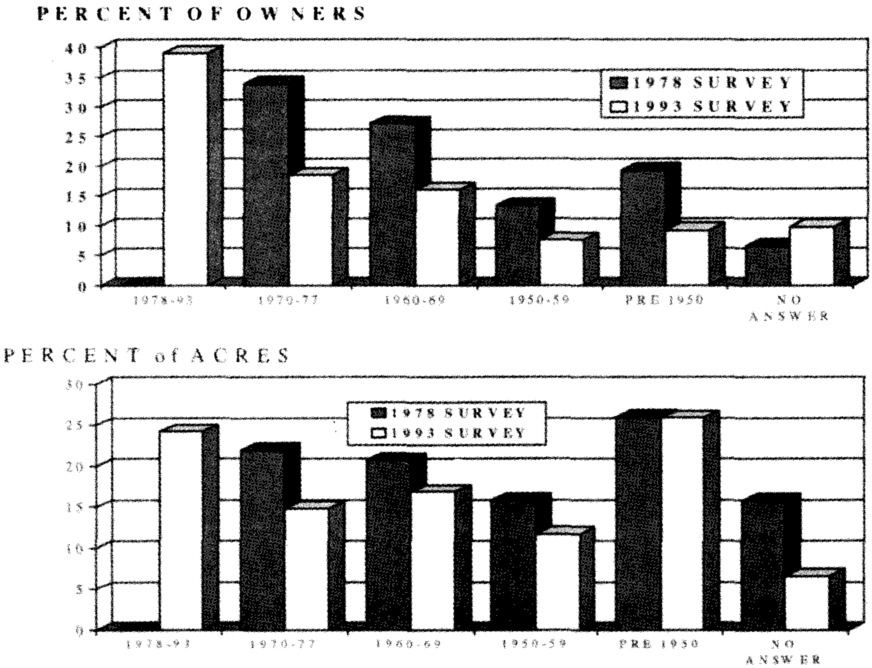

Figure 6. Distribution of private ownerships by year acquired, eastern U.S., 1978 and 1993.

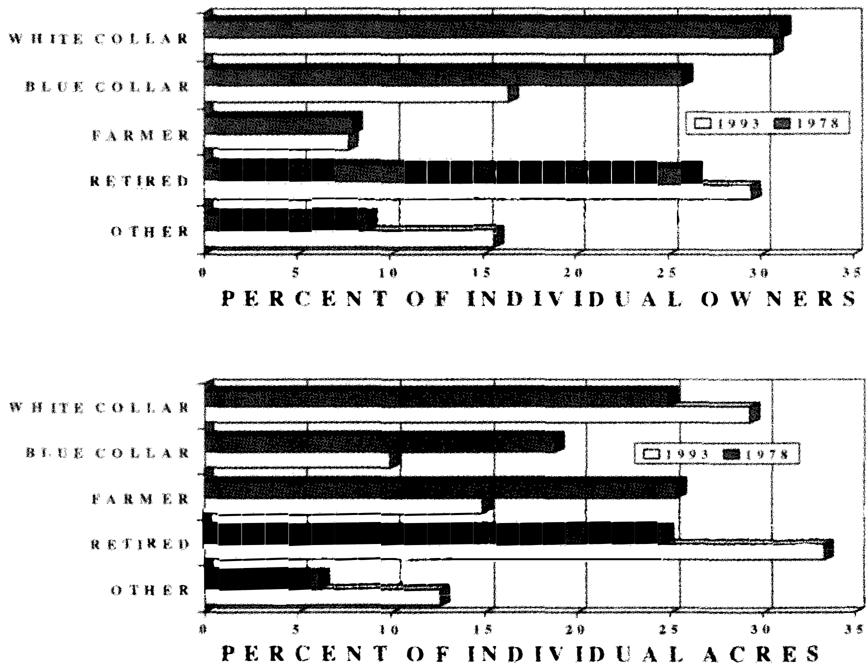

Figure 7. Distribution of individual ownerships by owner occupation, eastern U.S., 1978 and 1993.

Many retired owners and the families of owners over 65 years of age face serious tax problems with management and tenure implications (Peters et al. 1996). Increased stumpage values and the demand for forestland for nontimber uses create high prices for land and timber. When linked with federal and state death taxes, those higher values place a heavy financial burden on the heirs of current owners. Many estates may be forced to harvest timber prematurely or sell the land to pay the taxes between now and 2020.

Owner Objectives

Forests produce many benefits for their owners, so it is not surprising that people express diverse reasons for owning forestland. Many potential benefits are not competitive with each other; some are derived with little or no effect on others, and some even increase when another benefit is produced.

For nearly 40 percent of the private forestland owners in the East (Figure 8), the primary reason for owning forestland is that it is "part of the farm" or "part of the residence." These ownerships hold smaller than average-size tracts. Another 9 percent of the owners believe that farm or domestic use is the most important reason for owning forestland. Many of these owners consider their woods to be a source of fenceposts, fuelwood and similar products.

Recreation and aesthetic enjoyment are the primary reasons why 22 percent of the owners hold forestland. The area owned by people with these objectives represents 18 percent of the private forestland in the East.

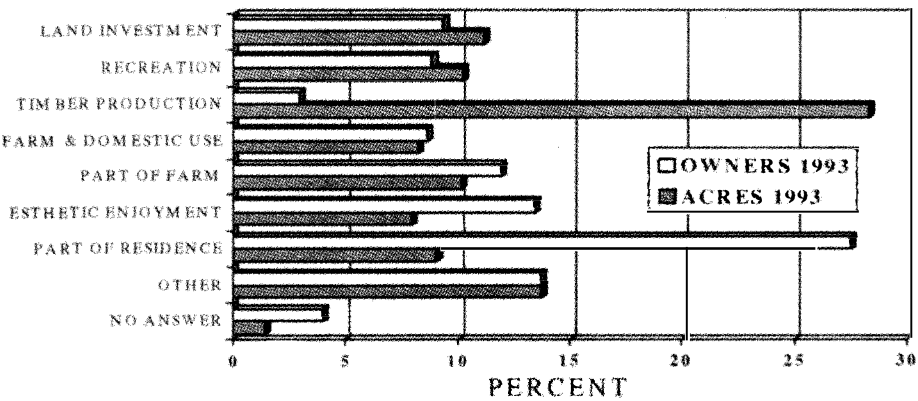

Figure 8. Distribution of private ownerships by primary reason for owning forestland, eastern United States, 1993.

Private ownerships that list land investment as the primary reason for owning account for 9 percent of the owners and 11 percent of the private forestland. Insurance companies and pension funds are a rapidly expanding group of large forestland owners. They are diversifying their portfolios by owning forestland and managing those lands intensively. Although intensive management is pervasive in the South, it also is gaining a foothold in the North.

Although only 3 percent of private forestland owners hold their land primarily for timber production, these owners control 28 percent of the private forestland. Forest industries with primary wood processing facilities own 60 percent of this acreage. Some owners hold forestland for the minerals under the surface. Many of these are included in the "other" category. Also in this category is forestland owned by Indian tribes as part of their cultural heritage.

Private forest owners currently have nearly total authority with respect to decisions affecting both marketed and nonmarketed commodities. However, new forces are becoming important to the decision process. Regulation of forest practices both at the state (Ellefson et al. 1996) and local level are having an impact (Floyd et al. 1996), and conservation easements to preserve critical habitats are producing new partnerships at the local level (Best and Wayburn 1996, Boelhower and Van Ryn 1996). Also, the Sustainable Forestry Initiative of the American Forest and Paper Association (AFPA) is defining its commitment to sustainable forestry (Cantrell 1996). Measures are being initiated so that the public can monitor industry's commitment to stewardship. AFPA will measure the performance of member companies as they set standards for industry and other private owners.

As a measure of management activity currently in place, only 5 percent of private forestland owners have some form of written management plan for their acreage (Figure 9). These plans cover 35 percent of the private forests in the East. Forest industry owns 43 percent of the forestland covered by written plans. The other 57 percent of the forest area is controlled by NIPF owners with some form of written plan.

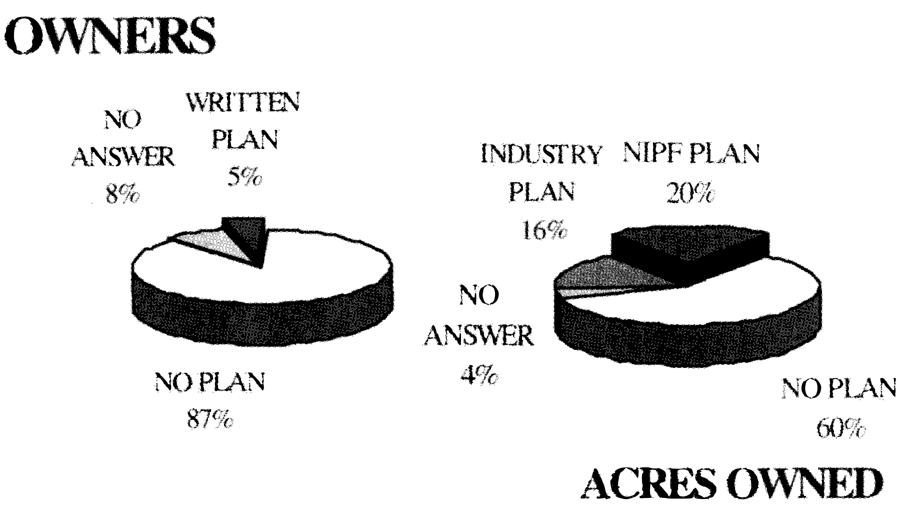

Figure 9. Distribution of private ownerships and acres of forestland owned by whether a written management plan had been prepared, eastern United States, 1994.

There is a strong relationship between size of ownership and having a written management plan (Figure 10). Ownerships with more than 5,000 acres (2,024 ha) of forestland is the only class where a majority of owners have a written plan. This group represents only 1 percent of the owners with a written plan, but nearly 60 percent of the area covered by written plans. Within the eastern United States, 64 percent of the written plans were for owners with 10 to 200 acres of forest, but these plans cover only 16 percent of the area covered by written plans. More than half of the written plans were prepared by the owner or by a state employee, such as a service forester or wildlife biologist. Plans prepared by consultants cover larger holdings than those prepared by public employees who are often limited as to how much time they can spend working on a particular ownership in any year.

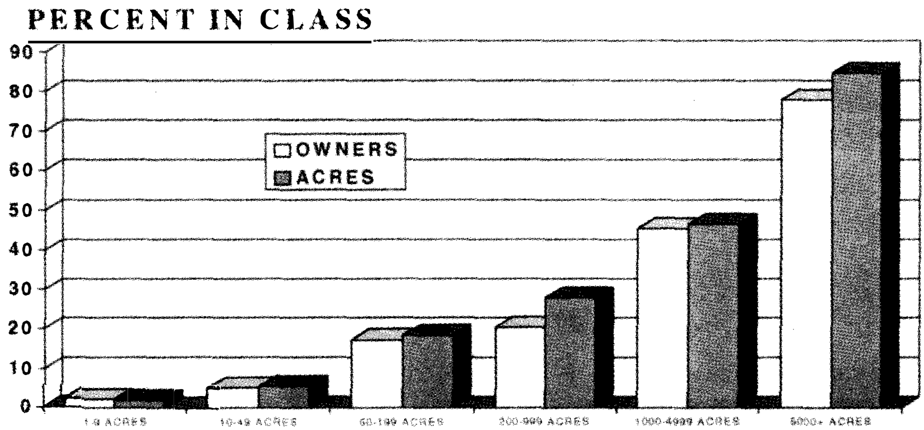

Figure 10. Distribution of private ownerships and acres of forestland owned by proportion with a written management plan and size class of ownership, eastern United States, 1994.

Discussion

Looking toward the first two decades of the next century, I see three major trends that will shape the forest resources of the eastern United States: (1) parcelization of forested lands; (2) rapid turnover of lands currently owned by white-collar workers, retirees and farm owners; and (3) public influence on the management of private forests.

Private ownerships of forestland in the East are projected to increase from 8.8 million to nearly 10 million by 2020. This increase will be in ownerships with fewer than 100 acres of forestland. The acreage in these ownerships will increase by 10 to 15 million acres and come from ownerships with 100 to 1,000 acres of forestland. Ownerships with more than 1,000 acres of forestland should remain constant or increase slightly (fewer than 1 million acres) as forest industries and other intensive-management firms consolidate their holdings as desirable properties come on the market.

By 2020, nearly 50 percent of the owners will be people who first acquired forest-lands after today. They are projected to control more than 25 percent of the forest resources. These owners will be younger, better educated and more affluent than the owners of today. Most will be in white-collar and service occupations, or be owners who will retire from their current line of work.

Public influence on the management of private forests will increase in many forms. Regulation of forest practices both at the state and local levels will become almost universal. Whether they take the form of "best management practices" or formal regulation depends on the importance of forests in the economic well-being of the particular state or locality. Voluntary programs, such as the Sustainable Forestry Initiative and the Forest Stewardship Program (which promote forest planning on private lands), will increase to the point where 60 percent of private forests in the East will be covered by some form of written plan.

The interaction of these three forces will call for the careful monitoring of this valuable resource. To meet this demand for forest inventory, there is increased interest in shorter inventory cycles. In the South, a five-year cycle is being advocated both by environmental groups and forest industry. In the North, similar interest has emerged. There also has been increased understanding that the owners of the resource play an important role in the management of the forest resources.

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Wildlife Habitat in a Computer: Integrating Wildlife with Other Resource Analyses

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Resource managers frequently are responsible for evaluating the potential effects of forest management activities on wildlife populations. Obtaining direct and reliable population estimates is inherently difficult and can be very expensive. In lieu of sampling populations, wildlife biologists frequently sample habitat with the basic assumption that habitat suitability is related to species fitness. Having high-quality information on species' habitat requirements is imperative to this process. This same information can be used to promote habitat for wildlife. If habitat requirements for a species are known, a land manager can prescribe treatments to provide those features.

Wildlife habitat includes compositional, structural and functional components that vary from land cover type and distance from open water to the presence of downed logs and density of the shrub layer. If the importance of each of these characteristics can be determined for a particular wildlife species or species group, then the likelihood of a specific area supporting a population of that species can be estimated. However, the sheer variety and number of important characteristics combined with the number of different wildlife species in a region make this task daunting. The computerized data structure can be used to obtain a list of wildlife species that corresponds to a set of habitat conditions, or to obtain a set of habitat conditions associated with a list of wildlife species. The results of a search can be stored and combined with other searches, resulting in answers to complex database queries. Making these queries easier to perform encourages resource managers to evaluate different management scenarios for their effects on wildlife.

In the "New England Wildlife" series (DeGraaf and Rudis 1986, DeGraaf et al. 1992), natural history and habitat information was compiled for inland (nonmarine) wildlife of New England. Species habitat information is presented through a forest management-related classification system. This information can aid foresters and forest wildlife biologists in assessing the potential effects of proposed habitat management practices on wildlife species. It also can help land managers develop and evaluate alternative resource management plans.

NEWILD

NEWILD is a computer program designed to assist in access to and evaluation of information on species/habitat relationships for 338 vertebrate species in New

England. This program was developed on the basis of publications by DeGraaf and Rudis (1986) and DeGraaf et al. (1992) that describe the habitat conditions used or preferred by the birds, mammals, reptiles and amphibians of New England. Some of the text from the publications has been incorporated into the Help portion of NEWILD. A user can provide NEWILD with a description of habitat conditions and learn what species are likely to use the area, or have the program identify the habitat preferences of a particular species of interest.

Origin

The DeGraaf publications represent the most comprehensive information on wildlife habitats available for the northeastern United States. At their heart are matrices relating individual wildlife species to habitat features. The matrices will be used as the basis for the wildlife portion of NED, a decision-support system for forest management in the Northeast (Twery 1994).

A computerized data structure was designed to incorporate the DeGraaf matrices into NED, and quality-control software was developed to ensure that the information was correctly transferred. This software was particularly helpful in extracting information from the matrices, allowing access from either species to habitat or habitat to species. The user interface had a simple one-screen design with controls that were intuitive and easy to use. Minor modifications and the addition of a hypertext Help system resulted in a stand-alone product, NEWILD.

Description

Interface. The NEWILD interface is built around one screen that shows a list of species on the left and a variety of habitat characteristics on the right. (Figure 1). Through a series of point-and-click commands, users can identify a species or habitat of interest, search the appropriate matrix, and accumulate information on the links between species and habitat preferences.

Wildlife species. Each wildlife species in NEWILD has a corresponding page in the program's Help system containing information on life history (Figure 2). This information is an abbreviated form of the text in DeGraaf and Rudis (1986). Users are referred to that and other references for detailed information.

Limitations

The "New England Wildlife" publications are the source of the information in NEWILD. When describing how to apply the information, DeGraaf et al. (1992) state:

> "The information can be used for considering the potential responses of amphibians, reptiles, birds, and mammals to habitat alterations through forest management in New England. We stress the word potential. There is no substitute for sound field work and judgment in assessing the impacts of a specific project or

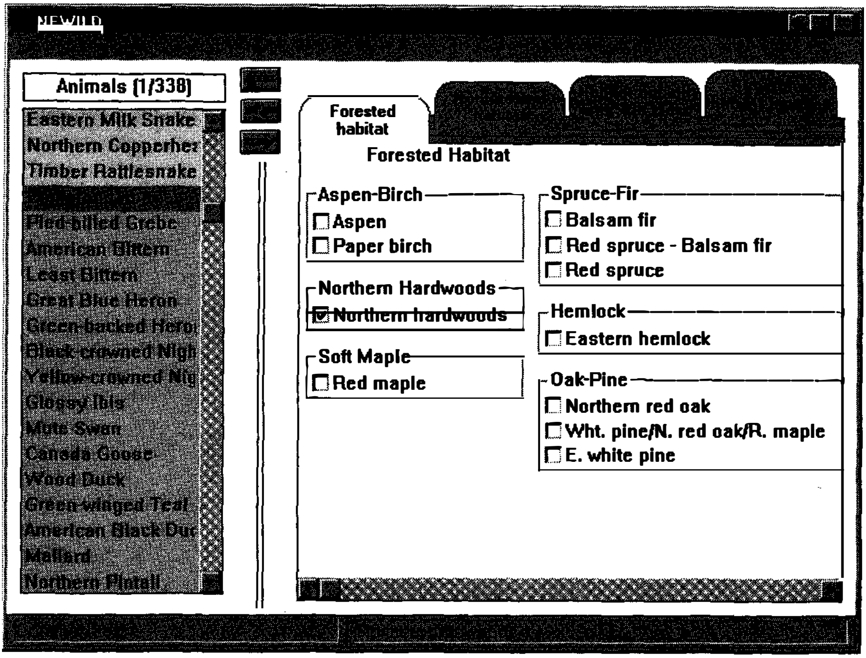

Figure 1. NEWILD main screen showing species list, forested habitats, search arrows and menus.

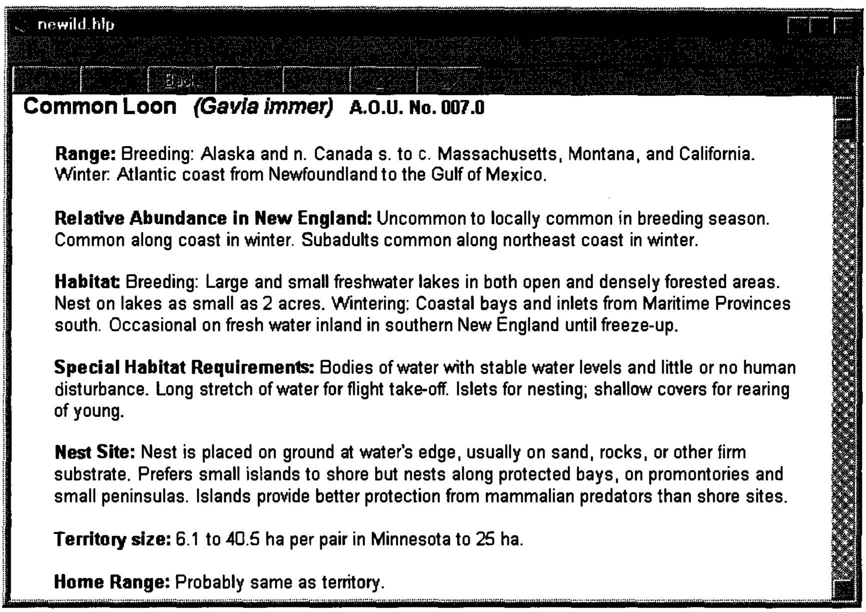

Figure 2. NEWILD help screen showing information available on individual wildlife species.

proposed management action. From a research standpoint, the habitat associations provided here are essentially a set of hypotheses that can and should be tested further. The information in this publication is most useful for land management and project planning; the larger the unit considered, the more accurately the species occurrence can be predicted. Large areas will likely contain more of the special habitat requirements, more edges due to the interspersion of habitats, and more successional stages, hence more species. Conversely, the smaller (more site-specific) an area, the less accurate will be assumptions or predictions of species occurrence, and the greater the need for biological experience and detailed field work."

When describing the accuracy of the information the authors state:

"The publication must be considered the beginning effort to assemble the natural history and habitat associations to enable sound management of New England wildlife. The data base needs to be expanded to other nonforested habitats, and entries need to be field-checked to improve accuracy. The limitations of the information point up some cautions:

- This publication is not a substitute for professional field work, nor for thoroughly checking each site proposed for management. At the very least, managers need field information on the special habitat requirements present or lacking on each site proposed for management.
- This publication lists the species potentially occurring in a given habitat. More are listed than will likely occur—the smaller the site, the fewer the species that will actually occur of those potentially able to occur. Factors other than habitat features affect a given species occurrence on a given area. This effect diminishes with increasing area of consideration. Still, several site visits will be required to determine whether a given species actually occurs on a given site.
- No information is included on habitat size. The best clue to help determine whether a given species will occur, after checking whether its special habitat requirements are present, is to compare its territory or home-range size with that of the proposed project. No detailed information, therefore, is provided here on how many of a given species will occur on a given area. Merely dividing the project area by the territory/home range area of a species is not recommended, because not all parts of the area will be occupied, and density will be overestimated. For an elaboration on these cautionary notes, see Verner and Boss (1980). We have provided sample densities when such information was reported. Note localities when consulting these entries."

Uses of NEWILD

Generate species list by habitat. Resource managers often are asked to identify the types of wildlife that may be present on a particular property. Full field surveys usually are impractical and too expensive for the initial, general inquiry about such resources. NEWILD is designed to provide help in identifying the range of wildlife that may be present. If clients are interested in further detail regarding actual species presence, then field work will be required.

Identify habitat characteristics for species. Individual species use various habitats for a variety of purposes. While some conditions are necessary for breeding, others may be preferred for feeding or in the nonbreeding seasons. NEWILD is a clear, concise source of general references detailing the habitat requirements for species of interest.

Generate research ideas. Attempts to summarize and synthesize research information into management guidelines inevitably lead to identification of areas in which the scientist is less than fully confident of the results. This is also true of wildlife habitat evaluation. The most common problem associated with encompassing models like the "New England Wildlife" series is that more is known about some species than others. The information presented ranges from expert opinion to actual tests of scientific hypotheses. The "New England Wildlife" series represents available information, and efforts should be made to fill in the gaps and field test the model.

Another area that needs to be addressed is wildlife habitat requirements across spatial scales. Resource selection by wildlife occurs in a spatially hierarchical fashion, from the geographic range of a species to regional and local populations, to individual home ranges, and finally specific elements within a home range (Manly et al. 1993). To be effective at evaluating management activities and promoting wildlife habitat, land managers must understand species habitat requirements on all spatial scales. Few research efforts have focused on the larger scales. Instead, most focus on the home range and within-home range levels. An accurate understanding of habitat requirements across scales is critical to evaluating cumulative effects of forest management activities. Research should be conducted to evaluate the requirements on all scales.

Integrating wildlife with other resources. The information from NEWILD can be used to integrate wildlife habitat management with management for other resources. We are accomplishing this through a larger software development process known as NED, a collection of software tools created to help resource managers develop goals, assess current and future conditions, and produce management plans for forests in the eastern United States.

NED

Overview

Natural resource management is a social activity in which people interact with ecological processes to fulfill social goals. Some of these goals are related to ecosystem functions, forest products, community vitality, recreational activities, aesthetic and spiritual values and experiences, and cultural and historical values. Managing wildlife habitats and populations can be a part of all these goals. Sometimes these social goals are those of an individual landowner, and sometimes they are interpreted by public land managers for society as a whole. In general, the goals must be defined before appropriate actions can be determined. It is from this premise that NED focuses on goal definition as the organizing principle of analysis and management recommendations.

NED includes a long-term, landscape-level view of the forest as an interconnected ecosystem. The analysis is based on the user's selection of management objectives, or goals, for any or all of five resources: visual quality, wildlife, water, wood production and general ecological objectives.

NED development is coordinated by the USDA Forest Service Northeastern Station's research unit on integrating the ecological and social dimensions of ecosystem management in Burlington, Vermont, in cooperation with other research units at the Northeastern, North Central and Southern research stations. Many state and educational institutions also are working with the Forest Service on this project. Thus, as the geographical scope of the project expanded, the software originally known as the Northeast Decision Model lost the regional reference in its name and became simply NED. NED software, including NEWILD, can be downloaded from the Internet at http://www.fsl.uvm.edu.

Component Development

Committees of experts in each of the specific resources have defined the conditions (desired future conditions) necessary to meet specified goals, and have determined common variables to allow consistent evaluation of the conditions across goals. Integrated evaluation is a key element in the process of determining acceptable prescriptions and evaluating whether different alternative actions across the entire area will meet the desired conditions.

To collect the information needed for an integrated multiple-resource system, we organized committees of 8 to 20 experienced professionals in a particular discipline, such as silviculture, wildlife management or visual resources. Each committee includes a mix of research scientists and practitioners. The coordinators of the NED project participate in all meetings. Within each committee, a series of meetings and correspondences leads to the definition of potential desirable goals for that particular resource, plus a description of the conditions necessary to achieve each goal.

"The Forest Stewardship Planning Guide" (Alban et al. 1995) is a program designed to provide people with exposure to and explanations of a wide range of practices used to produce a variety of benefits from forests. The first step is to determine the landowner's goals for the forest. The program runs under Microsoft Windows and guides the user through a process of selecting forest stewardship goals. It offers basic information about forests and their management and includes menus of possible stewardship goals. This program makes limited recommendations on managing a forest for specific goals and describes the conditions that must be created or enhanced to accomplish them. A companion program, Stewplan, will be issued with the second version.

Stewplan is a form-generating program that will facilitate the drafting of standard Forest Stewardship Plans.

NED/SIPS (Simpson et al. 1995) is an initial product of the development of NED. The computer program, subtitled Stand Inventory Processor and Simulator (SIPS), provides a means of creating, managing and analyzing forest-inventory records at the stand level. Its user-friendly interface simplifies entering and editing stand-inventory data. Once entered, many analytical tools are available to help users understand the data. A variety of reports can be generated that describe the vegetation structure, timber value and economics of the stand. Users can apply any of a set of standard treatments to the stand or design a customized cutting scheme, and use one of the four incorporated stand-growth simulators to show what the stand may look like in the future. The NED/SIPS interface features pull-down menus and context-sensitive help, access to four growth-and-yield simulators using the same data file format (NE TWIGS, SILVAH, OAKSIM and FIBER), overstory summary tables for common measures of stand characteristics (such as density, species composition and volume), and economic analyses of incomes and expenses over the planning horizon.

Integrating wildlife with other resources. NED's data requirements are extensive, largely due to the comprehensive and flexible design of the program. Although some of NED's features operate with little more than tallies of species and diameter, many more cannot. Understory conditions are critical to both wildlife habitat and visual characteristics, and drive the need for additional data beyond traditional, timber-oriented stand exams. Although estimates may be made of size and density of understory plants or down woody material based on an overstory estimate, the mixed forests of the eastern United States are extremely variable, and reliable models predicting such variables are not available.

The complete input data needs for NED include variables at the management unit, stand within management unit and plot within stand levels. Plot-level tallies are required for midstory and overstory trees (greater than 10 feet tall), the shrub layer (woody vegetation between 3 and 10 feet) and ground-level vegetation (less than 3 feet). In addition, several variables important to wildlife and visual qualities are collected between plots, including, for example, down woody material and subterranean habitat.

Often, managers prefer to minimize forest inventory efforts because of the great expense of taking field data. Many variables can be entered by a user at a summary level, avoiding the need for a new, detailed inventory, but such practices will undoubtedly reduce reliability. Similarly, if a manager has many similar forest stands and chooses to inventory one and assume that others are just like that one, an analysis can be developed, but its reliability will be only as good as the data.

Characteristics of vegetation often are described using different size classes and summarization techniques depending on management objectives. The development of an integrated program such as NED, which uses the same data sets to evaluate vegetation for habitat, wood production, water production and visual quality, requires standardization of measurement to avoid duplication and confusion.

Evaluations

Potential species evaluations. NED will include three types of analyses to evaluate wildlife habitat for a management area. The user can:

- select a species of interest and determine which of its required or desired conditions are met and, thus, the likelihood of its presence;
- request a report evaluating the existing conditions within the management unit and describing which of the many possible wildlife species have their habitat requirements met within the area; and
- request an evaluation of existing conditions within the management unit and receive a report describing conditions likely to increase species richness and how those requirements are met within the area.

Trade-offs. Particular species of wildlife require specific sets of conditions within an area for that area to be considered suitable habitat. Very often, multiple conditions are required for different parts of an animal's habitat, such as hiding cover and foraging territory. Different animals have differing requirements and so may or may not be able to use the same territory. As a result, designing management strategies and actions to provide wildlife habitat is complicated when a landowner expresses a desire to manage for more than one species. When management objectives include other resources, such as timber or visual quality, the potential variety of conditions needed to meet those objectives is multiplied. Evaluation of multiple objectives is one of the key elements that NED addresses by presenting a matrix of objectives identified by a user and identifying which objectives are compatible with each other and which are feasible given the existing conditions on the property in question.

Analyzing alternatives. Through the use of NED or other decision-support programs, users can analyze different alternatives without actually implementing them. This ability to test the results of actions by simulating them and examining the changes in outcomes is an important and useful role of a decision-support system. An open process in which the public can explore the assumptions behind recommended actions and experiment with new and different proposed actions can provide great benefit for the planning process for public land.

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Act 250—Vermont's Land Use Development and Control Statute: A Tool for the Effective Management of an Eastern Forest

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Forested land in Vermont, New Hampshire, New York and Maine is a persuasive example of the resiliency of nature in the face of direct interference—or at best, human indifference to nature's relentless course. The apparent recovery of northeastern forests is a delightful surprise to many. State and local governments in the region have historically done little to prevent large-scale forest clearing and fragmentation, and in some cases have actually promoted it. Despite this, and with only minimal efforts to actively promote reforestation, trees are returning at a steady pace. Along with the emergence of the true landscape comes an opportunity to plan for and properly steward the region's expanding forest resource. It would be an overstatement, however, to suggest that there is a consensus about the ecological health of northeastern forests. In a 1993 forum of the Northern Forest Lands Council (NFLC) addressing biodiversity, Ranier Brocke of SUNY Syracuse stated that, "there is good news in the Northeast!"; while a colleague from the University of Maine, Malcom Hunter, maintained at the same session that biodiversity was "poor and declining" (Trombulak 1995: 284).

Writer Bill McKibben (1995: 15), who resides in the Adirondacks, nevertheless cites the resurgence of eastern forests as a cause for hope:

> "Our woods will never again be forest primeval: they will forever be affected by our economies and habits, by our care or carelessness. Wilderness—in its truest sense, of places totally separated from human influence—is extinguished, here as everywhere else. But I'm done mourning. Innocence gone, we need to work wisely to build societies that allow natural recovery, that let the rest of creation begin, however tentatively, to flourish once more. And we need to do it quickly, for the recovery even of the East is tentative and uncertain. Every kind of human threat imperils this new nature, as we shall soon see. For the moment, though, I want this region to stand for the most bottom-line kind of hope; as I tell its story, imagine what could happen to your own place, wherever it is, if people backed off a little."

McKibben's optimism is encouraging. Although, it appears that without a good reason to do so, people will not back off at all. As both history and biology prove, people will keep coming and they will keep pushing. Still, hope is critical to one's vision of eastern forests. Hope is what enables an image of the healthy, sustainable forest to emerge through views of fragmented, overcut islands of trees. It is, after all, the healthy forest—not just trees—that should be enthusiastically welcomed to return to the American East.

Act 250, Vermont's Land Use and Development Control Law, sets out a regulatory framework through which nine District Commissions and a state Environmental Board (Board) review the impacts of certain development and subdivision proposals.[1] Where these proposals conform with applicable health and safety regulations and with the 10 criteria of Act 250, the projects are granted a permit. Often, however, proposed projects jeopardize certain values sought to be protected by the Act. In those cases, the District Commissions, or the Board on appeal, require land developers to "back off a little." Frequently, this is done through the imposition of permit conditions that mitigate a project's impacts. Rarely is a permit denied outright. In a conversation with the Board's Director of Administration, he confirmed that over the past 20 years an average of 2 percent of applications have been denied (Michael Zahner personal communication: 1997). Although it does not directly manage forest practices in Vermont, Act 250 is a powerful tool for the effective management of Vermont's forests, and could serve as a model for other states throughout the East.

Northeastern Forests: A Broader Look at the Northern Forest Region

The NFLC attempted to define the geographic parameters for its research, data collection and analysis that would eventually lead to its 37 recommendations to the U.S. Congress regarding the "Northern Forest Lands" (NFLC 1994). In so doing, it established a laudable precedent by not limiting the scope of its inquiry and subsequent recommendations to a region that had been previously delineated by political boundaries. Rather, the NFLC attempted an ecosystem-wide assessment. The short time that has elapsed since the NFLC began its study has in many respects, however, prohibited the adequate collection of data relative to that specifically defined area.

The scientific literature and public policy research conducted in this region as a result of the NFLC's public hearings and recommendations has been exceedingly valuable for biologists, foresters, land managers and the public. Notwithstanding, much of the data on land ownership patterns, land transactions, economic data and forest health continue to be indexed by state and are therefore not easily reducible to the "northern forest" region (Trombulak 1994). This paper focuses on northeastern forests. The term is intended to be inclusive of all those forested lands within the states of Vermont, New Hampshire, New York and Maine. The concerns regarding forest conversion, fragmentation and habitat destruction are similar among these states. Also similar are the land ownership patterns and the trends in industrial forestry.

The forest management concerns in Vermont are comparable to those in other states throughout the East. The discussion of Act 250 and its application, however, is necessarily limited to Vermont. Thus, most citations are to Vermont laws and policies. Although proposed as a model for other eastern states to follow, Act 250 is very much a localized response to the impacts of growth and development. Nonetheless, it

[1]*See* 10 V.S.A. §§6001-6092 and the Environmental Board Rules for specific definitions of "development" and "subdivision," among other legally significant terms. For a detailed overview of Act 250, as well as the roughly 25 years of legal precedent which it has spawned, see Brooks 1996.

could be well-suited for rural areas of the American East characterized by low population densities and a significant percentage of forested and agricultural lands. In the Northeast, this would include New Hampshire, Maine, the northern portion of New York, and perhaps the western parts of Connecticut and Massachusetts.

Toward ecosystem management. Ideally, northeastern forests and other cognizable terrestrial biomes, or "bioregions," will be managed by cooperative enterprises including state, local and federal governmental entities, as well as private citizen groups and coalitions. Such cooperation has been effective in addressing transboundary water resource management issues. A recent example involved the eight Great Lakes states, the province of Ontario, the environmental community, academia, industry, municipalities, and Environmental Protection Agency (EPA) regional and national offices. The integration of collaborative decision making and an ecosystem management approach resulted in EPA's promulgation of Final Water Quality Guidance for the Great Lakes System (EPA 1996). Indeed, the water resource analogy may be particularly apt to ecosystem management issues in the northeastern forest region which one commentator has described as a "river" of biodiversity (Breckenridge 1995).

Act 250: Overview

Act 250—so-called because it was the 250th legislative enactment in 1969—has been implemented in Vermont to review the impacts of the development and subdivision of lands that meet certain jurisdictional thresholds.[2] The administration of the Act is distributed among nine District Environmental Commissions throughout Vermont and a nine-member Environmental Board located in Montpelier. The governor appoints three citizens from each district to serve on the Commission. The governor also appoints the nine citizen Environmental Board members who hear appeals from District Commission decisions, as well as petitions for revocation of permits. Board and Commission members act as volunteers, receiving only nominal compensation for their often exhaustive efforts. Only the Board's Chairman is a full-time, salaried state employee.

Once jurisdiction is asserted by the Coordinator, the applicant must prove to the Commission, in a relatively informal hearing, that the proposed project complies with any applicable health and safety regulations and the criteria of Act 250. Evidence and testimony are often presented by adjoining landowners and statutory parties, typically with particular concerns about potential project impacts. If the project is permitted,

[2]A Jurisdictional Opinion (JO) is made in the first instance by staff members of the District Commissions known as District Coordinators. The JO is based primarily on the assessment of the proposed project type and the amount of acreage involved. If a town plan, as well as subdivision and zoning bylaws, have been duly adopted by the town in which the project is proposed, the minimum acreage required to assert jurisdiction is 10 acres (4.05 ha); if those local planning devices have not been adopted, a project on a tract greater than 1 acre (.405 ha) may be subject to jurisdiction. (Towns may specifically elect to have jurisdiction apply for all projects which comprise greater than 1 acre of involved land; however, most do not so elect.) The JO may be appealed to the Environmental Board.

the Commission, or the Board on appeal, will issue a land-use permit, or an amendment to an existing permit. The permit, with appropriate conditions attached, is then recorded in the land records of the town in which the project is located. Any exhibits that were admitted into evidence and marked "approved" are also binding upon the permittee. Once issued, the permit runs with the land.

Several commentators have attributed the effectiveness of Act 250 to its unique delegation of legal authority. Former EPA Administrator, Doug Costle, praised the process in the following manner:

> "While some would argue that there's a faster way to run a permit process, few would say there is necessarily a better way. Any sluggishness in the process is outweighed by the benefits of having laypeople make decisions within a decentralized system. Like democracy itself, the process often appears inefficient, but how many of us would be willing to trade it for something else?" (Argentine 1993: vi-vii).

The Board recognizes the need to balance centralized authority against a strong Vermont tradition of local control and decision making, and is thus careful not to assume too much control over the Commissions (Kaplan 1981). In addition, the Board continues to refine the balance between deference to the autonomy of local governments (as expressed in local plans) and the overarching resource protection compelled by statute.[3] The program is strengthened by its administration through local, lay citizen decision makers. It is further strengthened by the liberal party status rules that establish the foundation for highly participatory public hearings.[4]

Particularly concerning issues of intergenerational equity and resource sustainability, the empowerment and significant involvement of local citizens are essential. Long-term protection of large areas, such as those that comprise northeastern forests, will not succeed without the favor of local people. The people need to have an economic stake in resource protection and they must understand that stake (Gell-Mann 1994). This is particularly true in northeastern forests where most of the land is held in private ownership. Ridley and Low (1993) maintain that to be effective, a regulatory scheme that involves citizen participation must function in a community that is small, stable, communicating and has a strong concern for the future. These characteristics are prevalent in Vermont, and seem prevalent in other states within the Northeast.

Who Needs an Act 250 Permit?

An Act 250 permit is required only for those projects that meet the statutory definition of development or subdivision. In order to trigger jurisdiction as a development, a project's involved land must exceed a minimum acreage amount (*see* footnote

[3]See *Re: The Mirkwood Group and Barry Randall*, Application #1R0780-EB, Findings of Fact, Conclusions of Law, and Order (August 19, 1996) at pp. 25-32; and *James E. Hand and John R. Hand d/b/a Hand Motors et al.*, Land Use Permit #8B0444-6-EB, Findings of Fact, Conclusions of Law, and Order at pp. 29-36.

[4]For a concise overview of standing and party status issues in the Act 250 process see Healey 1977, Environmental Board Rule (EBR) 14.

[2]). Projects that pre-existed the enactment of the statute in 1970 are grandfathered unless alterations substantially change the project.[5] A subdivision only triggers jurisdiction if 10 or more lots are created within a 5-mile (8.05 km) radius from any point on the involved land within any continuous period of five years after April 4, 1970 (*see* EBR 2[B]).

The exemptions for silviculture and agriculture. Act 250, insofar as it relates to silvicultural and logging activity, specifically exempts from review all such activity that occurs below 2,500 feet (762 m) unless it is performed in conjunction with an activity that is determined to be either a subdivision or a development (e.g. road building, creation of ski trails or lifts, land clearing, etc.).[6] Forests above 2,500 feet (762 m) exist under extreme growing conditions characterized by low-fertility soils, harsh climate, shortened growing seasons and increased exposure to airborne pollutants. Accordingly, Act 250 jurisdiction is triggered for logging activity that is conducted in these high-elevation forests.

As contrasted with broadly applicable forest practice laws, Act 250 may more appropriately be characterized as an indirect mechanism with which to manage northeastern forests in Vermont. This does not compromise its effectiveness as a tool to manage eastern forests. Industrial and commercial developments, and residential subdivisions are most closely scrutinized through Act 250 because these land uses most indelibly affect the character of the land resource. Once approved and constructed, developments usually remain forever affixed to the landscape.[7] Likewise, once land is subdivided it remains so. One cannot unring the bell.

An Integrated Approach: Planning and Case-by-case Review

When it enacted Act 250, the legislature intended to ensure that the only uses of land that would be permitted would be those which are not unduly detrimental to the environment, and which promote the general welfare through orderly growth and development and are suitable to the demands and needs of the people of Vermont.[8] To

[5]These are, of course, generalizations. Certain other scenarios may also require a land-use permit or a permit amendment.

[6]Thus, where a quarry operator clearcut 30 acres, and where he had already secured local approval for the quarrying operation, the Board found that the "logging" was commencement of construction on the quarry, and a permit was required. See *J.P. Carrara & Sons*, Memorandum of Decision and Order, #1R0589 (April 3, 1987) and Findings of Fact, Conclusions of Law, and Order, #1R0589. A particularly difficult area to regulate and the most flagrant abuse of the logging exemption is the logging of land prior to an applicant's formal proposal of a subdivision. See *Lawrence and Darlene McDonough*, Memorandum of Decision and Dismissal Order, Declaratory Ruling #306 (December 22, 1995); Advisory Opinion #2-94 (April 19, 1994) and Addendum (September 12, 1994).

[7]Land-use permits, though comprehensive in most respects, do not typically require that a commercial or industrial structure be removed after a continuous period of abandonment, although to do so would not seem to contradict the purposes of the Act.

[8]Act 250 Findings and Declaration of Intent, 1969, No. 250 (Adj. Sess.), §1, eff. April 4, 1970; codified at 10 V.S.A. §§ 6001-6092 (as amended).

bring about this result, the legislature set forth the statutory framework for a two-tiered approach. To ensure that particular development proposals were not unduly detrimental to the environment, it set out criteria against which to judge a proposed project's potential impacts. To promote orderly growth and development it acknowledged the importance of planning and called for both a state land-use plan, and a capability and development plan.

The 10 criteria. Act 250 promotes more sustainable communities. Specifically, it requires an applicant to demonstrate compliance with broadly stated principles of sustainability which are codified in statute as 10 distinct criteria.[9] The livelihood of a logger or farmer depends heavily on the potential of the land used for production to replenish itself. Many persons, including commercial and industrial operators and developers of residential subdivisions, do not share this dependency.[10] Accordingly, few seem to have an economic incentive to establish a relationship with or cultivate a respect for the unique values and functions of the land. In requiring compliance with the criteria, Act 250 forces enterprises that typically are concerned primarily with economic efficiency to contemplate sustainability beyond the horizons of their amortization tables. The end result is more sound development and, typically, a more stable investment. The broader benefit to the people of Vermont is an improved quality of life (Bolduc et al. 1995). The criteria are as follows:

(1) Will not result in undue water or air pollution.
  (A) Headwaters.
  (B) Waste disposal.
  (C) Water conservation.
  (D) Floodways.
  (E) Streams.
  (F) Shorelines.
  (G) Wetlands.
(2) Does have sufficient water available for the reasonably foreseeable needs of the subdivision or development.
(3) Will not cause an unreasonable burden on an existing water supply, if one is to be utilized.
(4) Will not cause unreasonable soil erosion or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result.
(5) Will not cause unreasonable congestion or unsafe conditions with respect to use of the highways, waterways, railways, airports and airways, and other means of transportation existing or proposed.
(6) Will not cause an unreasonable burden on the ability of a municipality to provide educational services.

[9]*See* 10 V.S.A. §6086 (a); although these are commonly referred to as "the 10 criteria," there are actually 29 independent environmental and social impacts which are assessed. See list on this page.

[10]As distinguished from person (*homo sapiens*), here "person" is intended to reference the statutory definition as codified at 10 V.S.A. §6001 (14)(A) and (B). It includes, among others, corporations and partnerships.

(7) Will not place an unreasonable burden on the ability of the local governments to provide municipal or governmental services.
(8) Will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites or rare and irreplaceable natural areas.
   (A) Necessary wildlife habitat and endangered species.
(9) Is in conformance with a duly adopted capability and development plan, and land use plan when adopted.
   (A) Impact of growth.
   (B) Primary agricultural soils.
   (C) Forest and secondary agricultural soils.
   (D) Earth resources.
   (E) Extraction of earth resources.
   (F) Energy conservation.
   (G) Private utility services.
   (H) Costs of scattered development.
   (J) Public utility services.
   (K) Development affecting public investments.
   (L) Rural growth areas.
(10) Is in conformance with any duly adopted local or regional plan or capital program under chapter 117 of Title 24.

State-wide planning. In addition to implementing a comprehensive regulatory structure in which citizen Commissions and the Board would measure a proposed project's potential impacts against the above-enumerated criteria, the legislature also contemplated a prospective planning role. This was to consist of two distinct components. A State Capability and Development Plan (Capability Plan), adopted in 1973 and codified at 10 V.S.A. §6042, endeavors to accomplish a coordinated, efficient and economic development of the state's land, while identifying and protecting its most significant natural resources. A state land-use plan was also called for in the statute. If adopted, it may have taken the form of an "overlay" of the state's resources, such as that system of land-use planning advocated by Ian McHarg (1969) in *Design with Nature*.

The planning devices urged by the legislature were designed to delineate more clearly those functions which the land was performing through the analysis of natural processes. Resource managers and developers could thereby more clearly identify sensitive areas in which development would be at odds with natural functions and could facilitate preservation of those lands most critical to serving important natural functions. Unlike the case-by-case approach, such plans could also lay a foundation for a broader view of resource management, such as that pursued by basin planning or ecosystem management.

Vermont's statewide planning effort has largely been a disappointment. The statewide planning component of Act 250, which could have served a significant role in determining how individual projects were reviewed under criterion 9, has not been adopted (Brooks 1996). Moreover, the findings of the Capability Plan have not been fully incorporated into Act 250. Of the provisions of the Capability Plan which were adopted, two are extremely significant with respect to Act 250's capacity to manage forests and specifically to prevent forest fragmentation. Those have been integrated as subcriterion 9C, addressing the protection of forestry soils, and subcriterion 8A, addressing necessary wildlife habitat.[11]

Lasting Impacts of Subdivisions and Development

Residential subdivisions, commercial developments and industrial uses, once permitted, effectively remove the land on which they are situated from the productive uses of silviculture and agriculture. Thus, it is no surprise that despite the apparent recovery of eastern forests, the resurgence of forests—or even trees—has not occurred in areas of intensive residential, commercial or industrial development. This underscores two important points. Developments and subdivisions are more or less permanent commitments of the land resource to a given use. As such, developments and subdivisions must accommodate the functional integrity, landscape limitations and scenic values of the natural context in which they propose to be situated.

Issues concerning wildlife management. Maintaining the functional integrity of natural systems is critical to human self-preservation (Odum 1993). It is also critical to the preservation of *other* species. The biological integrity of forest resources is

[11]Criterion 9(C) reads (i-iii in abridged format):

(C) Forest and secondary agricultural soils. A permit will be granted for the development or subdivision of forest or secondary agricultural soils only when it is demonstrated by the applicant that, in addition to all other applicable criteria, either, the subdivision or development will not significantly reduce the potential of those soils for commercial forestry, including but not limited to specialized forest uses such as maple production or Christmas tree production, of those or adjacent primary agricultural soils for commercial agriculture; or

(i) [can recover fair market value only by removing forestry or agricultural potential]; and

(ii) [no nonforest or secondary agricultural soils alternatives]

(iii) [mitigation has been planned to minimize the reduction of forestry and agricultural potential]

Criterion 8(A) reads as follows (also abridged):

Before granting a permit, the board or district commission shall find that the subdivision or development:

(8) Will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites or rare and irreplaceable natural areas

(A) Necessary wildlife habitat and endangered species. A permit will not be granted if it is demonstrated by any party opposing the applicant that a development or subdivision will destroy or significantly imperil necessary wildlife habitat . . ., and

(i) the economic, social, cultural, recreational, or other benefit . . .[of] development . . . will not outweigh the economic, environmental, or recreational loss . . . from. . .destruction or imperilment of . . . habitat or species, or

(ii) all feasible and reasonable means of [mitigating] imperilment of the habitat or species have not been or will not continue to be applied, or

(iii) [an] alternative site is owned or controlled by the applicant which would allow the development or subdivision to fulfill its intended purpose.

promoted through Act 250's criterion 8A. Criterion 8A introduces an obligation for people to "back off" when their residential subdivisions, ski areas or other developments infringe unduly on necessary wildlife habitat.

Without adequate planning devices in place, much of a state's necessary wildlife habitat will be converted to uses that are incompatible with use as habitat. Act 250 jurisdiction applies only in certain situations. Therefore, exempted subdivisions and developments can still have intense impacts on wildlife species, particularly those which are highly intolerant of human disturbance (Amestoy et al. 1990). An excellent example is presented by Salmon's (1990) study on Neotropical songbird populations in Vermont. He demonstrates how even small-scale residential development can alter the survival rates of several songbirds and how minor landscape changes can increase predation and "nest stealing" (brood parasitism). Even where Act 250 jurisdiction does apply, a case-by-case approach has significant shortcomings

The protection afforded through Act 250 permit conditions can only extend to the boundaries of the project tract under scrutiny. It is doubtful whether these boundaries even roughly correspond with actual necessary habitat boundaries.[12] Another troubling aspect of criterion 8A is that the habitat protection it affords is subject to an economic balancing test. To date, most applications of criterion 8A have been directed at protecting white-tailed deer (*Odocoileus virginianus*) populations. When species less *economically* valuable than white-tailed deer are at stake, a balancing test could significantly compromise habitat protection efforts. Although some have argued that the scope of criterion 8A's habitat protection may be unclear, the statute affords protection broadly (Perella 1987). Nonetheless, nearly all reported cases under criterion 8A have involved either white-tailed deer wintering areas or black bear (*Ursus americanus*) foraging habitat.

Without a legally significant state-wide (or ecosystem-wide) plan, it will be difficult for the Act 250 decision maker to fully protect necessary habitat even when applying criterion 8A. Jeffrey Amestoy (1990), recently appointed as Chief Justice of the Vermont Supreme Court, suggested that a legislative enactment providing for the compilation and development of data and detailed inventorying of wildlife habitats throughout the state might be the best answer to the dilemma over how best to ensure habitat protection. Absent such a plan, influential industries will continue to pressure Commissions to grant permits for projects on tracts of land that the applicant has chosen, irrespective of its value as habitat. Moreover, habitat protection will proceed in a piecemeal fashion.

A state-wide plan or habitat inventory that would have legal significance in an Act 250 proceeding could notify land developers and inform resource managers where necessary habitats for a variety of species are located. This inventory would be publicly available, as are the documents that identify the specific characteristics of deer wintering areas (Reay et al. 1990). It would be much more efficient for both developers and land-use managers to have established the boundaries of necessary habitat

[12]Where the land subject to Act 250 review abuts land under a forestry management plan, there is an opportunity to coordinate the habitat protection measures of Act 250 with those of any applicable forestry plan.

before a plan to develop or subdivide lands is proposed. Moreover, such a plan or inventory would potentially allow the coordination of necessary habitat protection on nearby or contiguous tracts, and it would also empower the Commissions to protect significant habitat that is less evident than deer wintering areas.

Despite the inherent shortcomings of implementing necessary habitat protection through a case-by-case approach, and without reference to a habitat plan or inventory, Commissions and the Board have effectively used criterion 8A to preserve significant amounts of deer wintering areas, *Re: Southview Associates*, Application #2W0634-EB, Findings of Fact, Conclusions of Law, and Order (June 30, 1987), *aff'd* in *In re: Southview Associates*, 153 Vt. 171 (1989); black bear habitat, *Re: Killington Ltd. and International Realty Corp et al.*, Application #1R0584-EB-1, Conclusions of Law, and Order (September 21, 1990) (Part III); and (May 11, 1989) (Parts I & II); and wetland areas sustaining rare plant species, *Geniatopsis crinita* and *Juncus marginatus*, *Re: Finard-Zamias Associates, et al.*, Land Use Permit #1R0661-EB, Findings of Fact, Conclusions of Law, and Order (November 19, 1990). Maine has followed a similar analysis regarding necessary wildlife habitat in its review of timber operations which have the potential to destroy deer wintering areas.[13]

Act 250 jurisdiction, once triggered, attaches to the entire tract on which the permitted project is located. Thus, in many instances the assertion of jurisdiction enables long-term management of both the forest, through a forestry management plan, and wildlife habitat through various permit conditions. These devices contribute significantly to the management of ski areas that necessarily tend to fragment and compromise Vermont's forest resources. Moreover, ski areas are situated among some of Vermont's most unique natural features and often surrounded by its most densely forested areas. As such, permits governing these operations are critical to mitigating adverse impacts, and allow an opportunity to work closely with the managers of ski areas to accommodate wildlife habitat, mitigate erosion, preserve water quality and protect aesthetic values.

In early cases, the Board's Criterion 8A analysis seemed to have been premised on an incremental gain model in which, for example, the last remaining 30 acres (12.15 ha) of what was once a 200-acre (81 hectare) tract of habitat would be valued, from the standpoint of resource protection, higher than the first 170 (68.85).[14]

The Vermont Supreme Court, in *In re Southview Associates* more clearly articulated what it means to be "necessary" habitat. The Court strongly validated the habitat protection afforded by criterion 8A and reinforced the fact that all habitat decisive to the survival of a species, not just the last remnants, is necessary. Consistent with the Board's precedent and with the analysis undertaken pursuant to the federal Endangered Species Act, the Court seemed most concerned about ensuring habitat necessary

[13]See for example, *Seven Islands Land Company v. Maine Land Use Regulation Commission*, Me., 450 A.2d 475, 478-483 (1982).

[14]Act 250 does not compel such an analysis, nor has the Board's reasoning been explicitly stated to confirm that it disproportionately values the last remaining or "critical" habitat. However, the Board's analysis in *Re: White Sands Realty Company*, Land Use Permit #3W0360-1-EB, Findings of Fact, Conclusions of Law, and Order (October 19, 1981), seemed to equate the term "necessary wildlife habitat" with habitat that is "critical to the survival to the species."

to the survival of a species rather than protecting that habitat which would promote viable populations. As Shaffer (1990) and others have noted, there often is a significant difference. Many scientists now acknowledge the inherent conflict between statutes aimed at merely ensuring survival of a species and the need to support more prospectively the viability of populations (Primack 1993). Robust populations which are not stressed by confinement within isolated pockets of critical habitat are essential to population viability and, as a consequence, genetic diversity (Shaffer 1990, Trombulak 1995). To promote a healthy forest ecosystem, managers and regulators must move beyond protection of "critical" or necessary habitat and implement planning measures aimed at promoting habitats as near to optimal as can reasonably be achieved given the competing economic demands on the land. A key to reaching this goal is the prevention of forest fragmentation.

Fragmentation. The subdivision or development of land, particularly in natural areas, not only converts the category of its use, but in many cases fragments the more or less continuous natural context of which it was once a part. Northeastern forest ecosystems have historically succumbed to the intensive pressures placed on the land for both the cultivation of crops and pasture lands and for timber extraction (NFLC 1994, Brooks 1996). After tremendous efforts to clear the lands of the Northeast for the grazing of domestic sheep (*Ovus aries*) and the cultivation of crops, the northeastern forests once again dominate the landscape. The quality of those "forests," however, is a subject of significant debate. Unfortunately, the resulting dialectic over whether the trees that have grown truly constitute a forest has focused—often myopically—on the trees.

The fragmentation of habitat caused by silvicultural activity and agricultural activity prior to the period of industrialization, although less random and more intensive than patterns of nonhuman disturbance, was far less pervasive and significantly less troublesome than that which is occurring today. Primack (1993) describes habitat fragmentation as the process whereby a large continuous area of habitat is both reduced in area and divided into two or more fragments. These fragments are often isolated from one another by modified or degraded habitat. Some fragmentation occurs as a result of natural events or disturbance, such as windstorms, floods and fires. Averill et al. (1996) emphasize that the long-term health of ecosystems is ultimately linked to such disturbance. It is difficult to characterize human-caused disturbance as unnatural. Over the past 6,000 years, humans in northeastern forests have suppressed "nonhuman-caused" disturbance and accelerated other types, notably for land clearing, agriculture and development. Averill avoids the question of whether human-caused disturbances are natural by completely disregarding a qualitative judgement about the source of the disturbance. He states that while the biological consequence of disturbance is neither good nor bad, the socioeconomic impact may be seen as both good and bad.

Industrial timber companies and their shareholders, who now manicure vast portions of northeastern forests, as well as governmental officials committed to maintaining the status quo, would contend that socioeconomic impacts of current management practices are good.[15] These corporations, despite considerable public opposition to their forestry practices, continue to harvest standing timber in the Northeast at an astounding pace (Palola et al. 1996). According to industry representatives, heavily mechanized industrial logging and the forestry practices that accompany it, are essential to ensure that large industrial forest owners remain competitive in meeting the ever-increasing demands of fast-paced global markets. In order to meet that demand, the timber practices employed by these industrial owners have been documented to rely heavily on even-aged management, the spraying of herbicides and intensive clearcutting. In Maine, large industrial operators managed 74 percent of their harvest area as even-aged, and of that, clearcut 81 percent (Lansky 1995).

The USDA Forest Service noted the short-term economic advantages of such a management strategy as follows: "Many advantages stem from its suitability for highly mechanized logging. With these harvesting systems individual trees do not have to be marked for cutting and a large volume of wood can be harvested with less labor at a lower per unit cost than with other harvesting systems" (Lansky 1995). The positive economic benefits of such a scheme—to industrial foresters and the timberland owners' corporate shareholders—are obvious. The contribution to local economies, employment and the integrity of the forest ecosystem are disastrous. This is the fine print beneath the satellite images which seem to depict a forest sweeping over the Northeast.

It is no surprise that those concerned with the integrity of natural systems and with the ecological health of northeastern forests, as well as those loggers whose jobs have been taken over by machines, see the socioeconomic impacts of current "disturbance" patterns as extremely bad. Many contend that current forest practices are not merely *disturbing* the forest, but destroying it. Act 250, as previously noted, exempts from its review silvicultural activity and agricultural activity. Traditional notions of agriculture and forestry in Vermont continue to define its essence. Moreover, part of the mythos of the entire northeastern region is attributable to images of pastoral landscapes, lush forests and clear mountain streams. Industrial foresters employ what are euphemistically dubbed "beauty strips" to continue to contribute to the perception that forests engulf the Northeast. Mitch Lansky, and scores of others, have looked "beyond the beauty strip" to demonstrate that the realities of modern industrial "forestry" call into question commonly held notions of what forestry is (Lansky 1995). The Environmental Board recently faced a similar issue regarding the definition of farming.[16]

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[15]Large industrial land holdings are particularly prevalent in Maine where St. Pierre (1996) documented that only 16 corporations held 9,465,769 acres (3,832,826.4 ha) of land.

[16]Thus, where a project consisted of five laying barns, two pullet barns, an egg washing and grading station, a feed mill, a manager's residence, two waste water disposal systems, and 700,000 chickens, the Board found that it had no jurisdiction, despite projected impacts, because the operation fit within the broad definition of "farming." *See Re: Vermont Egg Farms*, Findings of Fact, Conclusions of Law, and Order, Declaratory Ruling #317 (June 14, 1996).

Meaningful regulation of forestry and agriculture has historically been perceived by the predominant culture of the Northeast as intrusive, unnecessary and, therefore, politically unacceptable. This is the practical reason Act 250 jurisdiction does not extend to these enterprises. Farmers and loggers were, and most still are, perceived by their communities as exemplary stewards of the land. The trend today, however, is to marginalize the dutiful steward of the resource and reward large industrial agriculture, and large, heavily mechanized industrial forestry. Multinational corporations, most with logging, paper production and real estate subsidiaries, own a large percentage of forested lands in Maine. In Vermont, New Hampshire and New York, numerous large tracts are similarly held, but much of the forest is continually being subdivided into smaller and smaller parcels, and being sold for residential use (Case et al. 1996, NFLC 1994).

The Changing Face of Eastern Forests

The changing *face* of eastern forests demonstrates little about what is really happening therein—or what will become of them. Absent human manipulation of the landscape, forests are the dominant pattern of vegetative succession in the northeastern United States.[17] The mere presence of these forests contributes significantly to such natural functions as the protection of water quality, shorelines and soil productivity. The healthy forest provides significant and unique wildlife habitat. The healthier the forest ecosystem becomes, the more abundant and diverse its populations.

The forests of the American East have, at least to some degree, returned. There is no down side to protecting them. These forests should be encouraged to predominate the landscape of the Northeast not only to promote their landscape functions, but to enrich the cultural, aesthetic and recreational values which the residents of the Northeast treasure. We have been presented with an opportunity to promote the sustainable use of this resource. Act 250 is an effective tool to help us do it.

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[17]The presettlement forest composition in the Northeast was comprised of a mixture of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), northern red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*), red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*) and balsam fir (*Abies balsamea*), with frequent occurrences of pioneering species, such as pin cherry (*Prunus pennsylvanica*) or paper birch (*Betula papyrifera*) among others (Morgan et al. 1990, Jacobsen et al. 1993, DeGraaf 1991).

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Special Session 5. *Natural Resource Gleanings and Leanings*

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The Cultural Audit Process: A Compelling New Tool for Fish and Wildlife Agencies in the Nick of Time

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This paper is a discussion of the product that resulted from the Ph. D. research dissertation work of the author (Angus 1997). The problem for her study was to develop and pilot test a process model which could be used as a template for guiding the development and implementation of cultural audits for state fish and wildlife agencies confronted with change. Incorporated into the research design was the articulation of the theory base, obtained from an extensive review of the literature, into process. In other words, the concepts and ideas for assessing organizational culture were translated into practice through the development of an assessment tool—*CAP,* a cultural audit process model. The discussion herein focuses on the tool rather than the research that produced it.

Background

State fish and wildlife agencies are challenged to rethink how their human capital can efficiently and effectively sustain them. Significant economic and demographic changes in the U.S. have combined with compositional changes in fish and wildlife workforces. In addition, a continued emergence of new and different public constituencies has produced an organizational mandate for change in how state fish and wildlife agencies do business.

At the root of the issue is a conflict in historic and emerging human capital utilization paradigms. Historically, fish and wildlife agencies have done an excellent job of developing effective management methodologies and plans related to the biological and technical dimensions of their business. However, they have not done as effective a job managing and developing the human resource elements that contribute to organizational performance (Reeff et al. 1994). Likewise, traditionally, they have not done as good a job in the *nontechnical* human dimensions for accommodating eminent change in the external client environment (Bleiker 1995, Duda 1992).

To complicate things further, fish and wildlife agencies have been conspicuously ignored in the kinds of management studies, research and evaluations common to large corporations. Nielsen (1993) reports that because fish and wildlife agencies are small, poor and undifferentiated, they have had little to offer in order to attract professionals or others to conduct or finance research on the organization itself.

Today, fish and wildlife agencies are engaged in various previously unpracticed strategic planning and management change activities. These extend to team building, envisioning exercises, citizen participation efforts, human dimensions and total quality leadership among others. These interventions are intended to help the fish and wildlife agencies respond more effectively to the market and organizational changes they confront. However, these new types of efforts are being implemented into the fish and wildlife infrastructure with neither a strong knowledge nor experience base. As such, these strategies may not effectively consider the agency's changing organizational culture and adequately assess what congruencies may or may not exist with the value systems of current employees. The result is lack of employee alignment for effectively implementing total quality programs, citizen participation, strategic planning, etc.

A reality adding to the problem for fish and wildlife agencies is that most agencies typically do not have human resources development staff to plan and implement such complex social assessments as organizational culture. Personnel departments are generally the caretakers of the administrative paperwork related to employees' rights, compensation and benefits—a far cry from professionals trained in human resources development and organization development expertise.

Therefore, prior to engaging in short- or long-term initiatives intended to bring about organization change and behaviors, conducting an audit of the organizational culture becomes a critical aspect of the early phases of planning for such strategic change efforts (Alderfer 1976, Gardenswartz et al. 1993, Manzini 1988, Nolan et al. 1993, Pfeiffer et al. 1989, Schein 1990), and one demanding a *new tool.*

What is Organizational Culture?

Attributing *culture* to an organization is fairly recent. In spite of its youth, the concept has moved into the forefront of management thinking and strategic planning with other important organization development and behavioral considerations (Hofstede 1991, Luthans 1992, Moran et al. 1993, Morey et al. 1987, Pfeiffer et al. 1989, Frost et al. 1985, 1991). The term culture has been borrowed from anthropology and can be differentiated simply as society having a social culture; where people work has and is an organizational culture.

In spite of extensive literature on the subject and wide acceptance among both practitioners and academics, a definition for the concept of organizational culture remains elusive. Much of the disagreement in the literature centers fundamentally around the composition of organizational culture, that is, what are the elements, constructs and attributes of an organizational culture? Compositional differences reflect a broader level of disagreement related to organization development, including how an organization is investigated, managed and changed (Ott 1989).

There is, however, widely held agreement among many of those writing about organizational culture that it is at the least:

(1) socially constructed, forming from, by and of the organization's people;
(2) historical, reflecting the history of the organization;
(3) gestaltic, focusing on wholes of the organization;
(4) anthropological, relating to some of the methods for studying organizational culture, for example, rituals, symbols, norms and language;
(5) *soft*, making quantification hard;
(6) dynamic, making change difficult, but potentially empowering the organization;
(7) important, but often ignored, in organizational change efforts (e.g., Beyer et al. 1987, Hofstede 1991, Luthans 1992, Ott 1989, Schein, 1990, Trice et al. 1993).

These descriptors were not common to traditional organizational and management analyses, but appeared to be unique to organizational analysis from a cultural perspective, enabling the capture of information previously ignored. Organizational culture has been referred to as an organization's "soul," providing meaning, direction and mobilization more powerful than any one person or the system (Kilmann 1985); the "organizational unconscious," beneath routine awareness yet critically important for constructive change (Allen et al. 1980); and the "software of the mind," a type of collective mental programming which distinguishes the members of one organization from another (Hofstede 1991).

A Definition

This research effort adopted the three-layer model and conceptual schema for organizational culture of Edgar Schein (1985), resulting in a working definition for the concept as a pattern of shared basic assumptions that the group learned and considers valid, teaching them to new members as the correct way to think. Organizational culture can be thought of metaphorically as an onion (Figure 1), having layers on the surface such as artifacts, attitudes and behaviors, then deeper layers of values, and finally the basic assumptions lying deeper still. Organizational culture is not a simple thing; it is not monolithic; it is not easy to assess nor is it easy to change; but organizational culture affects all behavior within an agency.

In spite of a dearth within the literature regarding subcultures which may have different and even incompatible beliefs, values and assumptions, this phenomenon has obvious importance, particularly when organizations are involved in strategic planning initiatives (Bartunek et al. 1991).

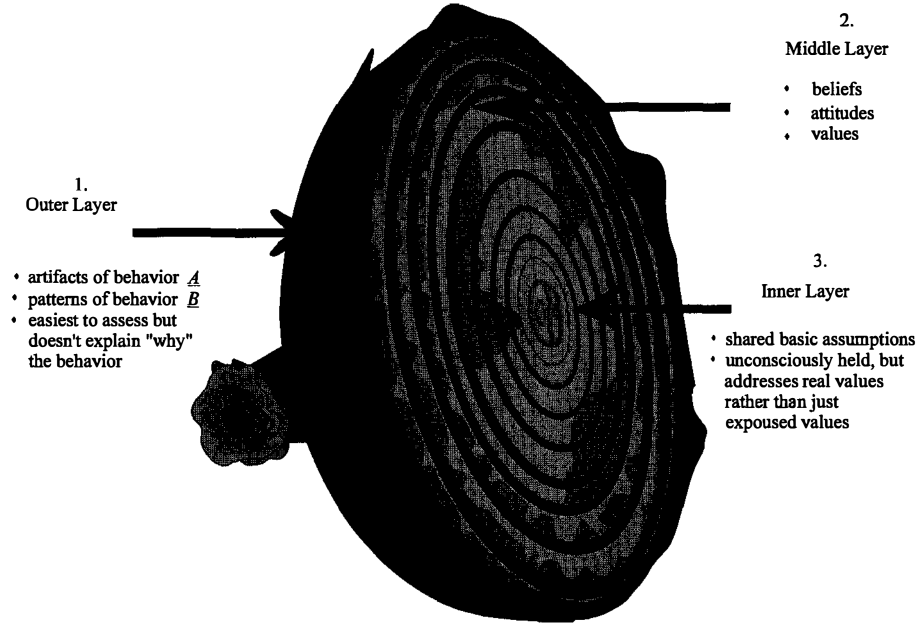

Figure 1. The onion metaphor (Angus 1997) illustrates Schein's 1985 three-level concept of organizational culture.

- Like an onion, organizational culture is multilayered, difficult to separate into parts and unclear as to what is holding it together.
- The outermost layer is protective, visible, dry and easiest to peel off.
- The middle layer lies just beneath the surface and is harder to separate into distinct, separate layers.
- The deeply rooted innermost layer is the most difficult to reach.
  Note: all three layers need to be planted if you want growth and change; using part will not work.

Culture and Performance

Overall, the link between effectiveness and organizational culture has yet to be firmly substantiated (Ott 1989, Siehl et al. 1990), although more recently, a number of research efforts have set out to do that. One effort, for example, consisted of four studies by Kotter and Heskett (1992) that examined whether a relationship existed between corporate culture and long-term economic performance. In summary, these studies found that corporate culture can have a significant impact on a firm's long-term economic performance, that its importance in determining the success or failure of firms will probably increase in the next decade, and that, although tough to change, corporate cultures can be made more performance enhancing.

Various provocative, yet unproven, strategy-contingency models have been proposed linking organizational culture to performance as a competitive advantage for organizations (e.g., Quinn et al. 1985, Sathe 1985, Wilkins et al. 1983). The fact that confusion remains around the construct of effectiveness has also failed to negate widely held agreement within the literature that organizations with cultures congruent with their business strategies are better performers than firms that lack this congruency (e.g., Schwartz et al. 1981, Tichy 1983).

Three Views on Culture and Performance

Within the literature there were found three general variations on the theme of culture and performance: *strong cultures, strategically aligned cultures* and *adaptive cultures.*

Strong cultures. Viewing strong cultures as helping performance is the perspective most widely held (e.g., Deal et al. 1982, Hofstede 1980, Peters et al. 1982). Important to this perspective are the assumed factors of goal alignment among employees, a consequential increased motivation and control that is self-directed from sharing values. One of the weaknesses of this perspective centers around causality, that is, strong performance can help to create strong cultures or vice versa. Kotter and Heskett (1992) found only a modest positive relationship between strength of corporate culture and long-term economic performance.

Strategically aligned cultures. The second perspective (e.g., Davis 1984, Lawrence et al. 1967, Schein 1992) asserts that the content of a culture is as important as its strength, enhancing performance only when it "fits" or is aligned with its organization (contextually or strategically). Within this perspective, some have argued that in order to enhance effective organizational performance, the interconnected components within organizations which potentially affect each other must be designed so as to create work setting conditions that will best support effective on-the-job behaviors of organizational members. A high degree of interrelationship drives the need for congruence among the parts. In other words, if different components are congruent, they will complement each other, but if they are not aligned well, they are likely to work at cross-purposes, resulting in inefficiency and ineffectiveness (Beer 1980, Nadler et al. 1977, Porras et al. 1992, Steers 1977, Tichy 1983). Advocates believe that the strategically aligned organizations and cultures are associated only with short-term economic performance, and that cultures can be changed from within to accommodate changing conditions. Vagueness as to what constitutes "good fit" is a weakness of this venue (Kotter et al. 1992).

There is wide agreement among organization development practitioners that alignment, or systemic integrity, requires a realignment of all subsystems (structure, values, beliefs, skills, systems, practices, and policies) once critical competencies for achieving the organization's vision have been defined (Foltz 1993).

Adaptive cultures. The third perspective (e.g., Beer 1980, Denison 1990, Likert 1967, Kilmann et al. 1985, Kotter 1990) sees cultures that can help organizations anticipate and adapt to environmental change as being associated with superior performance over long periods of time. Argyris and Schon (1978) have pointed out that the notion of organizational effectiveness implies the correlated notions of organizational tasks, environments and purposes.

Increasingly, intervenors have had to recognize that their main challenge is not to help an organization become more effective at the performance of a stable task in the light of stable purposes, but rather to help an organization restructure its purposes and redefine its task in the face of a changing environment. Conducting a cultural audit, therefore, like organizational learning, can be considered an important component in defining the goals of the intervention.

What is a Cultural Audit?

A cultural audit essentially is a form of a needs assessment. Within the context of this research effort, a cultural audit is considered significantly different than a typical attitude survey. It is compared with a type of cultural photograph or "culturegraph" of a fish and wildlife agency, or some part of an agency. This culturegraph is produced from assessing the various elements of culture that are collectively used to identify gaps or areas of misalignment between agency staff and the agency mission, values and goals. A cultural audit is a way to unravel, at least in part, the complex ball of organizational behaviors and discover what is really at the center driving them.

The Theory Base for the Cultural Audit Process Model

An extensive review of the literature and a comparison between categories of organizations with that of fish and wildlife agencies indicated several important principles that were used to build a theory base for developing a cultural audit model specifically appropriate for state fish and wildlife agencies. These theoretical underpinnings were borrowed from thinking found in a number of different disciplines, for example, organization behavior, social psychology, social anthropology, business management and research methodology, but all within the organization development dimension focus. The principles were considered critical foci to undergird the model.

Outstanding among the principles used to construct the cultural audit model were the ideas obtained from organization development and action research that emphasized a problem-solving format utilizing employees in a collaborative fashion in order to obtain data, and the ongoing nature of information collection to facilitate agency improvement (Beckhard 1989, Lewin 1951, Manzini 1988, Porras et al. 1992).

In addition, the work of Argyris and Schon (1978) on organizational learning was a rich source for what the model would need to be able to do, that is, to be able to help identify values that are espoused from what is actually in use, and the Model I and Model II types of learning organizations. A profound idea from the writings of these theorists was that employees may not be consciously aware of them, thus adding an additional challenge for the audit.

The contingency approach to organization management (Lawrence et al. 1967, Sergiovanni 1984) is closely related to the view of organizations as open systems with inputs, outputs, etc. The idea for the model borrowed from the contingency approach was the value of contingencies or choices to meet varying needs of cultural assessment as opposed to a one-stop-shopping approach.

The contingency approach also fit well with another critical focus for the model, that of an emphasis on a process approach. Lippitt (1959) cited advantages to the process approach for consulting used as an organization development intervention. They are summarized by this paper's author as if applied to a cultural audit model:

(1) Process permits the cultural audit assessment to be a strategy from which organizations are able to select from a variety of choices the most appropriate methods, tools, techniques, dependent on the identified need, rather than an instrument or singular tool.
(2) Process attends to the other factors critical to the success of any change efforts that often are overlooked or not emphasized when assessment methods are selected.
(3) Process provides repeated utility throughout the change and strategic planning processes in contrast to a "one way for one purpose at one time" approach.
(4) Process permits the user to go beyond the assessment step, integrating the assessment more fully into the strategic planning or change initiatives.
(5) Process has greater power for engaging the group's participants in the change initiative's goals and needs, as opposed to a singular instrument.
(6) Process facilitates the organization to recognize a bigger picture than may be possible with the perception of their being involved in "just another survey," for example, it may reveal the need to assess additional or different variables than initially believed.
(7) Process has a front and a back portion which permit greater opportunities to see where, when and how connections can be made to the overall change initiative, for example, it may reveal the organization needs to conduct several audits addressing different issues or it may need to plan a long-range comprehensive organization change initiative rather than the singular issue initially identified which called for conducting a cultural audit.
(8) Process has the potential of guiding the organization to engage in a more comprehensive, in-depth assessment process that would produce a richer, deeper visual of the agency.

From the management literature, a number of critical ideas related to strategic planning were used in the model building process (e.g., Bryson et al. 1996, Nolan et al. 1993, Pfeiffer et al. 1989, Tichy 1983). From the diversity management literature, the model would need to differentiate clearly the terms *culture*, *diversity* and *audit,* and accommodate for potential increased sensitivity to semantics surrounding potential misperceptions about the audit as judging personal values.

From research methodology literature, a perspective was developed for the model to take a "whatever works" approach to the collection of data. The selection of methods and techniques for collecting organizational cultural data would not be dictated, nor would the research approach, that is, qualitative, quantitative or a mix of both (Ott 1989, Sanday 1983, Siehl et al. 1990, Van Maanen 1982).

The Unique Fish and Wildlife Profession

One of the basic premises of this research effort was the hypothesis that because of the uniqueness of the fish and wildlife profession, tools developed for business as well as other types of organizations would not be as applicable for fish and wildlife. This study compared organizational factors between various types of organizations and fish and wildlife agencies. The findings showed that fish and wildlife agencies and organizations have a number of unique characteristics specific to that profession.

Of the 17 areas of unique organizational attributes of fish and wildlife agencies that were found, the following are several examples: an enduring traditional history, a workforce sharing common demographics, a unique bureaucratic development and structure, transcendent values, a social clannishness, an institutionalized paradigm, external closely aligned groups, multiple political masters of influence, and a missionary zeal, to name just a few examples.

The *CAP* Model

Together, the elements obtained from the review of the literature produced a "best inquiry strategy," that is, a prototype model for cultural audits in fish and wildlife agencies. The "best inquiry strategy" was pilot tested in a state fish and wildlife agency that used the prototype model, referred to as *CAP* (Cultural Audit Process) Model, in a planning exercise to plan a cultural audit for their agency. Input on the strengths and weaknesses of the model was thus obtained and the model refined.

The *CAP* model is a four-phase, ten-step algorithmic process (Figure 2) for planning and conducting a cultural assessment within a fish and wildlife agency. It is designed to act as a template to guide an agency through the required decisions, therefore, the *CAP* model presents a series of choices, from how to obtain buy-in to how to select appropriate data collection methods and instruments. The *CAP* model was developed with the unique organizational attributes of fish and wildlife agencies in mind, thus, it offers significantly greater value-added potential than that of off-the-shelf resources which typically do not incorporate a process for integrating the cultural audit into other initiatives and planning of the agency. The *CAP* model is presented graphically as a flow chart and is articulated into process through a practical User's Guide.

How is the Model Used?

An expanded discussion of the steps of the model and suggestions for how to use the material presented at each step was put into a practical user manual entitled, *User's Guide: The CAP Model for Planning and Conducting a Cultural Audit in Fish and Wildlife Agencies.*

In general, the *User's Guide* is a self-contained, workbook manual including explanatory models, choices and recommendations to help the user follow the 10 sequential steps of the model. Reflective of the model, the *User's Guide* is organized into four distinct phases (Introduction, Pre-Audit, Audit and Post-Audit) that reflect specific content and process based on ideas from the literature review. The *User's Guide* is packaged in a 55-page, *nongovernment issue* format. Great care was taken for it to appear to have utility without appearing too slick and reflective of all the latest bells and whistles.

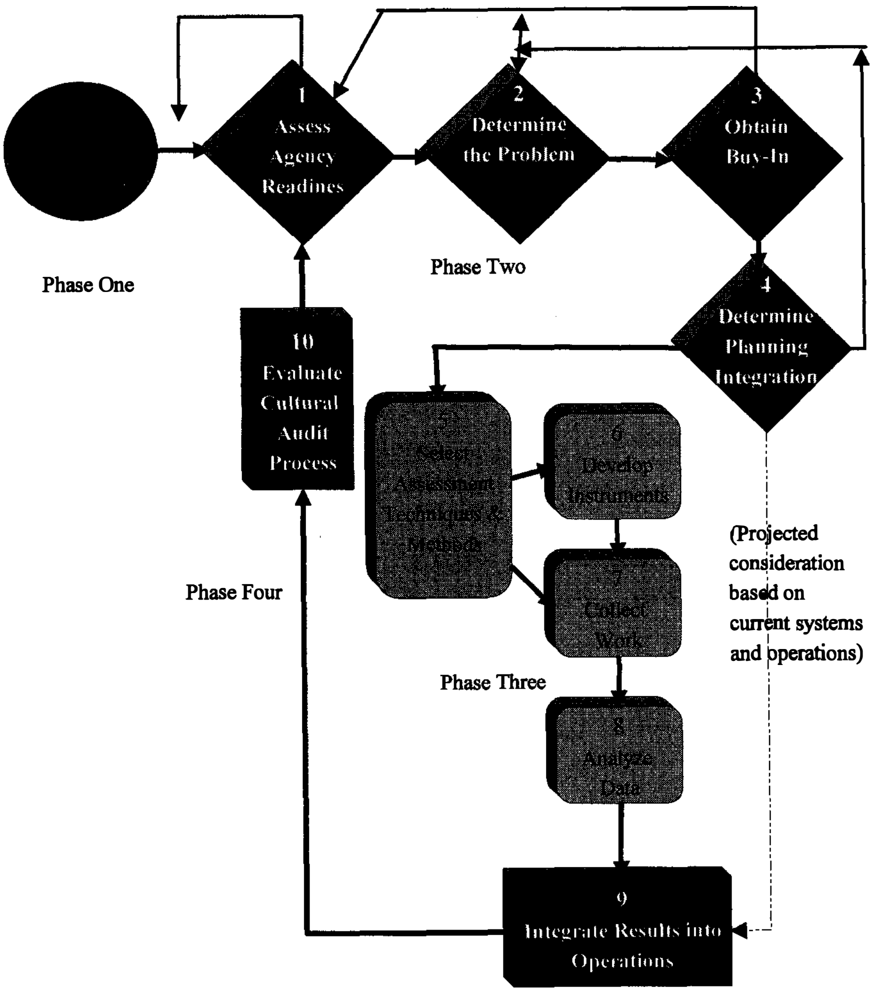

Figure 2. CAP Model (Angus 1997) for a cultural audit process. Note: Phase One = Introduction; Phase Two = Preaudit, steps 1-4; Phase Three = Audit, steps 5-8; and Phase Four = Postaudit, steps 9-10.

The *User's Guide* is presented in informal, nontechnical language, and is suggestive rather than directive, offering advice and choices to the user, but leaving the decisions up to the user as to what most appropriately fits their particular needs. Further, thoughtful consideration was given to the packaging of the user manual, such as the selection of the font type and taking advantage of distinct, familiar agency cultural symbols, that is, the incorporation of icons that have a distinct fish and wildlife connotation. For example, a white-tailed deer icon appears as a footer with the page numbering. The overall design of the *User's Guide* employed the three F's—user *familiar*, user *friendly* and user *fun*.

Atypical of most stand-alone surveys or other interventions, the "Introduction" in *CAP* is considered by the researcher of this study to be a key element of the overall cultural audit process. It is the user's first introduction to the concept of a *cultural* audit, thus, the purpose of this phase is to prepare the user for doing a type of assessment that is different from the typical surveys or needs assessments that they may have participated in before. According to the literature on diversity, it is important to clarify the purpose and disposition of any initiative that is related to differences between employees, and even more so when those differences are values based (Thomas 1996).

The use of graphics and *CAPPER* people icons break up text in a very light and unthreatening way. Definitions for organizational culture and alignment are presented early to clarify further what the user would be engaging in. The "Introduction" explains how the manual is organized. There is attention to providing as much white space as possible for ease of reading. The 10 steps to the model are presented with the *CAPPER* people icons to engage the user and provide a clear overview of the *CAP* process.

The steps in Phase II of the model engage the user in the *CAP* process from a problem-solving perspective. Questions are designed to provoke thinking in the dimensions of timing, extent of employee participation, confidentiality, preselection versus emergent selection of the variables to be considered, the target population and the depth of the *CAP* needs assessment. Later in the process, the user will make decisions as to how the data will be collected based on the defined problem and the appropriate level of culture to be assessed. Practical factors, such as timeliness, level of employee morale and trust, and budgetary considerations, are also part of the process.

How Can a CAP Help You?

A *CAP* enables a cultural audit reality check on what you may think are your agency's workforce values and attitudes and what those values and attitudes really may be, what you think are your agency's goals and what's driving them, and where you really might be headed and why. It can help an agency to identify cracks within the agency framework through which important human potential may be lost. A *CAP*, therefore, is a proactive step *in the nick of time* toward maximizing your agency's human capital through increased attention to the human resource and improved alignment, facilitating the achievement of your goals.

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Hunting 1996, A Year To Remember

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The year 1996 will probably be remembered as one of the great years, if not the greatest year, for hunting in Manitoba since the disappearance of the buffalo. This paper will explore the reasons why this statement may prove true with the passage of time.

Over the past few hunting seasons, I and those with whom I hunt have frequently reflected on the state of hunting in Manitoba. On the one hand, there has been an abundance of game. We have observed the statistics showing the increases of waterfowl in Manitoba. The white-tailed deer population is increasing and, in fact, second deer licenses have been issued, beginning in 1994, partly in order to reduce crop depredation resulting from overpopulation in particular areas. There was an observed increase in the grouse populations over the past few years. Yet, despite these strong wildlife populations, it has become a rarity to see another hunter in the field. Even on a relatively large marsh or lake, it is uncommon to find other hunters. This has made hunting in Manitoba a very high-quality experience for those of us still in the field. On the other hand, we cannot help but realize that, in the long term, it will be difficult for future policy makers to maintain hunting seasons for but a relative handful of hunters.

What Is Happening to Our Hunters?

The title of this paper—"Hunting 1996, A Year To Remember"—is not intended to refer only to the amount of game that was readily available in Manitoba in 1996. In fact, you are asked to accept as a given that there are large wildlife populations. Instead, the title is intended to refer to the possibility that if current trends continue, it will be difficult, 15 or 20 years hence, to justify maintaining hunting seasons for the few hunters that will remain. We have gone from approximately 48,500 migratory bird licenses sold in 1979 to 19,300 in 1996. In fact, the number of licenses sold declined virtually without interruption from 1979 until 1995. (The exception was 1986, when sales increased by about 3,000.) In 1995, there was an increase of just more than 800 licenses, a lower increase than would be expected with the rebound in waterfowl populations.

Until 1979, gamebird license sales were generally increasing and could be seen to more or less track the southern Manitoba mallard population (Figure 1). A decline in the mallard population tends to be reflected in the next year's license sales. After 1979, license sales steadily decreased (except for 1986) regardless of the state of the mallard population. Decreases in the duck population after 1977 still tended to influence license sales negatively, but increases in duck populations could no longer engender more hunters the following year.

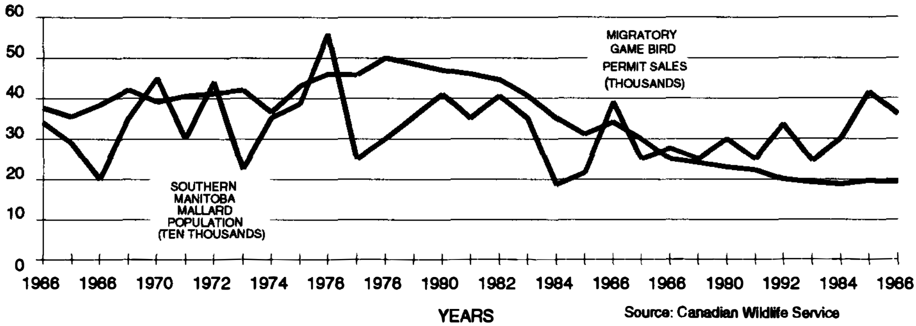

Figure 1. Southern Manitoba mallard population versus migratory gamebird license sales, 1966 to 1996.

In Manitoba, as in most other jurisdictions in North America, there is a hunter safety program that is a requirement for all new hunters. There has been an almost steady decline in the number of graduates from the course since the course became mandatory for new hunters in 1969 (Figure 2). In that year, there was a significant increase in the number of graduates. During the 1970s there was an average of about 5,000 graduates per year. That dropped to about 3,300 in the '80s, and so far in the '90s, the average is about 2,500.

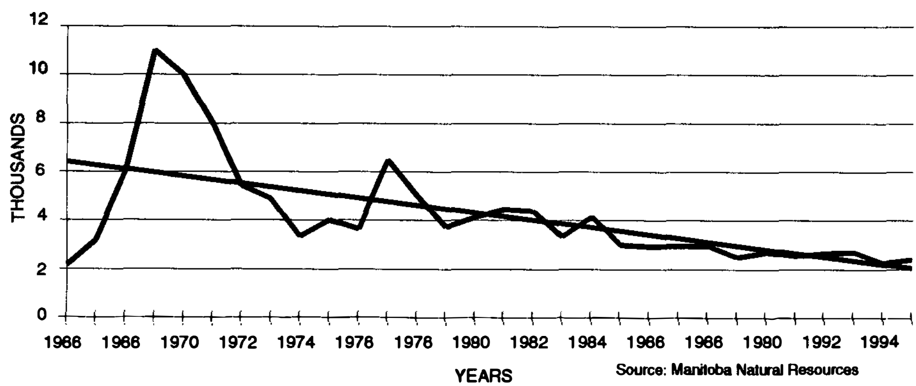

Figure 2. Manitoba Hunter Safety certificates earned, 1966 to 1994.

In Canada, since 1979, there has been a requirement to have a Firearms Acquisition Certificate (FAC) in order to purchase shotguns or rifles. To obtain an FAC it is necessary to arrive in person at a police station to obtain the form. It is then necessary to fill out the form, provide two character references, pay a $50 fee and wait about three months for the application to be processed. In 1993, the fee increased from $10 to $50. On January 1, 1994 it became necessary to take a course, separate from the hunter safety course, that usually takes two evenings and requires a fee of about $100. Those individuals who previously held a provincial hunter safety certificate are not required to take the additional course. The effect of the changes in 1993 and 1994 has been an approximately 65-percent drop in FAC applications in Canada (Figure 3).

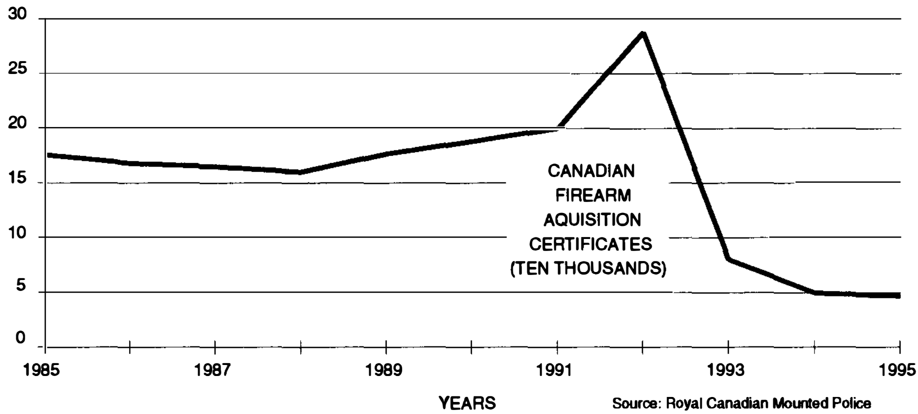

Figure 3. Canadian Firearm Acquisition Certificates (FAC) purchased, 1985 to 1995.

This increased concern related to gun control has resulted in a significant decrease in gun sales in Canada. Representatives for Browning, Winchester and Remington, while reluctant to provide specific sales information, indicate that the gun control controversy and the FAC changes in 1993-1994 resulted in a loss of sales in the order of 60 percent.

The federal government in Canada has made steel shot mandatory for 1997. It is the position of Manitoba that there should be a longer phase-in period for this than the two years provided. Manitoba already has non-toxic shot zones in certain areas of the province identified as having a potential lead toxicity problem. With an aging hunter population, the combination of the FAC application process and the requirement for non-toxic shot may cause a near collapse in bird hunting in Manitoba. While the provincial hunter safety course is accepted for those who have taken the course prior to 1994, this may have the effect of "grandfathering" everyone except grandpa. The provincial hunter safety program became mandatory for new hunters beginning in 1969. Those who hunted before largely have not taken the course. Assuming that most of the hunters who took the course were under 18 years of age (from 1994 to 1996, 62 percent of graduates were under 18 years of age), then most hunters over the age of 46 will not have graduated from the hunter safety program and, therefore, will have to meet the more costly FAC course requirement.

The introduction of steel shot poses a number of concerns to hunters. One concern is cost; the price of a 25 pack of 3-inch, 12 gauge steel shot such as Remington Nitro Steel or Federal Steel is $26.99 and $24.99, respectively, at Manitoba's largest ammunition retailer.

The other consideration for the hunter is whether or not his firearm is appropriate for steel. If it is not, the hunter will be faced with the prospect of replacing it. This can be a significant task. First, he or she will have to spend approximately $100 to take the FAC training course, followed by a $50 FAC application fee. After waiting three months or so for the FAC application to be processed, he will then have to buy the gun along with the expensive steel shot. A lot of hunters simply will not bother.

The possible result of the combination of the already declining hunter population, along with the introduction of stringent federal gun control legislation and the decision by the federal government to impose the steel shot requirement, may be to cause the decline in licence sales and hunting interest to steepen greatly. This problem may compound with future cyclical declines in wildlife populations. At what point will declining hunter numbers force Manitoba legislators and policymakers to decide whether recreational hunting is to continue? Ten years? Twenty years?

If there is some good news to be found, it is that big game hunting has not declined to the same extent as bird hunting in Manitoba. The actual number of deer hunting licenses sold has actually increased in the past few years. This reflects introduction of new types of firearm licenses, as well as increased interest in bowhunting. An individual can purchase a general rifle season licence, a muzzleloader license, a bowhunting license or an antlerless license that can be used to kill a second deer in conjunction with any of these licenses, in their respective seasons.

However, using just the general deer license (rifle) category, there would appear to be a slight downward trend, despite a strong deer population that has generally been increasing (Figure 4). What is uncertain is what effect this harsh winter will have on the deer population and, in turn, on hunter participation.

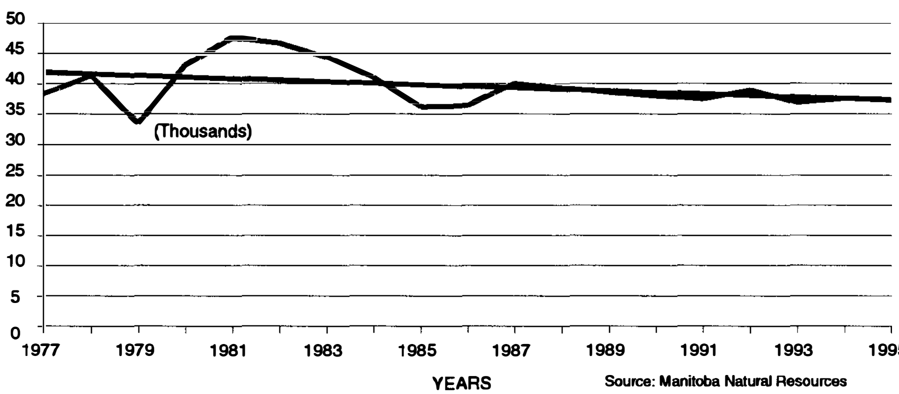

Figure 4. General deer license sales, 1977 to 1995.

There is also the possibility of some good news on the horizon with regard to the cost of steel shot. Both retailers and manufacturers expect that some lines of steel shot will be made available in the $12 to $14 range. This is nevertheless a substantial increase over the base price for lead shot, which can be purchased for as little as $5 per box.

What Can We Do to Ensure the Continuation of Hunting in Manitoba?

The trend in hunting license sales appears to more or less trail by one year the game population trend. This suggests that hunters rely on assessments of the quality of the previous year's hunt, as passed on by other hunters. With the three or four months lead time required for an FAC, it appears to be increasingly important to communicate the state of the resource to hunters and, more importantly, to potential hunters and those that have been "sitting out" for a few years. This will help them make decisions in spring to acquire the gun for fall. It may also provide realistic expectations to hunters when game populations drop, to avoid disappointment and prevent their departure from hunting.

As the number of Manitoba hunters declines, it will become increasingly important to stress the economic importance of hunting, especially in Manitoba. While the number of licenses sold to Manitobans has dropped, the number of licenses sold to nonresidents has remained more or less stable. As a percentage of licenses sold, the nonresident component has therefore been steadily increasing (Figure 5). We must begin to further enlist the support of the outfitting industry, the hotel owners, the airline industry and the gas station and grocery store owners in making the nonhunter aware of the economic importance of hunting. In Manitoba, about two-thirds of the 1 million inhabitants live in the City of Winnipeg. However, these people only account for about one-third of the license sales in the province, and only about 1 percent of the city's population has a bird hunting license. A strong message about the economic importance of hunting to the province may be the only way to convince the other 99 percent that recreational hunting merits retention and even promotion.

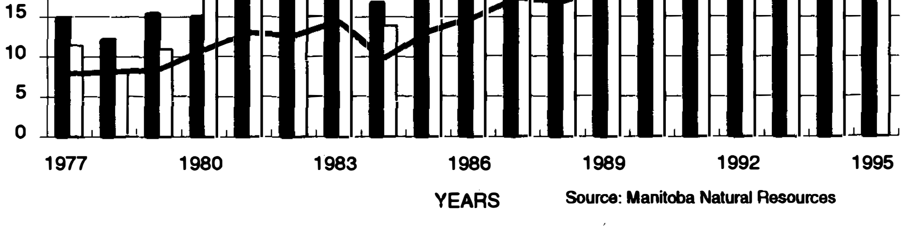

Figure 5. Nonresident duck and goose harvest percentage of total provincial harvest.

The other thing that we can do is to build and strengthen links with the aboriginal community. In Manitoba, aboriginal people have a recognized right to hunt and fish for food. Commercial sale or use of wildlife or fish is not recognized as a right. A lot of energy, time and money are spent by various parties in defining, defending and often criticizing these rights or their limitations. We must look beyond the short term and begin to see the importance of having significant participation by aboriginal businesses in the hunting industry and, especially, in the nonresident hunting industry. This type of participation would not be an aboriginal right in Manitoba, but would be licensed as are other hunting-related enterprises in the province. As the number of recreational hunters decreases, eroding the capacity of established hunting organizations in the province to influence government policy, it makes sense for nonaboriginal hunters to become allied with aboriginal hunting businesses in preserving hunting seasons. A strong aboriginal voice to maintain the licensed sport hunt may one day go a lot farther, especially among the citizens of Winnipeg, than the relatively few nonaboriginal hunters who will remain.

Conclusion

In conclusion, the essential points are: sport hunting in Manitoba, and especially bird hunting, is in serious decline and is further threatened by recent federal government policy decisions. Without some change in the declining numbers of hunters, it is difficult to foresee a long-term future for hunting in the province. Sooner or later, that fatal point will be reached; too few hunters to sustain the traditional sport hunt, overwhelmed by too great a sentiment against it. That is when we will count 1996 as a hunting year to remember.

The Opposition to Hunting: A Typology of Beliefs

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In the proverbial theater of American political campaigns, media, courts and grassroots activism, the acceptability of hunting is being questioned. In 1996 alone, a record number of wildlife-related ballot measures brought the debate over acceptable methods of hunting to the electorate. To some within the wildlife management profession, this public debate over hunting is disturbing for several reasons, one of which being that, with few exceptions, state wildlife conservation programs are largely dependent on income generated through participation in hunting.[1]

Although a state wildlife management agency's mission statement may mandate representation of wildlife interests of all of the state's citizens, concern for the stability of the revenue source may compel agency personnel to adopt a consumptive-user advocacy stance.[2] Advocacy—or arguing for a cause on behalf of others—requires the ability to communicate persuasively to defend and advance one's position. To be successful advocates of hunting, wildlife management professionals must first understand the complexity of the hunting acceptability issue and, in particular, the diversity of beliefs that underlie the opposition to hunting in the United States.[3]

Understanding the Issue

The Parties in Conflict

The first step in understanding the societal issue of the acceptability of hunting is to identify the parties in conflict. The most common approach has been to classify the disputants into dichotomous camps: the pro-hunting side and the antihunting side. For instance, the issue has been labeled by some in the academic community as the "hunting/antihunting controversy" (Public Policy Research Institute 1992) and the "hunting versus antihunting debate" (Wood 1997).[4]

Mass media news coverage that frames the issue as a two-sided argument further reinforces this reductionist view of the hunting acceptability issue (Karlberg 1997). The hyperbole of the public discourse on the issue depicts the extremes as confrontational, intolerant and self-righteous. This adversarial framing emphasizes destructive rather than constructive discourse and amplifies positional statements and demands while obscuring underlying values and beliefs; it also tends to unduly polarize and alienate social groups from one another (Karlberg 1997).

Although the depiction of two neatly defined, diametrically opposed adversaries is convenient, intuitively comfortable and popularly saleable, it does not functionally serve to represent the parties involved in the hunting acceptability issue. Along with those who hold the extreme attitude that all hunting is unconditionally acceptable or unacceptable, there are individuals who see hunting as context specific and provisional. That is, there is a range of attitudes and beliefs about various hunting motives (e.g., sport, trophy), methods (e.g., techniques, equipment), prey species, locales (e.g., public versus private land), and participants (e.g., youths versus adults).[5] In addition, opposition to hunting may not only be based on beliefs about the act of hunting per se but also about topics perceived to be associated with hunting, such as trespass, gun ownership and ecological health.

Defining the antihunting side. The task of defining an "antihunter" may seem straightforward (i.e., an antihunter is someone who opposes hunting). However, when a specific form, approach or method of hunting is opposed, the label "antihunter" is a misnomer. For example, is the small game hunter opposed to using bait to hunt black bears (*Ursus americana*) an "antihunter"? It is more accurate, albeit more cumbersome, to describe this person as an "anti-bait-bear-hunter" than as an "antihunter."

Kellert (1978: 417) used two criteria to define an antihunter:[6] (1) strong agreement with the statement, "hunting for sport is wrong," and (2) no hunting experience (i.e., individuals who strongly agreed that hunting for sport is wrong but who had hunted some time in their life were not considered antihunters in his analysis).

However, this definition is not adequate because a person's reasons for opposing hunting may or may not have anything to do with the evaluation that hunting, or a particular motive for hunting, is wrong or unethical. For instance, as I will show later, a person may believe that hunting for sport is ethical but may be opposed to a particular method of sport hunting due to a belief that the method (e.g., use of hounds) results in trespass problems for private landowners. Thus, defining an antihunter as only those who think hunting, or a particular motive for hunting, is immoral unduly restricts our understanding of the opposition to hunting.

Heeringa (1984: 9), in his review of research on attitudes toward hunting, concluded that "the distinction between hunters, antihunters and non-hunters is useful for the discussion of public attitudes and behaviors on wildlife issues" but that "the boundaries between these groups are certainly not rigidly defined." He further stated that "even among antihunters, it is possible to define subgroups who differ in the basis for their antihunting attitudes" (Heeringa 1984: 10). "The fact that hunting opposition is highly circumstantial partially accounts for the existence of so many distinct beliefs and is in fact justification for developing a typology" (D. Jones, The Animal Protection Institute, personal communication: 1997). The typology described here encompasses opposition to hunting based on moral reasons as well as opposition based on other reasons that are outside of the philosophical debate of morality.

The Beliefs and Values in Conflict

The second step in understanding the societal issue over the acceptability of hunting is to identify the beliefs and values in conflict. For purposes of this paper, beliefs and values of only the opposition to hunting are explored. Several researchers have investigated the psychological foundations of antihunting sentiment (e.g., Applegate

1973, Shaw 1973, Linder et al. 1974, Shaw and Gilbert 1974, Shaw 1977, Kellert 1978, Rohlfing 1978, Adams and Thomas 1990, Hooper 1992, Dizard 1994, Fleishman-Hillard, Inc. 1994, DiCamillo 1995, Duda et al. 1995).

A study conducted nearly two decades ago identified 90 distinct perceived problems with hunting from the viewpoint of individuals (n = 152) who professed to be neutral about hunting (Rohlfing 1978). Respondents rated the perceived problems in terms of how "bothersome" they were and how frequently they were perceived to occur (Rohlfing 1978: 406). Because the perceived problems were stated very specifically, there was considerable overlap, with the top 20 specific perceived problems falling into one of three general categories (Rohlfing 1978: 409):

(1) "Hunting results in animals being wounded and becoming crippled or dying a slow agonizing death.
(2) The typical hunter is untrained and incompetent, possessing neither skills nor a knowledge of the basic rules of his[/her] sport, and therefore is dangerous to protected species, himself[/herself] and others.
(3) The hunter often behaves without regard for laws, rules, regulations or the rights of others."

Shaw and Gilbert (1974: 161) found that college students "appeared to be considerably more concerned with the pragmatic rather than philosophical issues concerning sport hunting." Their research indicated that among college students, the top five reasons for being against hunting were:

(1) the belief that hunting endangers some species;
(2) the dislike of trophy hunting;
(3) the dislike of killing for pleasure or sport;
(4) the belief that too much game meat is wasted; and
(5) the belief that too many hunters are "game hogs" (Gilbert and Shaw 1974: 162).

To ascertain the importance of reasons for opposition to hunting among members of antihunting organizations, Shaw (1977) asked members of a state chapter of the Fund for Animals (n = 179) to rate 12 reasons for being opposed to hunting (Table 1). No one reason was clearly identified as the primary basis for opposing hunting, with mean responses indicating that each of the reasons was rated as being important to some extent (Shaw 1977) (Table 1).

Wood (1997), in his synopsis of the controversy over hunting, categorized objections to hunting into five major themes: hunting is sadistic, inhumane, unethical, chauvinistic and not ecologically sound.[7] He also identified five specific arguments used to oppose hunting that he noted were basically rejections of common pro-hunting arguments (Wood 1997: 74-76):

(1) sport hunting is not "romantic" (i.e., it does not instill or restore a human's closeness to nature);
(2) contemporary sport hunting is not meat hunting (i.e., neither for subsistence nor for the purpose of obtaining meat);
(3) sport hunting is not necessary;
(4) hunting depletes the food sources of natural predators and scavengers; and
(5) sport hunting is not a wildlife management tool (e.g., it does not prevent starvation or limit the growth of wildlife populations).

These earlier works provide insight for understanding and explaining antihunting sentiment, yet none of them offers a complete list of the possible reasons for opposing hunting that may exist among antihunting, noncommitted or even some generally pro-hunting publics.

Table 1. Mean importance of reasons for opposing hunting according to members of the Michigan Fund for Animals (Shaw 1977).[a]

Reasons for opposing hunting[b]	Mean importance[c]	Number of respondents
1. I dislike the idea of killing for pleasure.	1.00	169
2. I dislike the idea of taking the freedom of a wild and free animal	1.14	169
3. It [hunting] is cruel and inhumane to the animals.	1.26	168
4. The animals really do not have a chance against modern "sportsmen."	1.37	169
5. It [hunting] encourages an undesirable attitude of dominance over nature.	1.42	168
6. Hunting disrupts nature's balance.	1.52	165
7. Hunting is destroying what is left of our wildlife populations.	1.60	168
8. Hunting makes people insensitive to suffering.	1.61	166
9. I do not like human behavior that involves violence.	1.65	170
10. Too many hunters abuse the privilege.	1.66	166
11. Hunting encourages people to want and like guns.	2.16	167
12. I do not like the type of people who usually hunt.	3.68	162

[a]©The Wildlife Society. Reproduced with Permission of The Wildlife Society 1997.
[b]This list of reasons was generated by Shaw (1977) and was presented as a close-ended list in his survey instrument (i.e., the respondents were not asked to generate their own reasons for opposing hunting).
[c]Scale: 1 = extremely important; 2 = quite important; 3 = moderately important; 4 = slightly important; 5 = not important.

Methods

A comprehensive and exhaustive list of antihunting beliefs was developed from a qualitative analysis of past research on attitudes toward hunting and popular arguments advanced against consumptive uses of wildlife. The qualitative data were collected from a review of more than 500 different sources, including radio and television news and debate broadcasts, materials produced by animal protectionist groups (e.g., videos; print materials such as newsletters, brochures and fact sheets; written correspondences), print news items (e.g., antihunting letters to the editor, opinion pieces and news coverage of antihunting protests), scholarly literature and popular media (e.g., magazines, books, feature films, and television documentaries and series). Unstructured discussions with antihunting advocates, noncommitted publics and hunters who opposed certain types of hunting also provided insights for development of the typology.

During the review of the material, I was aware that the statements made may not necessarily reflect the underlying beliefs and values of the sender because skilled advocates tend to use the rhetorical means that maximize the likelihood of their arguments resonating with broader audiences. In other words, antihunting advocates may state arguments that encompass a range of interests perhaps only incidental to their primary concern but of considerable salience to potential supporters (Krogman 1996).[8] However, no effort was made in the analysis to determine the centrality of the beliefs or to differentiate between underlying beliefs and incidental claims expressed in support of the position.

The Typology of Beliefs

Nine distinct domains of antihunting beliefs and more than 60 different claims used in antihunting arguments in the United States were identified (Table 2). My goal was not to rate the validity of the antihunting beliefs and claims but instead to document and codify the full range of contemporary antihunting beliefs and claims. In addition, the frequency and prominence of the beliefs and claims were not quantified and should *not* be inferred from the ordering of categories in the typology. For ease of reference, I label the nine belief types as follows:

Type I: Hunters Kill
Type II: Harm to Game Animals
Type III: Unsportsmanlike
Type IV: Problems for People and Domestic Animals
Type V: Harm to NonGame and Environment
Type VI: Game Management is Harmful
Type VII: Catering to Hunters
Type VIII: Unnecessary
Type IX: Poor Character and Conduct

The first eight types might be viewed as beliefs supporting *antihunting* sentiment, whereas the last type might be viewed more appropriately as beliefs supporting *antihunter* sentiment (Shaw and Gilbert 1974). Type I consists of perceptions associated with the act of killing, with the word "killing" seemingly used by antihunting advocates, in some instances, interchangeably with the word "hunting."[3] Types II through V consist of beliefs directly about the act of hunting or the perceived impacts or consequences of hunting on game, nongame, the environment, domestic animals and people (including both hunters and nonhunters).[9] Beliefs in types VI and VII deal with the management of wildlife by public wildlife management agencies and the issue of "ownership" of wildlife. Type VIII focuses on the belief that hunting is not necessary and presents a list of refutations to justifications commonly presented in support of the necessity of hunting. Type IX consists of beliefs about the character and social conduct of hunters.

Although these belief types are preserved as mutually exclusive categories (with a few exceptions as noted in Table 2), any one person may hold any combination of the beliefs presented in the typology. Often, one belief may predominate in the cognitive schema of an individual, but any number of other beliefs that support this overarching belief may also be held. For instance, Kellert (1978), in describing the "moralistic antihunter," noted that their basic attitudinal orientation that killing for sport was wrong was based on a number of other beliefs, such as a perception that hunting was unnecessary.

Table 2. Typology of beliefs of the opposition to hunting in the United States.[10] (Disclaimer: listing of a belief/claim does *not* imply that the belief/claim is accurate.)

Type I. *Hunters Intentionally Kill (or try to kill) Animals (i.e., Hunters Willfully End Life).*[11,12]

- A. The act of killing animals is immoral/unethical.
    1. Sentient beings should be afforded equal consideration by humans.[13]
    2. Animals should be afforded the right not to be killed by humans (Animal Rights[14]).
    3. Animals have inherent/intrinsic value and should not be killed for any human purpose or benefit.[14]
    4. Killing animals morally degenerates the person who does the killing.
    5. Killing animals morally degenerates society as a whole.
    6. People (especially youths) who are exposed to or recruited into hunting are morally degenerated (e.g., instills insensitivity toward life).
- B. Any desire to kill is immoral/unethical/abnormal/unnatural/uncivilized.[15]
    1. Motives for killing (i.e., trophy; recreation/sport/fun; interpersonal bonding) are perverse.[16]
    2. Humans don't or shouldn't have a predatory instinct.
    3. People who want to kill animals are inherently deviant from the rest of society[17] (e.g., having a predisposition toward psychopathy and sadism).
    4. People who want to kill animals are less evolved than those who find killing/hunting to be repugnant.
- C. Hunting is oppressive.
    1. Hunting is a symptom of a patriarchal society that subjugates and objectifies women, children and nature.
        - a. Hunting is a manifestation of the male tendency toward violence/abuse/exploitation.
    2. Hunters are speciesists and, as such, are no better than racists or sexists.[18]

Type II. *Hunting Harms Game Animals.*

- A. Hunting harms individual game animals.
    1. Hunting is inhumane (i.e., it causes individual animals to suffer): slow, painful death; wounding; lead toxicity; abandonment of young; the chase causes psychological torment and prevents fat accumulation for over-wintering (animal welfare[19]).
    2. Some hunting practices (i.e., baiting) increase intraspecific conflicts (competition among individuals of the game species) due to increased density of game animals.
    3. Some game animals are too cute and innocent to kill or cause pain (humanistic[20]). (This assertion may be focused on juveniles or females of the aesthetically appealing game species.)
- B. Hunting harms game species populations.
    1. Hunting causes extinction of game species or decimation of local populations (see Type V, A).
        - a. The wildlife population size is too low to support hunting.
        - b. Wildlife management agencies do not have enough adequate information on the game species on which to base harvest objectives, so allowing a harvest to occur jeopardizes the population.

Table 2. continued

c. Hunters kill too many animals, thereby depleting the population.
2. Hunting disrupts game species' "natural" habits or their "wildness"[21] (see Type IV, D).
3. Selective harvest weakens the gene pool of the hunted species, causing successive generations of poorer quality ("less fit") animals.

Type III. *Hunting is Not Fair Chase (the "unsportsman-like" argument).*

A. Contemporary hunting techniques and equipment are too effective at killing.[22]
  1. Technology gives humans an unfair advantage over game animals.
  2. Some hunting methods (e.g., baiting, calling) are too effective at luring animals to the hunter.
B. Put-and-take hunting operations (e.g., stocking game birds in an area) provide no challenge.
C. Game animals have no way to defend themselves or can't escape (e.g., fenced in).
D. For hunting with hounds: dogs do all the work in the chase.

Type IV. *Hunters and Hunting Cause Problems for People and Domestic Animals.*

A. Hunting threatens the safety of the nonhunting public, domestic animals and hunters.
  1. Hunters are untrained/unskilled.
  2. Guns/people with guns are dangerous.
B. Hunting disturbs private property owners.
  1. Hunting causes inconvenience or disturbance to landowners (e.g., noise from firearms).
  2. Hunters and their hounds do not respect private property boundaries.
C. Hunting interferes with other user groups (e.g., nonconsumptive wildlife enthusiasts have fewer viewing opportunities because hunters disturb wildlife).
D. Some forms of hunting (e.g., using bait) result in increased wildlife-human conflicts (nuisance problems) because animals are made less wild (see Type II, B, 2).
E. Eating wild game meat is bad for one's health (e.g., contaminants; not federally inspected).
  1. Sponsors of programs that donate wild game meat to charities jeopardize the health of the recipients.
F. Hunters abandon their families to go hunting.
G. Using dogs for hunting puts the dogs at risk.

Type V. *Hunting Harms "Nongame" and the "Natural" Environment.*

A. Hunting extirpates faunal species (nongame as well as game species—see Type II,B,1) (i.e., the accidental or intentional taking of nontarget species endangers non-game individuals and populations [sometimes referred to as "indiscriminate killing"]).
B. Hunting harms nongame individuals.
  1. Hunters (while hunting) disrupt individuals or social units of nongame animals.
  2. Hunting tackle is harmful to nongame animals (e.g., lead shot is toxic to nongame).
C. Hunting disrupts nature's balance.
  1. Selective harvest goes contrary to nature.
  2. Hunting depletes the food sources of natural predators and scavengers.
D. Hunters degrade the environment.
  1. Hunters leave litter (e.g, trash, bait).
  2. Off-road vehicles used by hunters damage the land.

Type VI. *Game Management Practices Harm "Nongame" and the "Natural" Environment.*

A. Game management provides habitat for game but not nongame.

Table 2. continued

1. Nongame animals "lose" habitat to game animals or do not directly benefit from habitat provided for game.
2. Providing game species habitat increases the density of game animals causing increased interspecific competition between game and nongame animals.

B. Game management advocates killing predators in order to protect game animals.

C. Single-species game management is incompatible with management for biodiversity (ecological argument; anti-exotics).

1. Maintaining game species at "artificially" high levels impairs ecological processes (e.g., floral regeneration) and reduces floral abundance and diversity (threatening protected floral species). Resultant changes in vegetative community structure negatively impact faunal species (threatening protected faunal species).

D. Wildlife management is undesirable and unneeded manipulation of ecosystems (antimanagement sentiment).

Type VII. *Wildlife Management Bureaucracy Caters to Hunters' Interests (neglecting all other stakeholders even though wildlife is a public trust and not exclusively hunters' property).*

A. Nonhunters are denied an equal voice in how wildlife is treated/hunting is imposed on nonhunters.

B. Wildlife management personnel (e.g., biologists, administrators, commissioners) are biased toward hunting because they are hunters, have been indoctrinated into the hunting mind set in their training, and/or think their jobs are dependent on money from hunting-related fees/taxes.

1. Alternatives to hunting are not given just consideration by wildlife management personnel.
2. Wildlife management personnel willfully misrepresent information in order to perpetuate hunting.
3. Wildlife management personnel are not concerned about individual animals, "nongame" or biological diversity. They are interested only in "prey-supply management."

C. Hunters should not be allowed to kill and reduce to possession wildlife that belongs to all citizens.

D. Taxpayers unknowingly or unwillingly subsidize hunting, especially on public lands (and especially on public lands that are part of the National Wildlife *Refuge* system).

Type VIII. *Hunting is Not Necessary.*

A. Justifications for hunting based on hunters' perceived personal benefits from hunting are invalid.

1. There are alternative sources for psychological, physiological, or affiliative benefits hunters think they derive from hunting (e.g., for satisfaction, exercise and family kinship, people can do other things besides hunt).
2. Hunting does not bring the hunter closer to nature.
3. The "meat" justification for hunting is invalid.
   a. Humans do not need to eat meat and would be better off not to.
   b. The hunted animal is too small to provide enough meat.
   c. Humans can get meat from other sources (e.g., grocery store).

B. The "population-regulation" justification for hunting is invalid.

Table 2. continued

1. Hunting is ineffective at controlling wildlife populations and ending wildlife/human conflicts because hunting reduces the population only in the short-term, with the lower competition for food among survivors resulting in increased nutritional health and reproduction (i.e., hunting is self-perpetuating).[23]
2. Hunting does not prevent wildlife overpopulation because populations are purposefully managed for "surplus" by state game management agencies.
3. Hunting does not prevent over-winter starvation of game animals and is not an acceptable substitute for starvation as a population regulation mechanism.
    a. An animal's death caused by hunting is not more merciful than death from starvation.
    b. Starvation is a "natural" process of death for a game animal and therefore is preferable to the "human-imposed"/"unnatural" process of hunting.
    c. If the real purpose of hunting was to prevent starvation of the game animal, the timing, length and quota specifications for hunting seasons would be different than they are currently.
4. If the real purpose of hunting was to regulate wildlife populations, hunters would be allowed to kill only females of the game species.
5. There are alternative (nonlethal) methods to use to regulate the distribution/size/growth rate of wildlife populations.

C. The "hunters pay" justification for hunting is invalid.
1. Non-hunters contribute money to wildlife management efforts (e.g., via income taxes, site fees, nongame donations), especially management on federal lands.
2. Present-day hunters were not the ones who instigated the Pittman-Robertson excise tax and, if they had the choice, they would rather not pay the tax (e.g., the contention that hunters voluntarily contribute to wildlife restoration and management is a lie; they have no choice but to pay the tax).
3. The Pittman-Robertson excise tax is paid by all purchasers of sporting arms and ammunition, of which only a small proportion are hunters (e.g., target shooters and street criminals who buy guns pay for conservation as much as do hunters).

D. The "hunting as conservation" justification is invalid.
1. Hunting is not wildlife conservation.
    a. Hunting does not instill a conservation ethic in the hunter; rather, it instills an exploitation ethic.
2. Hunters' motives for "conservation" are self-serving (e.g., so they can be sure there will be animals to kill in the future).[24]
3. Commercial business interests (e.g., hunting equipment manufacturers) who "promote hunting as conservation" only do so in order to perpetuate and bolster hunting-related sales to ensure their own economic gain.

Type IX. *Hunters Are Social Misfits* (see Type I, B, 3 and 4).

A. Hunters are socially inept and exhibit socially unacceptable behavior (e.g., beer-drinking slobs; immature; lower class; insecure about their sexual appeal; insensitive; discourteous; irresponsible, egotistic).[25]
1. Hunting does not make a person "cool," macho or sexually attractive; rather, it has the opposite effect.
2. Hunters behave without regard for laws (see Type IV, A and B).

B. Hunters do not respect animals.
1. Hunters waste the meat of the animals they kill.
2. Hunters use animals as nothing more than animated targets.

Applications of the Typology

This typology of antihunting sentiment has five main uses for resource management professionals. First, it facilitates the inventory and analysis of arguments used to denounce hunting. The methodical list of beliefs provides a structure by which to systematically identify and categorize antihunting claims. This recasting of complex antihunting arguments as a set of particular beliefs provides resource management professionals with the opportunity to constructively manage the controversy rather than being overwhelmed and rendered ineffectual by the multitude and combination of assertions that may be made against hunting (Weick 1984).[26]

Second, the typology serves as a guide for formulating persuasive messages to defuse and counter antihunting arguments.[27] It helps the hunting advocate predict the likely rebuttals to various pro-hunting messages. For example, messages designed to communicate the benefits of youth participation in hunting will likely be countered by claims that exposing young people to hunting desensitizes them to suffering and instills insensitivity toward life (Table 2, Type I, A, 6). This gives the hunting advocate the "*a priori* hindsight" to counter this counter-argument before it has a chance to surface.

Third, beyond the potential usefulness of this typology in the design and delivery of pro-hunting communication messages, this typology illustrates that there is a wide array of beliefs about hunting. Some of the beliefs listed in Table 2 will undoubtedly be rejected by resource management professionals as falsehoods; other assertions may be judged as stingingly closer to the truth. Regardless, the adage that "perception is reality" warrants that these statements be considered as sincere concerns of legitimate stakeholders in wildlife management.

Fourth, the typology is an invitation to wildlife professionals to reflect on their personal values and beliefs about hunting and to scrutinize the philosophies, tenets and practices of contemporary wildlife management with regard to hunting.[28] In my opinion, professional wildlife managers who see only two camps in the debate over the acceptability of hunting limit their ability to effectively address the issue. That is, the orientation that "you're either with me or against me" precludes many possibilities for constructively managing the conflict. Furthermore, when complex and multifaceted issues are reduced to simplistic dueling perspectives, effective public dialogue and deliberation cannot occur (Karlberg 1997: 25).

Finally, although this typology focuses on antihunting beliefs, many of the claims could be—and likely will be—adapted for use against recreational fishing, as both of these activities involve comparable motivations and experiences.[29] Indeed, recent efforts by People for the Ethical Treatment of Animals signal the emergence of a formalized "anti-fishing movement" (Armitage 1996). When the publics begin being bombarded with anti-fishing arguments,[30] the current widespread public support base for recreational fishing (Duda et al. 1995) could dwindle markedly, making advocacy of fishing more challenging. Using this typology as a guide, pro-fishing messages could be developed sooner rather than later, thereby affording fisheries managers the opportunity to be proactive to antifishing challenges.

Conclusion

As leading national animal protection groups set "aside the medical research controversy for other, more promising causes including trapping and sport hunting..." mass media attention to the issue of hunting acceptability will likely increase over the next decade (Jones 1996: 77). Thus, we can expect to hear and see more antihunting messages. The typology of antihunting beliefs provides a structure to assist in the prediction, interpretation and rebuttal of these messages.

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Endnotes

[1]Exceptions include the Missouri Department of Conservation and the Arkansas Game and Fish Commission, both of which receive substantial funding support from their respective state's sales tax in addition to the "traditional" funding support from hunting license sales and the Pittman-Robertson federal excise tax.

[2]Whether or not such advocacy is appropriate is debatable (see, for instance, Kellert 1989, Loker et al. 1994, D. Witter, Missouri Department of Conservation, personal communication: 1995). Still, the fact remains that many state wildlife management agencies currently practice hunting advocacy, whether by choice or by perceived practical necessity.

[3]Many authors have addressed the challenge of defining "hunting" (e.g., Ortega y Gasset 1972, Fund for Animals 1997, Wood 1997). For the purposes of this paper, I do not present a formal definition of hunting but do outline the basic criteria by which *I* judge what hunting is and is not: (1) the hunter has the ***intention to kill*** the wild animal; the hunter's intent to kill is necessary but not sufficient to define the act of hunting; (2) the actual willful ending of the prey animal's life (via the infliction of the lethal blow to the prey animal) is not a necessary condition of hunting. That is, ***killing*** is not an essential part of the activity of hunting. (For disagreement, see Breer [unpublished, as cited in Kellert 1978].); and (3) some degree of ***pursuit*** is necessary, with pursuit being defined by the pursuer. Based on these premises, I judge that the act of hunting a wild animal is not synonymous with the act of killing a wild animal or the act of shooting a wild animal. I purposefully do not specify a motive in the criteria for defining hunting (e.g., meat hunting, sport hunting, trophy hunting). Furthermore, my use of the term "hunting" herein excludes market hunting and any other illegal taking of a wild animal. See Causey (1989: 332-333) for a discussion of "killing" versus "hunting" versus "shooting."

[4]These references illustrate that the "pro-hunting" side is commonly referred to simply as the "hunting side" (see also Kellert [1978]). Dropping the "pro-" from the protagonist side portrays the conflict as being between a status quo group and an antagonist group and also defines one side in terms of a behavior (i.e., those who participate in hunting) and the other side in terms of an attitude (i.e., those opposed to hunting). In addition, the opposition group is referred to seemingly arbitrarily in the literature as ***antihunters*** and as being antihunting. Although these portrayals of the parties in conflict are important in shaping the issue, a discussion of the implications of these portrayals is beyond the scope of this paper. Herein, I label someone who opposes hunting as an "antihunting advocate," which is the label preferred by some within the animal protection movement (D. Jones, The Animal Protection Institute, personal communication: 1997).

[5]However, these more "moderate" beliefs are not necessarily argued in the public forum with any less vitriolic and combative rhetoric than are the extreme positions.

[6]Given this definition, it is not surprising that Kellert (1978: 418) found that the two primary attitudinal orientations of antihunters were what he has termed "humanistic" and "moralistic," with the former focusing "on the presumed suffering of the individual prey animal" and the latter stemming "more from broad ethical and philosophical opposition to killing for sport," with the objection to hunting "based most of all on its presumably degenerative impact on human beings and society" (Kellert 1978: 419).

[7]Wood (1997) provided a reasoned and detailed discussion of these antihunting assertions, but for the purposes of this paper, only this brief synopsis is presented.

[8]This framing strategy, referred to as "piggybacking," and others commonly used in natural resources disputes are discussed in more detail in Krogman (1996).

[9]I use the terms "game" and "nongame" for convenience, with the recognition that these labels may be more sociopolitical than biological distinctions.

[10]The frequency and prominence of the beliefs and claims were not quantified and should ***not*** be inferred from the ordering of categories in the typology.

[11]Some antihunting advocates seemingly use the terms "killing" and "hunting" synonymously. See endnote #3 for my distinction between these two activities.

[12]My use of "animals" herein refers generally to nonhuman fauna.

[13]For a discussion of "sentience" (basically, the capacity to experience pain and pleasure), see Singer (1975).

[14]See Regan (1983) for a discussion of animal rights and inherent value; see also pages 353-359 of Regan (1983) for his perspective on why hunting and trapping are wrong.

[15]Causey (1989: 338, the emphasis is hers) argued that "the urge [to kill game] itself is an instinct, and instincts do not qualify for moral valuation, positive or negative. Thus, the urge to kill for sport is ***amoral***, lying as it does outside the jurisdiction of morality."

[16]Antihunting advocates' discussions of another's desire to kill often is accompanied by a claim that the desire to kill is a manifestation of the person's need to compensate for his/her (usually his) perceived inadequacies.

[17]One communication strategy that antihunting advocates use to frame hunters as deviant from the rest of society is to repeatedly state that a low percentage of the U.S. population hunts and that the societal acceptability of hunting is declining as evidenced by a decline in participation in hunting in the U.S. (For the record, the national participation rate in hunting ***is*** less than 10 percent [in 1991, it was found to be 7.4 percent] [U.S. Department of the Interior 1993]; However, although participation in hunting seems to be declining when evaluated ***as a percentage*** of the U.S. population, the ***absolute number*** of participants in hunting (12 years old and older) has been fairly constant since 1980 [U.S. Department of the Interior 1993].) Another strategy that antihunting advocates have used to try to further marginalize hunters is to emphasize the alignment of hunters with groups reputed as "animal abusers" (e.g., with trappers, by citing that hunters are in cahoots with trappers and that anyone who condones or supports trapping or wearing fur is immoral; with shooters of "tame" animals (e.g., "Pigeon Shoots" [Robbins 1996]).

[18]Speciesism is discrimination based on species (see Singer's (1975) argument that hunting is a manifestation of speciesism).

[19]For a discussion of three different views of the relationship between animal rights and animal welfare philosophies, see Francione (1996).

[20]For a discussion of humanistic preferences for wildlife species, see Kellert (1996) (especially chapter 5).

[21]For example, some antihunting advocates assert that baiting makes game animals less wild by habituating them to "unnatural" food sources and diminishing their natural wariness of humans and inhabited areas.

[22]Antihunting advocates may argue that "non-contemporary" ("primitive") hunting equipment (e.g., long bow, spear) is ineffective at killing and thus is inhumane (Type II, A, 1). The conclusion of this line of reasoning is that there is no acceptable hunting equipment because it is either too effective or not effective enough.

[23]Another strategy antihunting debaters may use to try to discredit the argument that hunting is an important tool for regulating wildlife populations is to assert that this justification for hunting is used for only a few game species (e.g., cervids, especially white-tailed deer [*Odocoileus virginianus*]), implying that it is a tenuous argument with limited relevance.

[24]As so-called evidence of this, antihunting advocates will note that hunters have, since the turn of the 20th century, brought back from near extinction only those select species that they want to hunt. This is a reproach of the pro-hunting claim that wildlife has been "unendangered" by hunters' conservation efforts.

[25]There is a striking contrast between these perceptions of American hunters and the perception of United Kingdom hunters as wealthy elitists (e.g., fox hunters on horseback).

[26]For examples of complex antihunting arguments, see "Animal Rights: Frequently Asked Questions (questions no. 63-67)." April 29, 1995, Online, Internet (http://www.pavilion.co.uk/david-pearce/faqfile.htm). February 12, 1997.

[27]Specific strategies to use in hunting/antihunting debates are presented in Duda (1990) and Minnis (1997).

[28]See Decker and Brown (1987) and Richards and Krannich (1991) for further considerations for wildlife professionals as they confront issues of animal rights.

[29]Although most anti-fishing assertions are subsumed in the antihunting belief typology (e.g., the perceived detrimental effects of lost or discarded fishing tackle on nontarget species is analogous to Type V, B, 2 in Table 2), there are a few antifishing assertions that are not readily analogous to any of the claims in the typology presented in Table 2 (e.g., the inhumaneness to the live bait used in some methods of fishing).

[30]Such as Inhumane Type (Table 2, Type II, A, 1) antifishing messages describing the acute nerves within the lips of fish, accompanied by rhetoric such as, "if only fish could scream." (For other antifishing claims, see Fishing: Aquatic Agony (no date), a flyer produced by People for the Ethical Treatment of Animals, Norfolk, Virginia.)

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Effects of Regulations and Duck Abundance on Duck Hunter Participation and Satisfaction

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The roots of waterfowl harvest management run deep, penetrating the sociopolitical and biological fabric of North American wildlife management. The Migratory Bird Treaty Act, signed nearly 80 years ago, continues to set both the legal bounds and tenor for contemporary waterfowl harvest management. Appropriately, the tenor is supportive of recreational hunting, but only within the bounds of long-term resource conservation. Discord is not uncommon, however, as managers attempt to balance resource protection with the desires of hunters. Ironically, the support provided by hunters for waterfowl conservation has created a double-edged sword that often confounds harvest management decisions.

Hunters both exploit and preserve waterfowl. In 1995, 1.4 million hunters harvested an estimated 12.6 million ducks and 2.3 million geese in the United States (Martin and Padding 1996). At the same time, fees from federal and state duck stamps, hunting licenses, and excise taxes on arms and ammunition contribute tens of millions of dollars annually toward waterfowl habitat conservation (Southwick Associates 1995). This income is bolstered by the voluntary contributions made by waterfowlers to conservation organizations such as Ducks Unlimited, which has raised $1 billion for waterfowl habitat conservation (Ducks Unlimited, Inc. 1997), and by the personal contributions of hunters toward habitat development on private land for hunting recreation or aesthetic values. The political support generated by hunters for waterfowl-friendly agricultural policies (e.g., Reynolds et al. 1994) and wetland protection laws has maintained or created important habitats for waterfowl (U.S. Department of the Interior 1994). Thus, the most appropriate regulatory decision for the waterfowl resource is not always obvious, because managers must consider the effects of their decisions on waterfowl harvest and waterfowl conservation. The magnitude of both responses is determined in large part by hunter participation.

Scherff and Ringelman (1994) reviewed 41 studies on the preferences, attitudes and behavior of North American waterfowl hunters, but found few that specifically addressed factors that affect participation. Although numerous hunter attitude surveys have been conducted by states, few have attempted to understand factors that motivate and satisfy hunters. Because many regulatory frameworks are mandated at the national level, it is difficult to recommend national changes based on state or regional survey results. Smith and Roberts (1976) reported on the first national study to understand motivations of waterfowl hunters, but did not do so in a manner that isolated the effects of specific regulatory components. However, they were among the first to

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point out that waterfowl managers work to satisfy hunters, but devote relatively little time to understanding the motivations of their clients.

When considering waterfowl harvest management strategies, most managers have two principal objectives: to protect the waterfowl resource from overexploitation and keep hunters satisfied. Even if scientific information is incomplete, a conservative approach to regulations ("erring on the side of the resource") and monitoring programs to inform future decisions has proven effective at safeguarding the waterfowl resource. However, to accomplish the latter, managers often rely on deductive reasoning that attempts to link regulations to hunting participation and hunter satisfaction.

Federal and state duck stamp sales provide a tally of the number of potential waterfowl hunters, but post-season harvest surveys are used to estimate the number of active hunters and hunter-days, an index to participation rate. Based on historic correlations among hunter numbers, hunter participation, waterfowl abundance and hunting regulations, most waterfowl managers believe that both waterfowl abundance and regulations affect hunter participation. Many managers assume that if hunters participate, they must be satisfied. Conversely, if duck stamp sales decline or hunter-days decrease, it is assumed that some hunters are dissatisfied with their potential recreational opportunity. In this context, recreational opportunity is defined as sufficient opportunity to pursue waterfowl with a reasonable chance of success.

Usually, the only direct approach used to gauge hunter satisfaction with regulations is through public comment at wildlife commission or other public meetings, although the number of waterfowl hunter surveys conducted by states has been increasing (Scherff and Ringelman 1994). Public forums often attract constituents who are dissatisfied with specific issues or proposed changes to regulations, and therefore fail to reflect the satisfaction level of the general public. Moreover, these meetings usually focus on local issues and often are inadequate to gauge overall public satisfaction with national regulation frameworks such as season length and bag size. The relationship between waterfowl hunting regulations and hunter satisfaction is rarely evaluated at appropriate scales or in a systematic manner.

The Adaptive Harvest Management (AHM) initiative (Johnson et al. 1993) affords an opportunity to make harvest management decisions within a framework of explicit objectives and alternative regulatory packages. Because AHM objectives and regulatory packages are ultimately formulated to address hunter satisfaction, consistent with long-term research management, and participation rates are important to predicting harvest rates under alternative regulations, a better understanding of the factors that affect duck hunter participation and satisfaction is central to thoughtful action under AHM. To address this need, I coordinated a national survey of duck hunters to determine how likelihood of participation and hunter satisfaction change in response to regulations, duck abundance and motivations for hunting. Additional explanatory variables included hunter demographics, participation tendencies, success and past experience, and flyway in which the hunting occurred.

Methods

Cooperators in 23 states participated in the duck hunter survey (Figure 1). I requested that each cooperator derive a sample population of at least 1,200 names of waterfowl hunters using one of the following sources: state duck stamp buyers, waterfowl hunting license purchasers or participants in the Migratory Bird Harvest Information Program. Only three states resorted to alternative sources that included respondents to previous hunter surveys or a list generated from names of attendees at Ducks Unlimited fundraising events. Thus, the sampling frame was composed almost entirely of persons who intended to hunt waterfowl during the 1995-96 season. The sample of 1,200 names was expected to result in 400 valid responses from duck hunters after the sample was reduced by undeliverable addresses, persons who purchased stamps for collecting, people who hunted waterfowl other than ducks, and nonrespondents. Because a state was the minimum stratum of inference, 400 responses would provide for estimates of population parameters with confidence intervals of ± 5 percent at a 95-percent level of confidence (Pierce et al. 1996).

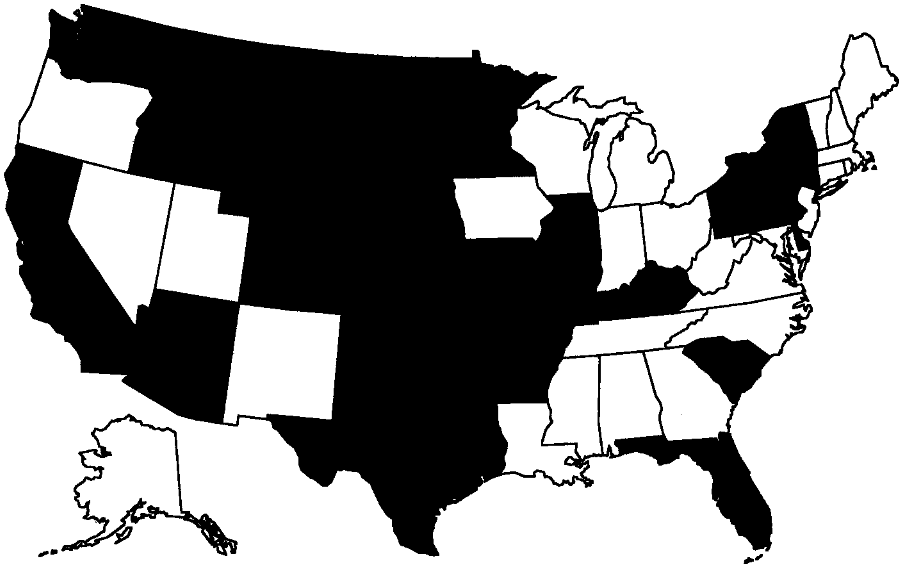

Figure 1. States participating in the 1995 national duck hunter survey (shaded).

A six-page, self-administered survey instrument (Appendix A) was developed in collaboration with state waterfowl managers, Ducks Unlimited staff and experts in human dimensions research. Included with the survey were a standardized cover letter and a postage-paid, pre-addressed envelope (or equivalent) for returning the survey to the cooperator. The cover letter identified the origin of the survey as the state wildlife agency, and requested that the recipient complete and return the survey as an aid to informing future waterfowl management decisions. It also noted the length of time needed to complete the survey (10 minutes), indicated that the recipient's name was randomly selected and would remain confidential, and requested that the survey only be completed by duck hunters. Recipients who did not consider themselves duck hunters were asked to write "not a duck hunter" across the top of the survey cover and return the uncompleted survey to the sender.

Surveys were mailed on or about May 20, 1996, and cooperators were requested to send a follow-up survey 30 days later. However, financial constraints and a high response rate to the initial mailing caused all but seven states to forego the follow-up mailing. Cooperators entered survey responses into an ASCII data file using format guidelines provided by me. Responses were compiled by early July, and the data file of hunter responses was sent to me for compilation and analysis. Each state waterfowl biologist (except Hawaii) was also sent a "manager's survey" and asked to complete the survey as they believed the "average hunter" in their state would respond. These surveys were also returned to me, then entered into a separate database for subsequent analysis.

Statistical analyses were performed using Chi-square and ANOVA (SAS Inst., Inc. 1989). An alpha ≤ 0.05 was judged statistically significant. Because of the large sample sizes, responses that differed by only a few percentage points were often statistically significant, yet did not provide meaningful management implications. I therefore limit the discussion of my results to those contrasts that were both statistically significant and meaningful to management, and do not report probability values in the text.

Response Rates and Bias

A total of 10,801 usable duck hunter responses were obtained. The number of responses from the Pacific (2,323), Central (3,512), Mississippi (2,411) and Atlantic (2,112) flyways were reasonably balanced (443 respondents did not indicate the flyway in which they hunted). An average of 448 usable responses were received per participating state. Survey response rate was 54.5 percent and duck hunter response rate averaged 45 percent, based on data from 13 states that provided information necessary to calculate response rates.

Because no follow-up mailing was made to nonrespondents, I attempted to gauge the potential magnitude and nature of nonresponse bias by comparison with a similar waterfowl hunter survey. Pierce et al. (1996) conducted a survey of factors affecting waterfowl hunting participation in Colorado using a 13-page survey containing questions that were identical or similar to my national survey. However, they followed their initial mailing with a reminder postcard two weeks later, followed by another survey mailed two weeks after the postcard. These mailings resulted in a 54-percent response rate. Individuals who still had not replied to these mailings were contacted by phone and asked to respond to a subset of the original questions. Even though phone respondents had an average of 5.2 more years of hunting experience than those who responded to mail surveys, they did not differ ($P < 0.05$) with respect to their use of private lands for hunting, the number of days they hunted or the number of birds they bagged. Thus, the findings of Pierce et al. (1996) provide some comfort that the response bias in my survey, if one exists, is likely to be small with respect to questions relating to participation rates and hunting success.

Hunter Characteristics

All but 2 percent of the respondents in the national survey were male, with a mean age of 41 (see Appendix A for complete numeric data). They averaged nearly 20 years of duck hunting experience. Although most respondents hunted during each of the previous four seasons, one-third hunted some, but not all of the last four years. Nearly 69 percent planned to hunt more than seven times in 1996.

I attempted to quantify multiple motivations for hunting using a five-point scale (ranging from not important to extremely important) and identical wording to that used by Enck et al. (1993) to describe multiple motivations for hunting. I considered the three basic motivations for hunting previously identified by Enck et al. (1993): (1) achievement-oriented hunters attempt to meet a self-determined standard of performance, such as bagging the limit of game; (2) affiliative-oriented hunters primarily accompany others afield to maintain or strengthen personal relationships; and (3) appreciative-oriented hunters seek the sense of peace, belonging and familiarity they associate with hunting. Of the three motivators, appreciative factors were most important to survey respondents. Affiliative factors were only slightly less important. Of least importance were achievement-oriented factors. These results are consistent with those of Enck et al. (1993).

The Importance of Bag Size, Season Length and Duck Abundance

Hunters were presented with hypothetical scenarios and asked to indicate their likelihood of participation compared with the previous year. They indicated whether they would hunt (1) no days, (2) fewer days, (3) the same number of days, (4) more days, or (5) don't know, based on alternative scenarios for bag size, season length and duck abundance. When asked how their participation would change as bag size increased but season length and duck abundance remained constant, 67 percent of respondents indicated they would not hunt or would hunt fewer days at a bag size of one. However, as bag sized increased to three ducks, most respondents would hunt the same number of days as the previous year. Expected participation increased little at bag sizes greater than six. Respondents slightly favored setting a bag limit that did not exceed a certain size (mean = 5.6 ducks), as opposed to a bag limited that was as large as possible yet consistent with population maintenance.

Given similar duck abundance and a bag size the same as the previous year, 67 percent of respondents would not hunt or would hunt less with a one-week season. Half of the respondents would hunt the same number of days with a five-week season, with increasing rates of participation up to 13 weeks. When presented with a choice of an additional bird in the bag or another 10 days of season, 71 percent of respondents indicated they would prefer the additional days. Remarkably, this result is nearly identical to the response reported by Smith and Roberts (1976) from a survey conducted 20 years ago. Given tradeoffs between (1) losing 10 days of season but gaining a duck in the bag, (2) losing a bird in the bag but gaining 10 days of season, or (3) maintaining current bag size and season, respondents were evenly split (44 percent each) between wanting additional days and maintaining the status quo. However, if hunting opportunity had to be restricted, 67 percent would prefer to lose one duck from the bag, whereas only 25 percent indicated they would prefer to lose 10 days of season.

Duck abundance had a greater effect on anticipated participation rates than either bag size or season length. Expected participation increased in a nearly linear function as hypothetical duck abundance varied from half the number of ducks seen the previous season to twice the number of ducks seen the previous season. However, 32 percent of respondents indicated that duck abundance did not affect their decision to hunt. Of those who did consider duck abundance when deciding whether to hunt, most (32 percent) relied on the number of ducks they saw or reports of duck abundance from friends to make their decision; only 15 percent relied on reports from wildlife agencies.

How Do Special Regulations Affect Hunter Participation and Satisfaction?

Bag restrictions for certain species or sexes of ducks, zones and season splits are regulations that are enacted to direct harvest pressure or increase hunter satisfaction. Additionally, opening the season on a weekend day, minimizing the annual changes in regulations and keeping regulations simple are intended to enhance hunter satisfaction and participation. My survey asked hunters to indicate their satisfaction with these "special" regulations, and attempted to gauge how the regulations affected participation and hunters' understanding.

Most respondents indicated that duck hunting zones and season splits did not make regulations hard to understand. Moreover, bag restrictions on certain species or sexes of ducks and simpler duck hunting regulations did not bear on a respondent's decision to hunt ducks. Most hunters would be unwilling to accept an overall smaller bag limit in exchange for fewer species and sex bag limit restrictions. Only 4 percent of respondents indicated that complex regulations deterred them from hunting during an entire season, and most (56 percent) did not care whether regulations change annually. However, 47 percent indicated that simplifying the regulations would increase their hunting satisfaction, whereas 52 percent said that simpler regulations would have no effect on satisfaction. When asked to select the single factor that most affected their decision to hunt ducks each season, 35 percent indicated that duck abundance was most important, followed by season length (18 percent), bag size (7 percent) and special regulations (3 percent). However, the greatest percentage (37 percent) indicated that none of the above factors most affected their decision to hunt.

Even though most respondents indicated that regulations were understandable and not a deterrent to participation, the question remains whether such regulations enhance hunter satisfaction. When hunters were asked this question directly, the large majority of respondents indicated that the special regulations discussed above had no effect on their duck hunting satisfaction. Surprisingly, even opening the duck season on a weekend did not affect the satisfaction of the majority of respondents (49 percent), although a large minority (39 percent) indicated that weekend openings did increase their satisfaction. Decreased satisfaction was associated with regulations for species and sex bag restrictions (22 percent) and annual changes in regulations (32 percent).

State and Flyway Differences

Although many statistically different responses were apparent among states and flyways, few were large enough to have meaningful implications to harvest management, and trends in responses were similar among flyways. Respondents from the Mississippi Flyway (MF) hunted more days in 1995 (mean = 15.6) than respondents from other flyways (mean = 11.2), and also reported bagging more than 10 ducks more frequently than respondents from other flyways (50 percent of MF respondents versus mean of 42 percent for other flyways). Over the previous four years, MF hunters were more consistent participants than Central Flyway (CF) hunters. Pacific Flyway and CF hunters desired slightly larger bags than the eastern flyways, and CF respondents were less concerned about preserving season length and more concerned about bag size than the other flyways. MF respondents were motivated by affiliative factors to a greater extent than hunters in the other flyways, which was reflected in their somewhat lower sensitivity to special regulations and regulatory changes.

How Well Do Waterfowl Managers Know Their Hunters?

Thirty-one of 49 state waterfowl biologists completed the manager's survey, in which they provided responses that they felt represented the opinions of the average duck hunter in their state. Except as noted below, the responses of managers generally reflected the opinions of the hunters. Managers felt that most (71 percent) of their hunters would report bagging 1 to 10 ducks during the season, but in fact most respondents reported bagging more than 10 ducks. Most hunters reported participating during each of the last four seasons, whereas managers believed that the slight majority of hunters would have indicated sporadic participation. Managers thought hunters would participate less frequently at small bag sizes, but more often at large bag sizes, than was indicated by respondents (Figure 2a). Similarly, managers overestimated the negative effects of short seasons on hunter participation, and also overestimated the increased participation response resulting from longer seasons (Figure 2b). If ducks were to become more abundant, respondents indicated they would hunt more often, but their positive response was not as great as predicted by managers. Most managers anticipated that their hunters obtained information on duck abundance most often from magazine and newspaper articles (40 percent), but only 4 percent of respondents indicated that they use these media as their primary source of duck abundance information.

Greater discrepancies between managers and respondents were apparent concerning the effects of special regulations. Generally, hunters were more accepting of special regulations than expected by managers. For example, 72 percent of managers believed that their hunters would experience decreased satisfaction as a result of species and sex bag restrictions, whereas only 22 percent of respondents indicated that such regulations would decrease their satisfaction. Similarly, most respondents (46 percent) did not want to accept a smaller bag in exchange for simpler regulations, whereas managers felt that their hunters (53 percent) would prefer this option. Managers believed that only 3 percent of respondents would indicate that zones and season splits decreased their hunter satisfaction, but in fact 23 and 32 percent of respondents, respectively, felt that these regulations decreased their hunting satisfaction. The converse was also true; 6 and 11 percent of respondents indicated increased satisfaction from zones and splits, respectively, whereas managers felt that their hunters (36 and 53 percent, respectively) received increased satisfaction from zones and season splits. Managers also thought that hunters would overwhelmingly (91 percent) favor a weekend opening for the hunting season, but a minority of respondents (42 percent) felt that weekend openings made a difference to them. The abundance of ducks was expected by managers to be the most important factor affecting their hunters' decision to participate (60 percent), but fewer respondents (35 percent) were concerned with duck abundance than with factors unrelated to regulations (37 percent).

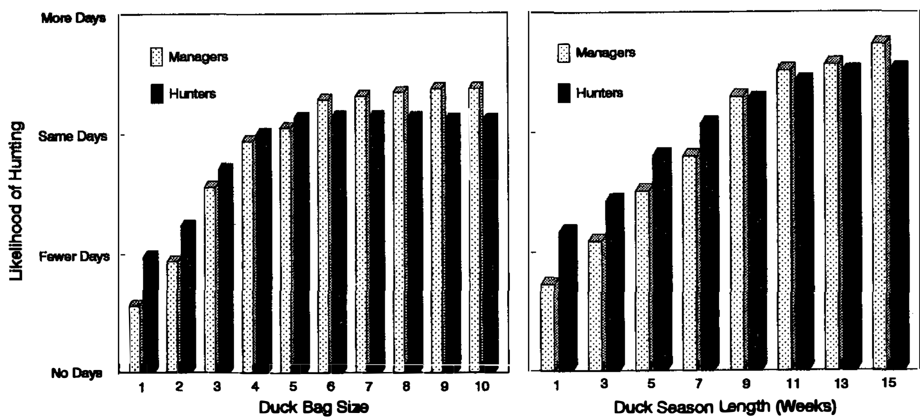

Figure 2. Mean rank of the likelihood of participation in duck hunting as a function of bag size (2a, left) and season length (2b, right). Darker bars indicate hunter responses, and lighter bars depict expected hunter responses as anticipated by waterfowl harvest managers.

Why do the perceptions of managers differ from those expressed by hunters? Managers have tended to formulate regulations to increase harvest, such as zones and splits that maximize the likelihood of shooting ducks, or the opportunity for adept hunters to achieve a higher bag by being more selective in the species or sexes of ducks they shoot. These actions address achievement motivations for hunting, but do little to satisfy most hunters, who are more motivated by affiliative or asssociative factors. When responding to the survey questions on motivation factors, managers consistently overestimated the importance of achievement motivators to hunters, while underestimating the importance of affiliative and appreciative factors.

Trends in Waterfowl Harvest Management

The bases for scientific waterfowl management are the extensive databases on breeding and wintering habitat, populations and harvest surveys, and band recoveries that provide information on the distribution of harvest, harvest rates and annual survival rates of waterfowl. Expanded application of these monitoring systems in the 1950s provided new information that was used to fine-tune waterfowl harvest management. The benefits were more liberal bags and seasons, but the cost was increased regulation complexity. Species and sex restrictions in the duck bag became more common in an effort to maintain the largest acceptable bag size while protecting species in need of reduced harvest pressure. In 1977, only 30 hunting zones existed in the U.S., and only 10 of these contained split seasons. In 1985, the number of zones increased to 80, most of which contained season splits (F. A. Johnson personal communication: 1997).

Examples of contentious harvest management issues that have surfaced in the 1990s include whether: (1) the framework date for opening of duck season should be October 1 or the Saturday nearest October 1, which would allow the season to open on a weekend; (2) an additional redhead (*Aythya americana*), wood duck (*Aix sponsa*) or other species should be included in the bag; (3) an additional day or two should be added to season length to allow season splits to open and close on weekends; (4) a management unit is really a zone and, therefore, precludes the ability of a state to offer an additional split over and above the two or three already in place; and (5) whether a smaller duck bag with fewer species and sex restrictions should be offered as a simpler alternative to the traditional duck bag. The desire to increase hunter participation and enhance hunter satisfaction was the motivation for these and similar debates. Unfortunately, objective data on the relationship between regulations and hunter satisfaction was unavailable to decision makers. Ironically, my data indicate that these issues have little effect on hunter participation, and even less effect on hunter satisfaction.

The Need for Change

Waterfowl management is changing. Adaptive Harvest Management is providing a framework for making better management decisions and forcing us to contemplate our true objectives for harvest management. The enthusiastic participation by 23 states in this national duck hunter survey is evidence of the desires of waterfowl harvest managers to learn more about their clients, the waterfowl hunters. Progress will continue only if managers make their sociological judgements with the same scientific rigor they use to make biological decisions. Focused, well-executed, human dimensions research is the foundation for informed sociological decisions. Although we need better understanding of the relationships among regulations, hunter participation and hunter satisfaction, knowledge is not enough. The more difficult challenge will be to change our paradigms about the satisfactions that hunters receive from hunting regulations, and then use our knowledge to formulate new regulations to meet the desires of those hunters.

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Appendix A

Appendix A. The North American Duck Hunter survey, as administered by 23 states in 1996. National averages are denoted by bold numbers followed by ±standard deviations and (sample size). Percentages are shown in bold, followed by total sample size for the question.

North American Duck Hunter Survey

Part A. We would like to know more about you and your duck hunting experience.

1. What year were you born? **1954.73 ± 13.52 (10,294)**
2. Are you: a. male **98.1%** b. female **1.9% (10,780)**
3. Which state do you hunt ducks in most often (if Montana, Wyoming, or Colorado, please also indicate Pacific or Central Flyway)?
4. How many years have you hunted ducks? **19.95 ± 14.23 (10,680)**
5. During the 1995-96 season, how many days did you hunt waterfowl (ducks, geese, and swans)? **12.10 ± 11.41 (10,556)**
6. How many ducks did you bag last season, 1995-96 (check one)?
   a. **9.9%** Did not hunt ducks last season.
   b. **8.7%** Bagged none.
   c. **38.3%** Bagged 1-10.

d. **43.0%** Bagged more than 10. **(10,728)**

7. In 1995-96, did you hunt with a family member who was under 18 years old?
   a. Yes **24.0%**   b. No **76.0% (10,705)**
8. If you answered yes to question 7, how many youth hunters in your family did not require hunting licenses because of their age? **0.90 ± 0.81 (2,598)**
9. Which one of the following statements best describes your participation in **duck hunting** during the **last 4 years** (check one)?
   a. **61.8%** I hunted ducks during each of the last 4 seasons.
   b. **33.7%** I hunted ducks during some, but not each, of the last 4 seasons.
   c. **4.0%** I am new to the sport of duck hunting, and last year was my first season.
   d. **0.6%** I plan to hunt ducks for the first time next season. **(10,715)**
10. How many days do you expect to hunt ducks **next year** (check one)?
    a. **1.9%** None.
    b. **29.4%** Less than 7 times.
    c. **68.7%** 7 or more times. **(10,763)**

Part B. The following questions relate to **BAG SIZE**, or the number of ducks you can shoot in one day.

In questions 1-10 below, we would like to know how you would react if the duck season length and the number of ducks you saw were the same as last year, and the **bag limit** was as indicated below (circle the appropriate number for each bag limit).

	Compared to last year, I would hunt				
If the bag limit was:	No days (wouldn't hunt)	Fewer days	The same # of days	More days	~~Don't know~~
1. 1 duck per day	**40.5%**	**27.2%**	**26.2%**	**6.1%**	**(9,492)**
2. 2 ducks per day	**25.4%**	**31.4%**	**36.8%**	**6.4%**	**(9,581)**
3 3 ducks per day	**9.4%**	**18.4%**	**63.7%**	**8.4%**	**(9,645)**
4. 4 ducks per day	**3.0%**	**7.2%**	**76.3%**	**13.5%**	**(9,697)**
5. 5 ducks per day	**1.5%**	**4.3%**	**74.0%**	**20.2%**	**(9,634)**
6. 6 ducks per day	**1.9%**	**6.8%**	**66.0%**	**25.3%**	**(9,362)**
7. 7 ducks per day	**2.4%**	**9.3%**	**60.0%**	**28.3%**	**(9,128)**
8. 8 ducks per day	**2.9%**	**10.8%**	**56.8%**	**29.5%**	**(9,000)**
9. 9 ducks per day	**3.2%**	**11.6%**	**56.1%**	**29.1%**	**(8,906)**
10. 10 ducks per day	**3.3%**	**11.7%**	**55.8%**	**29.2%**	**(8,912)**

11. If duck hunting opportunity could be **increased** over what was offered last year, would you prefer to have (check one):
    a. **21.0% Bag size increased** by one duck and **season length stay the same** as last year.
    b. **70.9% Season length increased** by 10 days and **bag size stay the same** as last year.
    c. **8.1%** Don't care or no opinion. **(10,736)**
12. If duck hunting opportunity could be **the same** as last year, would you prefer to have (check one):

a. **11.9% Bag size increased** by one duck and the **season length reduced** by 10 days.
b. **44.3% Season length increased** by 10 days and **bag size reduced** by one bird.
c. **43.8%** Same season length and bag size as last year (no change). **(10,687)**

13. If duck hunting opportunity had to be **decreased** from what was offered last year, would you prefer to have (check one):
    a. **67.5% Bag size decreased** by one duck and season length stay the same as last year.
    b. **25.3% Season length decreased** by 10 days and bag size stay the same as last year.
    c. **7.2%** Don't care or no opinion. **(10,683)**
14. Have you ever **not** hunted during an entire season because the bag size was too small?
    a. **13.6%** Yes b. **81.7%** No c. **4.6%** Don't remember **(10,750)**
15. When duck populations are high, which one of the following statements best reflects your opinion about how duck bag limits should be set (check one)?
    a. **46.4%** I believe that the bag limit should be set as large as possible, as long as duck populations will not be harmed.
    b. **53.6%** I believe that the maximum bag should not exceed a certain size. **(10,682)**
16. If you checked 15b above, please indicate what you think the maximum duck bag limit should be: **5.57 ± 2.48 (5,539)** ducks (leave blank if you checked 15a).

Part C. The following questions relate to **SEASON LENGTH**, the number of days you can hunt ducks.
In questions 1-8 below, we would like to know how you would react if the duck bag limit and the number of ducks you saw were the same as last year, and the **season length** was as indicated below (circle the appropriate number for each season length).

	Compared to last year, I would hunt:				
If the season was:	No days (wouldn't hunt)	Fewer days	The same # of days	More days	~~Dont know~~
1. 1 week long	**30.8%**	**36.4%**	**17.9%**	**14.9%**	**(9,474)**
2. 3 weeks long	**16.9%**	**38.8%**	**28.1%**	**16.2%**	**(9,493)**
3. 5 weeks long	**6.4%**	**24.0%**	**51.7%**	**17.9%**	**(9,493)**
4. 7 weeks long	**2.7%**	**12.1%**	**60.4%**	**24.8%**	**(9,456)**
5. 9 weeks long	**1.3%**	**6.0%**	**56.8%**	**35.9%**	**(9,392)**
6. 11 weeks long	**1.1%**	**4.4%**	**45.8%**	**48.7%**	**(9,210)**
7. 13 weeks long	**1.2%**	**4.5%**	**37.1%**	**57.2%**	**(9,091)**
8. 15 weeks long	**1.3%**	**4.8%**	**34.4%**	**59.6%**	**(9,146)**

9. Have you ever **not** hunted ducks for an entire season because the season was too short?
    a. **12.0%** Yes b. **82.0%** No c. **6.0%** Don't remember **(10,626)**

Part D. The following questions relate to the **ABUNDANCE OF DUCKS** and your interest in hunting.

1. Which of the following sources of information about duck abundance **most** affects your decision to hunt ducks (check one)?

a. **14.8%** The duck populations reported by state and federal wildlife agencies.
b. **8.2%** The duck populations reported by Ducks Unlimited and other sporting groups.
c. **4.5%** Magazine and newspaper articles about anticipated duck populations.
d. **32.5%** The number of ducks my friends and I see before and during the season.
e. **32.4%** Reports of duck abundance generally don't affect my decision to hunt.
f. **7.6%** None of the above. **(10,385)**

In questions 2-6 below, we would like to know how you would react if the duck bag limit and the season length were the same as last year, and the number of ducks reported by your best information source was as follows (circle the appropriate number for each prediction).

If the reported number of ducks was:	Compared to last year, I would hunt: No days (wouldn't hunt)	Fewer days	The same # of days	More days	~~Don't know~~
2. Only half the number of ducks as last season.	**11.6%**	**42.3%**	**43.3%**	**2.7%**	**(1,155)**
3. Somewhat fewer ducks than last season.	**4.0%**	**23.5%**	**69.4%**	**3.1%**	**(9,929)**
4. The same number of ducks as last season.	**1.0%**	**1.7%**	**87.6%**	**9.6%**	**(10,070)**
5. Somewhat more ducks than last season.	**0.5%**	**0.6%**	**64.2%**	**34.8%**	**(9,993)**
6. Twice the number of ducks as last season.	**0.4%**	**0.7%**	**38.3%**	**60.6%**	**(9,857)**

7. Have you ever **not** hunted ducks for an entire season because the reported population of ducks was too low?
   a. **18.2%** Yes b. **77.1%** No c. **4.7%** Don't remember **(10,641)**

Part E. The following questions relate to **SPECIAL REGULATIONS,** which describe what species and sexes of ducks you can keep, and when, where, and how you can hunt ducks.

1. Do bag restrictions for certain species or sexes of ducks (for example, no more than 1 hen mallard in the bag) **affect your decision to hunt** ducks?
   a. **12.1%** Yes b. **87.9%** No **(10,698)**
2. How do bag restrictions for certain species or sexes of ducks affect your duck hunting **satisfaction**?
   a. **13.5%** Increases satisfaction b. **64.9%** No effect c. **21.6%** Decreases satisfaction **(10,687)**
3. Would you be willing to accept an overall smaller bag limit to have fewer species and sex bag limit restrictions?
   a. **30.0%** Yes b. **45.7%** No c. **24.3%** No opinion / don't know **(10,695)**

4. Do duck hunting zones (areas that have different opening or closing season dates) make hunting regulations hard to understand?
   a. **37.9%** Yes b. **56.3%** No c. **5.9%** Not applicable **(10,698)**
5. How do duck hunting zones affect your duck hunting **satisfaction**?
   a. **5.6%** Increases satisfaction b. **71.1%** No effect c. **23.3%** Decreases satisfaction **(10,686)**
6. Do season splits (open and closed periods for duck hunting) make the duck hunting regulations hard to understand?
   a. **29.9%** Yes b. **67.4%** No c. **2.8%** Not applicable **(10,716)**
7. How do duck hunting season splits affect your duck hunting **satisfaction**?
   a. **11.5%** Increases satisfaction b. **56.0%** No effect c. **32.5%** Decreases satisfaction **(10,684)**
8. Does it make a difference to you whether the start of the duck hunting season occurs on a weekend?
   a. **42.1%** Yes b. **57.9%** No **(10,726)**
9. How does opening the duck season on a weekend affect your duck hunting **satisfaction**?
   a. **39.5%** Increases satisfaction b. **49.2%** No effect c. **11.3%** Decreases satisfaction **(10,715)**
10. Does it make a difference to you whether the duck hunting regulations change from year to year?
    a. **44.1%** Yes b. **55.9%** No **(10,697)**
11. How does changing the duck hunting regulations from year to year affect your duck hunting **satisfaction**?
    a. **5.8%** Increases satisfaction b. **61.8%** No effect c. **32.4%** Decreases satisfaction **(10,615)**
12. Overall, would simplifying the regulations **affect your decision to hunt** ducks?
    a. **28.5%** Yes b. **71.5%** No **(10,714)**
13. How would simplifying the regulations affect your hunting **satisfaction**?
    a. **46.7%** Increases satisfaction b. **52.3%** No effect c. **1.0%** Decreases satisfaction **(10,686)**
14. Have you ever **not** hunted ducks for an entire season because the duck hunting regulations were too hard to understand?
    a. **4.2%** Yes b. **94.1%** No c. **1.7%** Don't know **(10,721)**
15. Overall, which one of the following most affects your decision to hunt ducks each season (check one)?
    a. **6.8%** Bag size
    b. **18.3%** Season length
    c. **35.5%** Abundance of ducks
    d. **2.7%** Special regulations
    e. **36.8%** None of the above **(10,618)**

Part F. Questions 1-3 below list descriptions of 3 general types of satisfactions that a person could seek from duck hunting. Please read each description carefully, then circle the number that indicates **how important** those particular kinds of satisfactions are to you **as a motivation to hunt ducks**.

	Not Important		—>		Extremely important
1. Satisfaction Group 1					
Getting a bag limit or almost always being successful in bagging ducks, making a difficult shot, showing ducks bagged to family or friends, being thought of as a good duck hunter, or having good duck hunting equipment.	0	1	2	3	4
	1.89 $\pm$ 1.25 (10,561)				
2. Satisfaction Group 2					
Sharing stories of duck hunting activities with companions, maintaining traditions of duck hunting with others, or simply being afield with other people you like.	0	1	2	3	4
	3.32 $\pm$ 0.92 (10,612)				
3. Satisfaction Group 3					
Simply getting away from everyday problems, experiencing the solitude, smells, and sounds of the outdoors through duck hunting, and observing all types of waterfowl.	0	1	2	3	4
	3.67 $\pm$ 0.67 (10,647)				

THANK YOU VERY MUCH FOR YOUR PARTICIPATION. PLEASE RETURN THE SURVEY AS INSTRUCTED IN THE COVER LETTER.

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Enhancing Biological Performance of the North American Waterfowl Management Plan

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Waterfowl managers, like all natural resource managers, routinely make decisions in the face of restricted choices, limited financial resources and incomplete biological information. Rarely do they have the luxury of postponing action until sociopolitical conditions are more favorable or the outcome of management more certain. In fact, to do so would be ill-advised in cases where threats to populations or their habitats are imminent. In a very real sense, managers take calculated risks, weighing as best they can the competing interests of various groups, and the likely short- and long-term consequences of alternative management actions. Despite these difficulties, the pressure on waterfowl managers to make effective decisions is intense (Johnson et al. 1996).

Perhaps nowhere is this more evident than in the North American Waterfowl Management Plan (Plan), which is a multi-billion dollar effort to restore the continent's waterfowl resources to desirable levels. Inherent in this unprecedented undertaking is a degree of uncertainty about the most important factors limiting population growth and the effectiveness of management interventions (Anderson et al. 1996). For example, managers routinely ponder such questions as:

(1) How much good-quality habitat in the prairie-parkland region is needed to meet duck population objectives?
(2) In efforts to increase wintering survival along the Gulf Coast, should a higher priority be paced on securing natural freshwater marsh or on managing impounded agricultural land?

(3) What are the most cost-effective methods for increasing nest success?
(4) What composition and configuration of habitat types will produce the highest survival or recruitment rates?
(5) How should Plan funds be allocated between breeding, migration and wintering areas?
(6) What management actions would help ensure that nest success in planted cover is high enough to sustain local breeding populations?

We understand that managers will make the best decisions they can where conclusive answers to these types of questions are lacking. However, as members of the Plan's Evaluation Team, our role is to help managers learn from the experience of those decisions, so that Plan partners ultimately can achieve the highest possible performance from their programs.

Our purpose here is to stimulate dialogue about the implications of incomplete biological information for the design, delivery and success of habitat conservation programs. Although writers of the Plan noted the importance of learning from experience, evaluation programs often have been perceived as competitors for funds better spent on managing habitat. On the other hand, we probably have failed to demonstrate convincingly that evaluation is relevant to the performance of habitat management programs. Therefore, arguments to finance environmental monitoring or assessment of management programs have not always been compelling. As a result, feedback to Plan partners regarding the effectiveness of management programs has been limited (Anderson et al. 1996).

We believe the ability to achieve the biological objectives of the Plan ultimately may depend on our success in convincing Plan partners that evaluation is both relevant and cost-effective. We hope to do this in part by demonstrating that science and management can be integrated in ways that are comfortable and productive for managers. For the purpose of this paper, we define "science" as the accumulation of reliable knowledge, and "management" as the application of that knowledge in the sociopolitical arena. We believe that the integration of science and management is best served by departing from traditional approaches to science, which Holling (1993) refers to as "disciplinary, reductionist, and detached from people, policies, and politics." Rather, we stress the importance of "civic science," which also embodies the pursuit of reliable knowledge, but with an awareness and sensitivity to the real-world constraints faced by public policymakers (Lee 1993).

In exploring this notion, we address two questions regarding the design of habitat conservation programs in the face of incomplete biological information:
(1) How can managers determine the value of information, recognizing that some uncertainties are more critical to effective management than others?
(2) How should the value of information affect the design of management programs?

After briefly exploring these issues, we identify some of the implications for Plan delivery. Most concepts we present are not new, but have been discussed by fish and wildlife managers for some time. Interested readers are referred in particular to Holling (1978), Bailey (1982), Macnab (1983), Walters (1986), Sinclair (1991) and Nichols et al. (1995) for a fuller expression of these ideas. Our intent here is to provide a perspective that will interest Plan partners.

The Value of Information

Lee (1993) believes information is valuable as long as it increases the chances of success. Although we agree, information also must be worth the cost of its acquisition. The difficult question for managers is how much time and money should be invested in the environmental monitoring and assessment needed to provide useful feedback? Because nature gives up its secrets reluctantly (i.e., at high cost), managers often are hesitant to gamble limited resources on the chance that acquired information will improve long-term management performance. Often, their reluctance may be well-founded. The traditional scientific view that *all* biological information has intrinsic value has little place in management. Sometimes the cost of acquiring useful information exceeds the potential benefits that might accrue, or the best management action is the same whether the information is available or not.

We believe arguments to invest more heavily in Plan evaluation will not be successful if we cannot demonstrate, in explicit and tangible terms, the net benefit expected from increasing information about waterfowl biology and management impacts. Indeed, the analysis of uncertainty should become a topic in itself (Holling 1993), where objective assessments are made regarding the benefits and costs of new information expressed in terms relevant to managers. These assessments rely on decision theory (Holling 1978, Lindley 1985), but need not be complex or quantitative to be useful. Unfortunately, decision theory rarely is an integral part of wildlife curricula; most natural resource managers are trained more as researchers than designers of public policy.

To demonstrate how the value of information can be determined, consider the manager who is concerned about the success of his/her program to increase nest-success rates through grassland restoration. The manager's grassland treatments produce a nest success of about 24 percent on average (Figure 1), which typically is adequate to maintain upland-nesting duck populations (Cowardin et al. 1985, R. E. Reynolds personal communication: 1997). However, because the realized nest-success rate is an average, half of the manager's treatments will produce a rate of less than 24 percent, meaning that many treatment areas will not support self-sustaining populations. How can the manager increase the odds of success? How much should be invested in the monitoring and assessment needed to reduce the incidence of "failure"?

Various researchers have suggested that nest success may be related to the amount of grassland in a given area (Cowardin et al. 1995, Greenwood et al. 1995), and indeed the manager's data tend to support this hypothesis (Figure 1). We will refer to this relationship as our alternative hypothesis of how the managed system works. The contrasting null hypothesis is that there is no relationship between the extent of perennial cover and nest success. If the alternative hypothesis were true, then the manager could increase the frequency of success by establishing only large blocks of cover or by planting small blocks adjacent to existing grassland. We refer to this management policy as "directed." The alternative policy, which we refer to as "undirected," would involve applying grassland treatments without regard to block size or condition of the existing landscape.

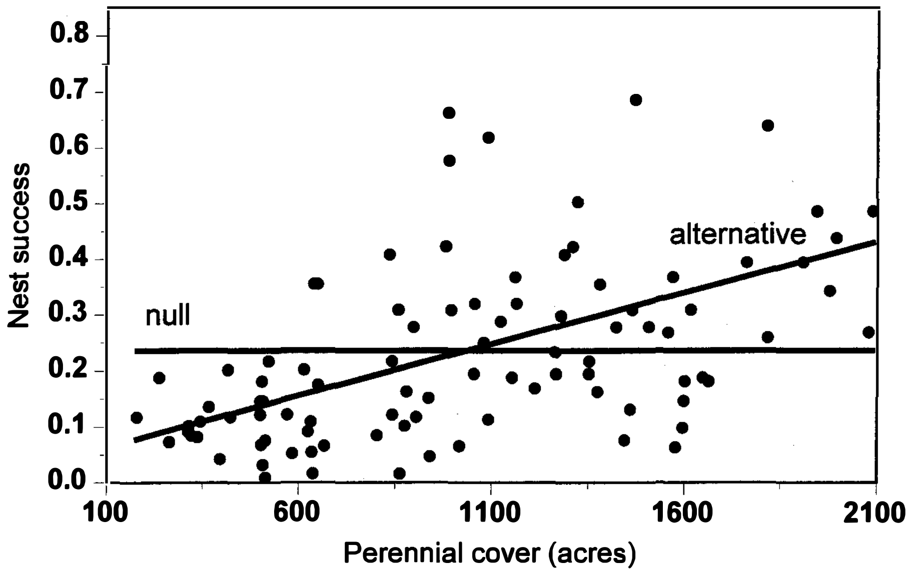

Figure 1. Estimated duck nest success in perennial cover of the eastern Dakotas and northeastern Montana, 1992 to 1995, based on a random sample of four square-mile study areas (R. E. Reynolds personal communication: 1997). The null hypothesis states that there is no relationship between nest success and acres of cover, whereas the alternative hypothesis expresses a positive relationship.

We calculated benefit:cost ratios of these two management policies relative to the competing hypotheses of nest success (Table 1). We assumed that the cost of planting cover was $94 per hectare per (Ribaudo et al. 1989) for the undirected policy. Faithful execution of the directed policy requires additional landscape monitoring so we added 25 percent to the cost of this policy. We assumed gross benefits were $500 per hectare per year, which seems realistic (Cowardin et al. 1995), but then reduced this value by the expected frequency of "failure" (i.e., nest success <24 percent) for each combination of hypothesis and management policy. Although our calculations of benefit:cost ratios are based on empirical information, we emphasize they are not applicable to all breeding-ground situations and, thus, are intended for illustrative purposes only.

What policy should the manager adopt in the face of uncertainty about the relationship between nest success and grassland acreage? If both hypotheses are deemed equally likely (i.e., complete uncertainty about which is correct), we simply average the benefit:cost ratios across the two hypotheses. In this case, the expected benefit:cost ratio is highest for the undirected policy (i.e., 2.66 versus 2.55), suggesting that the manager would be unwise to change to the directed policy without more assurance that the alternative hypothesis is correct. On the other hand, if the manager could know which hypothesis is correct, what is the maximum benefit:cost ratio he/she could expect? Here we simply average the maximum of the ratios under each alternative hypothesis (i.e., 2.98 × 0.5 + 2.66 × 0.5 = 2.82). The difference in performance between what the manager could expect without more knowledge and what the manager could expect with complete knowledge is the "value of information" (i.e., 2.82 - 2.66 = 0.16). This value represents the expected increase in performance (about 6 percent per annum in this example) if the true relationship between nest success and grassland area were known. As an aside, we note that the expected increase in performance would be different if the original odds on the two hypotheses were not 50-50 (i.e., the gain is directly related to the probability that the alternative hypothesis is correct).

Table 1. Hypothetical benefit:cost ratios for two management policies assuming that duck nest success is related (alternative hypothesis) or unrelated (null hypothesis) to grassland acreage. In the directed policy, the manager directs treatments only to those situations where he/she could attain more than 1,000 acres of grassland. In the undirected policy, the manager applies grassland treatments without regard to size.

	Benefit:cost ratio		
Management policy	Alternative hypothesis	Null hypothesis	Mean
Directed	2.98	2.13	2.55
Undirected	2.66	2.66	2.66

The value of information can be used as a measure of the investment the manager should make in evaluating the effect of grassland area on nest success. If the cost of evaluation were expected to exceed the expected gain in performance, then the manager should continue to use the undirected policy, which performs best (i.e., most cost-effective) in the face of uncertainty about which hypothesis is correct.

This type of analysis requires several key components. First, and most importantly, the goals and objectives of management must be explicit and agreed on by those doing the assessment. These objectives provide the basis for defining performance criteria so that identification of the "best" management action has meaning. Second, there must be a finite and succinct list of alternative management actions or policies. Here the manager must be realistic; if certain alternatives are not available due to sociopolitical constraints, then they should not be included in the analysis. Obviously, if only one management action is available, then the entire exercise is irrelevant. Third, the manager must be able to express biological uncertainties in terms of alternative hypotheses about how the managed system works. In our example, past experience supports at least two different hypotheses concerning the relationship between grassland area and nest success. Given each hypothesis, the expected consequences of each management policy can be calculated.

Perhaps the greatest value in this type of analysis is that it forces managers to think critically about what is involved in making good decisions in the face of limited biological information. Sometimes even very qualitative assessments can have value in structuring a problem and producing a shared perception of the issues (or at least clarifying areas of disagreement). As difficult as these assessments may be in practice, we believe they should be a prerequisite for committing financial resources to Plan evaluations.

The Uneasy Marriage of Science and Management

Assuming there is an expected net value of new information, how should the manager respond? A legitimate and often productive course of action involves allocating resources to traditional applied research (e.g., field experiments). Another approach involves taking advantage of the management process itself to gain the desired information. This alternative is likely to be acceptable, however, only when the differences between traditional science and management are recognized and accommodated.

However else they might differ, science and management tend to part company when it comes to balancing short- and long-term benefits and evaluating risk. Management of natural resources always involves tradeoffs between short- and long-term benefits and a balance between the two is needed for good overall performance (Anderson 1985). This concept is relevant here because of the recognition that all management actions impact not only the biological system, but also our understanding of that system (Macnab 1983). The manager's challenge is to balance short-term management benefits with the learning needed to improve long-term performance. The traditional scientist, however, often is inclined to prompt the manager toward aggressive learning, while making assurances that any short-term sacrifice in management performance will be mitigated over the long term. Aggressive learning is likely to be the optimal approach only in those cases where there is a high degree of uncertainty about the managed system and the impacts of management interventions (Walters and Hilborn 1978). The manager, more than the traditional scientist, must be concerned with balancing the immediate benefits of managing with incomplete information and the long-term benefits that can accrue as a result of learning.

Risk is inherent in any endeavor involving incomplete information, but scientists and managers should recognize that they often evaluate risk differently. Traditional science places great emphasis on keeping type I error rates low. Type I errors occur when the scientist concludes from the available data that there is a biological relationship or management effect when in fact none exists. Often in management, however, type II errors are of more concern, where potentially important patterns in the data go unrecognized or an effective management program is abandoned (Hilborn 1992, Lee 1993, Nichols et al. 1995). Traditional science demands high confidence (usually <10 percent chance of a type I error) before accepting evidence of a management effect or other biological pattern. Managers must weigh the evidence differently, recognizing that occasionally the potential benefits of assuming the management effect are high and the cost of being wrong is low. Sometimes with regard to statistical inference "managers must go where scientists fear to tread" (Hilborn 1992: 11).

Our distinctions between science and management have important implications for the design of evaluation programs. In most cases, Walters and Holling (1990) recommend allocating the management treatment to a larger portion of available study units and monitoring less precisely than is usually favored by researchers. However, this means evaluation programs must be implemented over longer periods of time so that there is sufficient opportunity to discern important biological patterns in the data.

Managers also may have limited opportunity to establish experimental controls so that observed responses can be attributed to the management actions in question. Where controls are lacking, investigators should account explicitly as best they can for large-scale events (e.g., hunting regulations, climate) that affect all study units (Nichols and Johnson 1989).

Recommendations

To improve biological performance of the Plan, we believe managers should think critically about how the management process could facilitate a better understanding of factors limiting waterfowl populations and responses to management. There should be more willingness to acknowledge the limits of biological understanding and to assess the potential benefits of reducing important uncertainties. Where the value of information is high, managers should strive to implement programs that balance short-term management benefits with the learning needed to improve long-term performance. Science is an essential tool in this endeavor, but it must serve the needs and perspectives of management. Managers should be willing to compromise as well, by recognizing that the autonomy of management programs occasionally must be yielded in the interest of pursuing reliable knowledge.

In some cases, managers need not be especially concerned about the limitations of available biological information. Acting as if the best available information were true, without regard for the impact on learning, sometimes can be the best policy. However, managers would be prudent to ask whether they might act differently if the odds of being successful were different. Explicit assessments of the value of information can help, although we acknowledge that such assessments often will be challenging to conduct. A greater availability of bioeconomic assessments, which make natural resource benefits tangible, would be valuable for these exercises (e.g., Hammack and Brown 1974, Cowardin et al. 1995, Teisl and Southwick 1995).

The conceptual approach we suggest is by no means a panacea for all problems associated with Plan evaluation. In fact, the explicit nature of the process will be burdensome in the short term, as all of us strive to be more methodical in our approach. We do not claim that it will be easy to express limits to knowledge in terms of concise alternative hypotheses, or that it always will be possible to gain consensus on assessments of information costs and benefits. We also recognize that there are institutional and political challenges to implementing habitat management programs that produce reliable knowledge as well as short-term management benefits. In spite of these obstacles, however, we believe that the Plan is at a critical juncture, where its continued viability will depend on our collective success in determining and improving the effectiveness of habitat management policies and programs. Obviously, Plan partners want to know the return on their investment and be assured that improved performance is a universal goal.

We recognize that improved evaluation must not come at the expense of the Plan's entrepreneurial spirit. The autonomy of Plan partners at regional and local levels is a major reason for the Plan's success and should be preserved. Cooperation among partners is desirable, however, in those cases where coordinated evaluations across spatial scales will produce tangible benefits for all involved. We believe that designing and implementing evaluations in tandem with regional and local management programs provide the best opportunity for integrating science and management, and ultimately for improving overall Plan performance.

Acknowledgments

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Challenges in Waterfowl Habitat Restoration of the Mono Lake Basin

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Mono Lake (Figure 1) is the fourth largest saline lake in North America (Russell 1889). At lake elevation 6,377 feet (conditions in 1989), the lake covers some 44,500 acres, and is a hydrologically closed, hypersaline, alkaline lake (salinity $\pm$88 gl., pH 9.8-10.0) losing water only by evaporation (Stine 1991a). Like other closed lakes in the Great Basin, water levels fluctuate because of changes in inflow and evaporation. During the past 3,800 years, Mono Lake has fluctuated over a vertical range of about 131 feet (Stine 1990). In 1857 the lake level was 6,407 feet, reached a historic high of 6,428 feet in 1919, and declined to 6,417 feet by 1940, prior to water diversions by the Los Angeles Department of Water and Power (LADWP) (Stine 1991a: 67). The 6,417-foot level in 1940 was slightly below the level at which Mono Lake would be today if water diversions by LADWP had not occurred (Vorster 1985, Stine 1995a). However, by 1982 the lake had dropped an additional 45 feet to its historic low of 6,372 feet, because of trans-basin water diversions. While legal battles have raged over the loss of potential habitat for California gull (*Larus californicus*), Wilson's phalarope (*Phalaropus tricolor*), red-necked phalarope (*P. lobatus*) and eared grebe (*Podiceps nigricollis*) perhaps no group of birds has been more impacted than waterfowl.

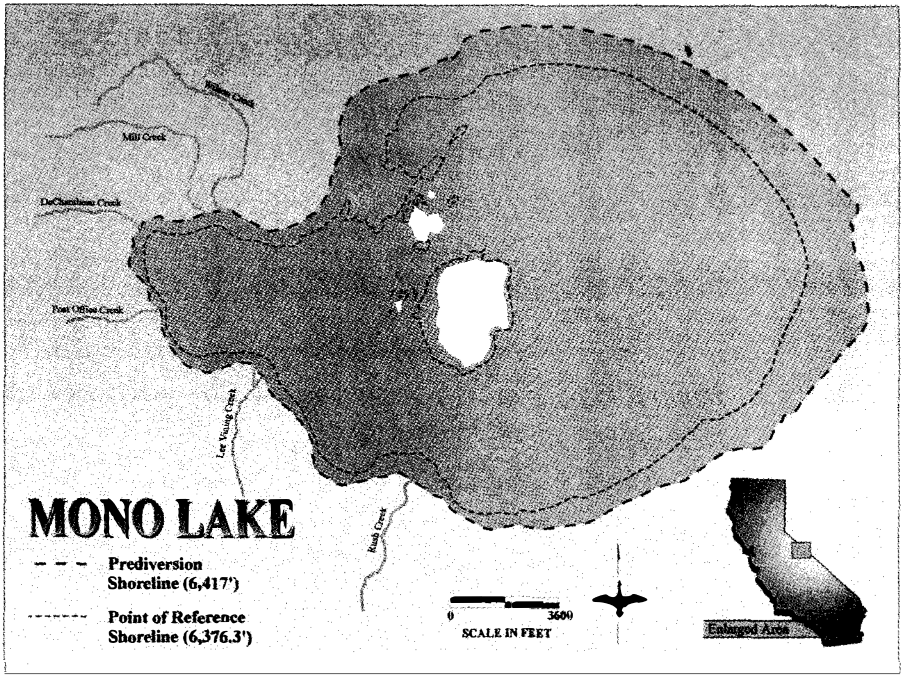

Figure 1. Mono Lake, depicting prediversion and point of reference shorelines.

Waterfowl Habitats of the Great Basin

The hydrographic Great Basin covers some 165,000 square miles and extends between the Sierra Nevada and southern Cascades in the west, to the Wasatch Mountains in the east, and south from the Columbia Plain to the Colorado Basin (Grayson 1993). It includes most of Nevada, western Utah and southeastern Oregon, with smaller sections in eastern California and western Wyoming. The Great Basin is among the most geologically diverse areas in the United States (Jensen and Platts 1990). Topographically, it contains many small to moderate size north-south mountain ranges separated by broad, level valleys (Minshall et al. 1989, Jensen and Platts 1990). All drainages are internal with no outlets to the sea. Most streams find their origin in the mountains, with the primary water supply from snowmelt, and they flow into closed basins such as Mono Lake.

Pleistocene lakes whose levels were higher than exist today because of altered ratios of precipitation and evaporation were termed "pluvial lakes." During the late Pleistocene, the Great Basin held at least 27.8 million acres of lakes, likely a conservative figure because small, ancient pluvial lakes are difficult to detect long after the fact (Grayson 1993). At least 11 times more of the Great Basin's surface was covered by water during parts of the Pleistocene than is covered today.

Some 45 permanent valley bottom lakes exist in the Great Basin today (Grayson 1993), covering 2.5 million acres, of which almost half is comprised by the Great Salt Lake. The actual area of these lakes, however, is highly variable because of changes in precipitation and diversions of water for other purposes. Most of these lakes are in the northern, eastern and western fringes of the Great Basin, with few in the south or central portions of the region.

A substantial number of Pacific Flyway waterfowl pass through the northern and central Great Basin (Figure 2) during migration between breeding grounds and wintering areas in California and western Mexico (Chattin 1964, Bellrose 1980). Wetlands

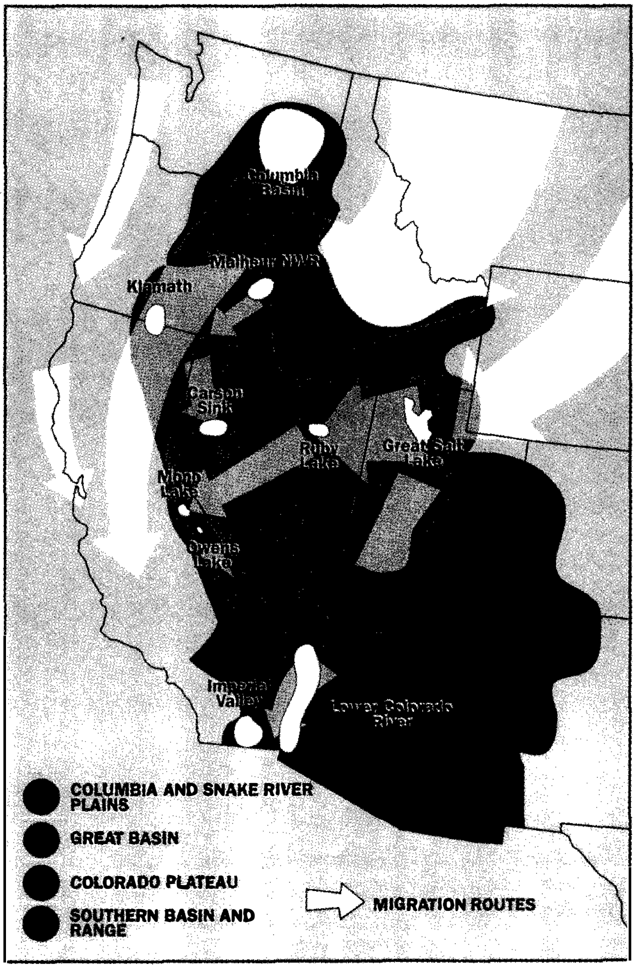

Figure 2. Conceptualized waterfowl fall migration corridors for Great Basin (after Bellrose 1980).

favored by waterfowl for migratory stopovers and breeding are usually associated with rivers, lakes or springs. Examples of major waterfowl habitats include the Great Salt Lake marsh complex in Utah (associated with freshwater deltas and springs of Bear, Jordan and Weber rivers); Ruby Lake marshes (spring fed) and Carson Sink (closed basin), Nevada; and the Malheur-Harney Lakes Basin (stream-fed) in Oregon. Many Great Basin wetlands have been impacted by human activities, especially drainage for agriculture and diversion of water for other uses (Kadlec and Smith 1989, Minshall et al. 1989, Ratti and Kadlec 1992, Jehl 1994).

Because of the arid climate and limited amounts of water, there is a perception that the region has limited value to waterfowl and other waterbirds. The importance of the Great Basin to waterfowl is perhaps best captured by Kadlec and Smith (1989: 451) who state: "In contrast to the perception that the Great Basin is a 'desert' of little value to waterfowl, the reality is that the marshes and wetlands are of higher value to waterfowl than are many areas in wetter regions. In fact, the very rarity of marshes in a dry region adds to their value." Because of limited numbers of wetland stopovers in the Great Basin, large and spectacular concentrations of migrating waterfowl often are found on suitable areas (Chattin 1964, Smith and Kadlec 1986).

Waterfowl in the Mono Basin

Pre-1955 waterfowl population data are rare for any locality in North America (Banks and Springer 1994), but California Division of Fish and Game Biennial Reports reveal a state harvest estimate of 1.9 to 2.0 million ducks in the early 1940s. Specific duck harvest estimates for 1940 in the Mono Basin indicate a harvest of 5,000 ducks, but it may have been considerably higher. Much of the actual Mono Basin waterfowl harvest may have been erroneously attributed to the Los Angeles area, since many of the hunters in the Mono Basin were recorded by their county of domicile. Even the 5,000 harvest estimate suggests a fall population level of more than 100,000 birds at Mono Lake in 1940, based on standard waterfowl harvest levels. An estimate of waterfowl harvest in 1948 for Mono Lake suggests "considering the number of ducks in the area, the season was poor from a shooting viewpoint. With a rough estimate of about 4500 man shooting days, less than 3000 birds were killed around Mono Lake" (Dombrowski 1948).

Statements by long-term residents of Mono Basin (California State Water Resources Control Board [CSWRCB] 1993), including D. Banta, K. DeChambeau, W. McPherson and J. Preston, described fall populations that numbered in the hundreds of thousands to a million waterfowl at a single time. Accounts of waterfowl in the nearby Owens River Valley, prediversions, also described more than 1 million ducks during fall migration (Jehl 1994: 267). The statements about Mono Lake duck populations were from waterfowl hunters who spent many days in the field, over many years, observing the ducks and geese they hunted. Their statements indicated that population levels stayed relatively high until the early to mid-1960s, when duck populations crashed (CSWRCB 1993). A September 1993 aerial survey, conducted by the California Department of Fish and Game (CDFG), counted less than 900 ducks on Mono Lake and associated tributaries (R. Thomas, CDFG, personal communication: 1994). Recent estimates during the 1980s-90s indicate that ±10,000 to 15,000 ducks use the Mono Basin annually (CSWRCB 1993(2): 3F 39-41).

Two CDFG employees (E. Vestal and W. Dombrowski) were in agreement with local hunters regarding much higher waterfowl population levels at Mono Lake prior to and during the early period of transbasin water diversions. Waterfowl population estimates in fall 1948 (Dombrowski 1948) indicated waterfowl numbers in the hundreds of thousands to a million. His estimates range from 175,000 to 200,000 ducks in late September, rising to 300,000 to 400,000 in late October, to "well over a million ducks" by November 1. Northern shoveler (*Anas clypeata*) and ruddy duck (*Oxyura jamaicensis*) comprised 80 percent of the duck numbers, but 70 percent of the harvest was northern shoveler; few ruddy ducks were harvested (Dombrowski 1948). Vestal (personal communication: 1994) stated he observed hundreds of thousands of waterfowl on Mono Lake on numerous occasions between 1939 and 1950, and that ruddy duck and northern shoveler were the predominant species. Vestal also noted that he had observed waterfowl in other important concentration areas in California, including some sites along the coast and in the Central Valley, yet he never observed as many waterfowl at those locations as he observed at Mono Lake in the late 1930s and 1940s. Based on current waterfowl migration corridors (Bellrose 1980), population levels of migratory waterfowl in the Great Basin and Pacific Flyway (Banks and Springer 1994, Bartonek 1995), and aerial photos depicting former lagoon and deltaic habitats along the Mono Lake shores and tributaries, prediversion lake wetland habitats supported several orders of magnitude more waterfowl than exist today.

When duck populations plunged during the 1960s, long-term local residents indicated that the ruddy duck may have become more dominant in the waterfowl community during that decade (CSWRCB 1993). Estimates of waterfowl species composition at Mono Lake in the 1980s and early 1990s by T. Taylor and J. Jehl (CSWRCB 1993) indicated that ruddy ducks and northern shovelers still predominated, comprising approximately 54 to 67 percent of the fall population, followed by green-winged teal (*A. crecca*) at 17 to 18 percent. Ruddy ducks have a higher salinity tolerance than most other ducks (CSWRCB 1993, Jehl 1994) and apparently were least affected by losses of freshwater habitats and the increasing salinities that resulted from declining lake levels.

The possibility has been suggested that waterfowl use at Mono Lake declined because duck populations that formerly stopped there no longer existed or had shifted their fall migration to other Great Basin lakes or the Central Valley of California. Indices of the number of ducks wintering in the Pacific Flyway showed declines from the late 1950s through the late 1960s, followed by increases during the 1970s, and major declines starting again during the early 1980s (Banks and Springer 1994). In the 1990s, Pacific Flyway duck populations began increasing (Bartonek 1995). It has been stated (Heitmeyer et al. 1989, Fredrickson and Reid 1990, Banks and Springer 1994) that the most important factor influencing the overall decline of most species of waterfowl in western North America and the Pacific Flyway during the past century has been the modification and hydrologic alteration of suitable habitat. In addition to the degradation of habitat in the Mono Basin, Pacific Flyway waterfowl habitats in such areas as Owens Lake, Rio Colorado/Hardy Delta, and other locations along the west coast of Mexico, Central Valley of California and elsewhere have also been degraded or totally obliterated. Winter waterfowl populations in the Central Valley have declined from 10 to 12 million birds in the mid-1960s to a current population of 4 to 6 million, representing a reduction of about 40 to 60 percent (Heitmeyer et al. 1989).

Systematic duck census data are not available from Mono Lake, but local residents reported that major declines in the lake's duck populations began during the 1960s (CSWRCB 1993). Assuming that their numbers also declined by about half between the late 1940s and early 1960s (i.e., to about 500,000 peak) and assuming about 10,000 to 15,000 ducks currently visit Mono Lake, the lake's duck populations have declined by about 97 to 98 percent since the early 1960s. In contrast, continental and Pacific Flyway midwinter and breeding population count data (Bartonek 1995) for the two dominant duck species found at Mono Lake during fall migrations (northern shoveler and ruddy duck) do not provide evidence of a population decline of this magnitude on a flyway scale. Compared with the magnitude of decline in waterfowl in the Central Valley (Heitmeyer et al. 1989) and the Pacific Flyway (Bartonek 1995), the much greater reduction in numbers of ducks in the Mono Basin since the 1960s indicates that fundamental changes in the quantity and quality of waterfowl habitat have occurred during the diversion period (CSWRCB 1993).

Reports during the 1940s and 1950s indicated that Canada geese (*Branta canadensis*), greater white-fronted geese (*Anser albifrons*), snow geese (*Chen caerulescens*) and tundra swans (*Cygnus columbianus*) also occurred as regular fall migrants at Mono Lake, but declined after the mid-1960s, although not to the same extent as ducks (CSWRCB 1993). Pacific Flyway population levels of these species generally have been stable to increasing in recent years, especially since the 1980s (Banks and Springer 1994, Bartonek 1995). Thus, recent declines in geese and swans as fall migrants in the Mono Basin result from alteration of suitable habitat rather than from declining flyway population levels of these species.

Waterfowl Habitats in the Mono Lake Basin

Numerous descriptions provided by long-term Mono Basin residents and others confirm that large populations of ducks concentrated in the lake and associated fresh and brackish wetlands prior to the mid-1960s (CSWRCB 1993). Rush Creek, including the delta area and the bottomlands below the Narrows, was recognized as a major waterfowl concentration area, and the lake-fringing habitats supported 45 percent of Mono Basin's ducks, far more than any other single area (Dombrowski 1948). The wetland complex on Rush Creek (Figure 3), including riparian, deltaic and hypopycnal areas, provided habitat requirements for loafing, foraging, courting and preening.

Detailed information concerning Mono Basin waterfowl habitats was provided in CSWRCB (1993, 1994a, 1994b), Stine (1991b, 1993, 1995 a, 1995b), Drewien et al. (1996) and records filed with the Mono Lake Committee. Preston reported that "there were so many ducks along the shore sometimes...that when they'd move out all

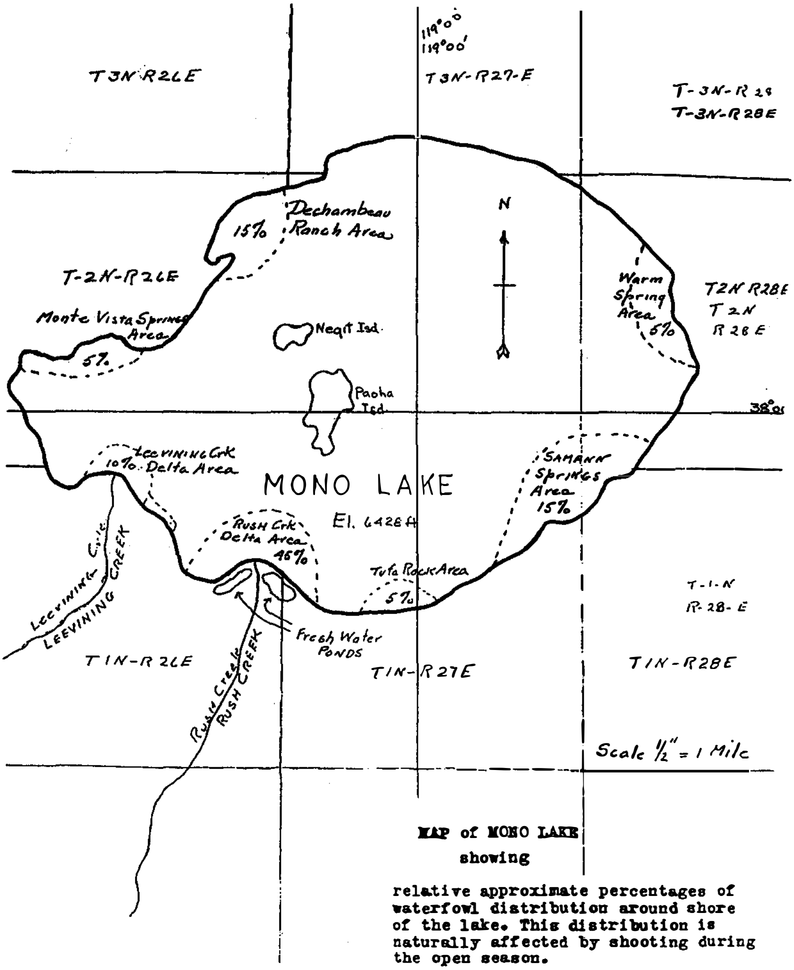

Figure 3. Fall 1948 duck population distribution (percentage) at Mono Lake (Dombrowski 1948).

together [it appeared] like the shore itself was moving out." He further stated that before diversions there were lots of duck blinds on the ponds and marshes at the mouth of Rush Creek. He postulated that ducks needed this freshwater for bathing, feeding and vegetative cover. Clover stated that "the sky used to go black with huge flocks of ducks...they fed in the lake near the mouth of Rush Creek and would rinse off their feathers in the fresh creek water. The ducks would settle in big flocks on the sandbar at the mouth of Rush Creek." Durand, raised near the mouth of Rush Creek, stated that her grandfather would bring home a gunnysack full of ducks at times. McPherson described fall duck populations that were so abundant that they appeared as a dark, moving, 10-foot wide ring around the lakeshore from the mouth of Lee Vining Creek to beyond the mouth of Rush Creek.

Likewise, Simons (Samann) Springs, Warm Springs, DeChambeau Ponds and other locations along the north and northwest shores and Paoha Island were described as important waterfowl concentration and hunting areas since the early 1900s by long-term residents (CSWRCB 1994). The major waterfowl concentration areas were associated with fresh and brackish water habitats including stratified hypopycnal environments (areas of freshwater inflows that overlay dense, saline lake water).

Declining water levels have resulted in large increases of lake-fringing wetlands classified as marsh, wet meadow and wet riparian scrub (CSWRCB 1993, Stine 1995a). Data at specific lake elevations (CSWRCB 1993, Drewein et al. 1996) suggest that at 6,417 feet lake elevation (prediversion), some 260 acres of ponds and lagoons were present; whereas, at 6,372 feet lake elevation, only 1 acre of ponds or lagoons is present and 2,859 acres of marsh, wet and alkali meadow, and wet riparian scrub are present. Our ground surveys in 1993 to 1995 revealed that the marshes are mainly choked with dense and often decadent stands of emergent aquatic vegetation. The vast increases in acreages of marsh and wet meadow habitats resulting from declining lake levels are misleading because the current condition of these habitats is mainly unsuitable for waterfowl.

Transbasin water diversions started in 1941, and by 1947, the lake began to recede. Within 20 years, water levels had fallen 30 feet, and in 1982, reached a historic low of 6,372 feet—a 45-foot drop from the prediversion period. Reductions in stream flows and the resultant decline in lake water levels adversely impacted a variety of waterfowl habitats associated with lake-fringing wetlands, springs, stream deltas and bottomlands, protected coves and bights, and hypopycnal environments in areas where freshwater inflows were reduced or eliminated. By the mid-1950s, some 200 acres of perennial brackish water lagoons had been lost along the north shore. Waterfowl habitat losses accelerated during the late 1950s and 1960s as the lake level continued to recede, specifically: (1) autumn flows in Lee Vining and Rush creeks were minimal ($\pm$2cfs-Rush Creek) to nonexistent, and creek deltas started incising; (2) lagoons, open-water marshes and freshwater ponds on delta plains disappeared due to incision; (3) wetlands in riparian habitats were greatly reduced or eliminated; (4) still-water coves and embayments along the lakeshore were stranded and then drained; (5) hypopycnal lenses were largely eliminated or disappeared; and (6) a decline occurred in the formation of ephemeral brackish lagoons along the lakeshore.

Major waterfowl use areas (percentage distribution) at Mono Lake were mapped (Figure 3) for fall migration during the early water diversion period (Dombrowski 1948) and showed that the most important areas were: Rush Creek delta (45 percent); Simons (Samann) Springs (15 percent); DeChambeau Ranch (15 percent); Lee Vining Creek delta (10 percent); South Tufa (Tufa Rock Area) (5 percent); Warm Springs (5 percent); and Mill-Wilson/DeChambeau Creek deltas (Monte Vista Springs Area) (5 percent). The combined losses of fresh and brackish open water areas greatly reduced the diversity of habitats available to the various waterfowl species and left mainly a hypersaline and hyperalkaline lake habitat that was primarily attractive to salt-tolerant waterfowl species, such as the ruddy duck and northern shoveler.

Studies of how various waterfowl species utilize different wetland habitats have not been conducted at Mono Lake. Further, virtually no information is available about hypopycnal environments and how they contribute to habitat requirements of waterfowl at Mono lake or elsewhere in the Great Basin. However, the testimony of long-term residents and information available about waterfowl habitat use in other Great Basin wetland complexes clearly support the concept that no single form of wetland habitat supplies the daily or seasonal needs of waterfowl (Smith and Kadlec 1986, Kadlec and Smith 1989, Reid 1993). The lakeshore, open lake and upwelling areas of the hypopycnal environment all are important sites for foraging on brine shrimp (*Artemia monica*) and alkali fly (*Ephydra hians*) (Dana and Herbst 1977, Lenz 1984, Boula and Jarvis 1984). Creek deltas and freshwater ponds are critical for bathing, drinking, courtship display, foraging, preening and escape from inclement weather. Stream corridors and associated marshes, sloughs and wet meadows provide important thermal cover from high winds and cold temperatures, as do sheltered lakeshore coves and embayments. The differential uses of habitat types by various species indicate that no single wetland type within the Basin will supply all waterfowl needs. Rather, all of the types should be in close proximity and must be restored in quantity and quality to a functional complex in order to sustain larger waterfowl populations. Directly related to water diversion, the most reduced habitat for waterfowl at Mono Lake is the suitable open, fresh and brackish wetlands.

Public Trust and Water Right Decision 1631

In 1940, the City of Los Angeles and the LADWP received permits to divert water from four streams (Lee Vining, Rush, Walker and Parker) that are principal tributaries to Mono Lake. Lawsuits filed in 1979 by the National Audubon Society, Mono Lake Committee and others resulted in the need to amend LADWP's water rights in relation to public trust resources in the Mono Basin. The decision and order amending water right licenses came under Decision 1631 (CSWRCB 1994b), which was signed on September 28, 1994. This decision prohibits the export of water from the Mono Basin until the water level of Mono Lake reaches 6,377 feet above sea level and restricts export to only 4,500 acre-feet per year until the lake reaches 6,391 feet. When drought reduces inflows, permitted diversions would cease at lake level 6,388 feet. Hydrological modeling suggests that the lake would reach 6,391 feet elevation between 7 and 20 years, depending on snowmelt cycles (Vorster and Hasencamp personal communications: 1995). An average lake level is predicted at 6,392.6 feet, with lake water above the 6,390-foot level approximately 90 percent of the time.

The Mono lake Basin Water Right Decision 1631 (CSWRCB 1994b) further stated that LADWP must submit a waterfowl habitat restoration plan to help mitigate the loss of waterfowl habitat due to the diversion of water. The plans shall include consideration of measures to promote the restoration of affected streams and lake-fringing waterfowl habitat which are functionally linked to the streamflows and lake levels specified in this order. A scientific team completed a review of potential restoration efforts (Drewien et al. 1996) with extensive assistance (CSWRCB 1993, Stine 1995a, 1995b, 1995c) and supplied their information to LADWP and CSWRCB.

Potential for Restoration

Restoring waterfowl habitats in the Great Basin can be difficult because these wetlands are complex hydrological systems, there are competing (and often increasing) demands for water, evaporation greatly exceeds precipitation in most locations, and many of the hydrologic patterns have been altered by humans. Surface modifications to intercept precipitation and snowmelt runoff have resulted in the single greatest impact on Great Basin wetlands (Engilis and Reid 1997). It is commonly assumed that wetland losses can be mitigated by restoring or creating wetlands of equal value. However, most wetland scientists recognize that duplication of natural wetlands is impossible, and simulation is improbable because information usually is lacking about what functions were lost and how to replace them (Zedler and Weller 1990, Cairns 1992).

Land management agencies' habitat goals at Mono Lake include maintaining the scenic integrity of the area and restoring natural ecological processes (USDA Forest Service 1989, Barry and Harrison 1995). Therefore, the most acceptable waterfowl habitat enhancement and restoration projects are those that attempt to emulate natural processes. The management of pristine environments should be passive, and emphasis should be placed on investigations or monitoring that result in understanding the dynamic processes of natural production, wetland function and wildlife use (Fredrickson and Reid 1990). However, the target lake level does not restore near pristine/prediversion (6,417 feet) levels (Figure 4) or a water level of 6,405 feet or higher which is considered necessary for maximum restoration of waterfowl habitat (CSWRCB 1994b).

Opportunities for Restoration

The single most important waterfowl habitat restoration priority is increasing the level of Mono Lake to a median level of 6,392 feet as ordered in Decision 1631 (CSWRCB 1994b). This passive action, increasing flows in Basin streams and raising the lake level, will restore the largest acreage and provide the most diversity of waterfowl habitats in riparian areas, lake-fringing wetlands and hypopycnal environments.

The second highest priority is rewatering of Mill Creek, with an average annual flow of approximately 22,000 acre feet, this is the third largest stream in the Mono Basin (Stine 1995c). Since before the early 1880s water has been diverted from Mill Creek, initially for irrigation and later (beginning in 1905) for hydropower generation. These diversions have had a substantial impact on the lower 11,000 feet of the stream, destroying much of the riparian vegetation and transforming the multi-channeled bottomlands into a single-channeled system (Stine 1995c). The lowermost 5,000 feet of the stream have been further impacted since the 1940s, when Mono Lake began to fall in response to the transbasin diversion of Rush and Lee Vining creeks by LADWP. This drop in base level forced Mill Creek to incise its exterior delta, creating two elongated trenches up to 10 feet deep.

Currently, perennial flows are limited to the upper stream reaches, whereas the lower reach receives water only during the snowmelt season of very wet years. To

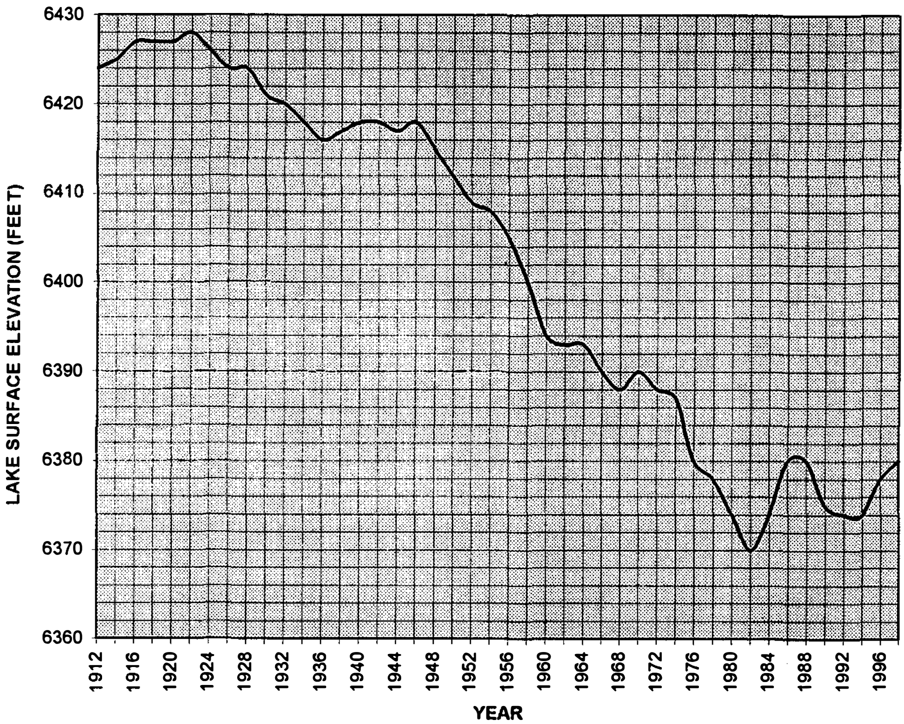

Figure 4. Mono Lake shoreline levels 1912 to 1997 (after Vorster 1985, LADWP).

restore waterfowl and other wildlife habitat, it is essential that Mill Creek be rewatered with year-round flows. High flows throughout spring and summer are essential for maintaining channel integrity, reestablishing riparian vegetation and replenishing groundwater that can then persist in fall and winter. While spills from Lundy Dam, and releases from the dam in anticipation of spills, occur relatively often, they are neither frequent enough, high enough nor prolonged enough to maintain multichannel bottomlands (Stine 1995c). Peak flows should replicate the timing and velocity of natural flows. These flows should be maximized during the spring/summer period, with increasing and decreasing flows on either end of the period to avoid unnatural lateral erosion in the stream corridor. To maintain the perennial nature of the stream and provide water to the bottomlands during the peak waterfowl use period, a flow emulating natural conditions (mean = 11.4 cfs) is critical during the fall/winter period (September to March). Restoring Mill Creek waterfowl habitat also will require the rewatering of five plugged and abandoned channels in the bottomlands, rewatering of both delta trenches, and reestablishment of perennial flows along the lower reach of the stream. Reopening the channels will provide more than 5,300 feet of additional watercourses replete with ponds, backwaters and channel-side marshes (Stine 1995c).

Rewatering of Mill Creek is dependant on obtaining additional water rights, especially in the fall/winter period, simulating the natural hydrology of periodic peak flows during the late spring/early summer period and providing base flows during the remainder of the year, and the need for structural improvements to the Mill Creek Return Ditch to convey increased flows from Wilson Creek.

Wilson Creek's channel, especially in its lower reaches, is so incised, narrow and steep that minimal waterfowl habitat exists. Historically an ephemeral channel, flowing only at peak runoff, Wilson Creek's channel currently has limited value to waterfowl and little potential for restoration. The best ecological use of current Wilson Creek water is to return most of it to Mill Creek as close to the headwaters as possible.

Prior to water diversions, Rush Creek bottomlands were characterized as 18,700 feet of primary stream channel and some 15,200 feet of secondary channel (Stine et al. 1994). This system spread water over the bottomlands and supported a high water table with a mosaic of associated riparian, marsh and wet-meadow waterfowl habitats. With transbasin stream diversions, most of these habitats were degraded or eliminated, leaving abandoned, desiccated channels and depressions, minimal acreage of marshes and wet meadows, and a reduced hypopycnal zone in the delta.

The recent perennial rewatering of Rush Creek, starting in 1984, has provided variable flows mainly to the primary stream channel and to some unplugged secondary channels. Extremely high stream flows experienced in 1995 raised the floodplain water table, rewatered additional segments of secondary channels, and flooded overflow channels and some depressional sites. In addition, the Channel 10 Complex (Reach 4B) was reopened mechanically in early October 1995, resulting in increases in the floodplain groundwater level and the rewatering of secondary channels and depressional wetlands (S. English, R. Ridenhour, S. Stine and B. Tillemans personal communications:1996). Subbing has occurred in lower portions of Channel 9 with the 1995 flows.

Additional secondary channels should be reopened in the Rush Creek bottomlands to provide small flows ($\pm$1-2 cfs) for backwater depressions. Rewatering selected channels will increase groundwater across the floodplain, reduce water velocities, increase silt deposition, and enhance the development of depressional wetlands, riparian and aquatic vegetation, marshes and seasonal wet meadows. Mechanical disturbance to surface areas by equipment should be minimized. Channels 4bii complex, 8 complex-unplugged lower portion, 11-unplugged lower portion, and 13 (Stine et al. 1994) have high potential to restore waterfowl habitat.

While fire history in the Mono Basin is limited, "fires have burned repeatedly throughout at least the past century in the Mono Basin....Fires are known to have swept over all vegetative types in the basin, including marshes, brushlands, woodlands, and forests....Within the scenic area there are known scars of over 40 fires that burned in years ranging form before 1875 to 1986, but no fire larger than 100 acres is evident. Most fires burn fewer than 10 acres before natural factors or direct intervention by fire-control teams limits their spread"(Patton 1987). Because humans have altered many natural perturbations in Great Basin wetlands, especially hydrologic cycles and wild fires, prescribed burns may simulate natural disturbances to promote vegetation diversity and habitat structure (Smith and Kadlec 1985, 1986). Our surveys of lake-fringing wetlands that exhibit degraded habitat due to the accumulation of decadent vegetation indicate that approximately 1,000 acres of marsh and seasonal wet-meadow habitats currently exist that could potentially be enhanced through a prescribed burn program. Experience from prescribed burns in other Great Basin areas indicates that cooler burns generally produce vegetative responses similar to existing vegetation and results are usually short-lived (one to three years). Hotter burns tend to stimulate growth of a greater variety of plant species and have a longer lasting effect (three to ten years) (L. Smith *in* Drewein et al. 1996). Hot burns are best achieved during late summer/early fall when temperatures are higher (75 to 90 degrees Fahrenheit), humidities are low (<30 percent) and winds are generally moderate (<15 miles per hour) (Smith and Kadlec 1985). An experimental burn was conducted at Simons Springs in November 1995 (Barry and Harrison 1995). One-time jackpot burning of debris piles in the Rush Creek Bottoms during the winter period is suggested. Continued and expanded eradication of salt cedar (*Tamerix pentandra*) is highly recommended.

At the onset of transbasin diversions, artificial freshwater ponds were created at DeChambeau Ranch. These ponds were flooded from a deep well and water was diverted out of the Mill Creek system into Wilson Creek and down into the ponds. As many as seven small ponds existed and were extensively used by waterfowl (CSWRCB 1993), principally northern shoveler, mallard (*A. platyrhyncos*), green-winged teal, northern pintail (*A. acuta*), gadwall (*A. strepera*) and Canada goose. Beginning in 1994, a consortium of partners, including USDA Forest Service, Caltrans, Mono Lake Committee and Ducks Unlimited, worked to restore the ponds and adjacent meadow. Water was obtained from groundwater pumping. The potential exists to flood the County Pond system (a natural lagoon that now is dry). Groundwater flooding (through artesian flow) of both DeChambeau and County ponds should be investigated and implemented if feasible (Drewein et al. 1996). One or several shallow depressions near Black Point could be flooded by artesian flow.

Off-site or out-of-basin mitigation measures are not recommended because adequate opportunities exist within Mono Lake Basin.

Monitoring

Baseline inventory data are a prerequisite to evaluate progress and success of habitat restoration and enhancement projects. However, baseline data on current waterfowl populations using Mono Lake are minimal and inadequate to accomplish this task. High monitoring priorities are to establish the current status of waterfowl populations by species and determine how these populations use various Mono Lake wetland habitats during fall migration. Hydrologic monitoring should include lake water levels and flow data from Mill, Lee Vining, Walker, Parker and Rush creeks, as well as springs at Simon Springs and Warm Springs.

Reduced salinity of lake waters may affect survival and population levels of brine shrimp and alkali fly. As these are probable important food items for some waterfowl species, especially northern shovelers and ruddy ducks (Boula and Jarvis 1984), annual monitoring is critical. Aerial photography of waterfowl habitats should occur annually during peak stream flows and historical waterfowl use periods (mid-October to early November). Fall aerial counts of waterfowl should include Mono Basin and nearby Bridgeport Reservoir and Crowley Lake. This will assess fall waterfowl population trends in the eastern Sierra and provide insights into interpreting rate of population changes at Mono Lake in response to restoration efforts. Activity budgets of waterfowl should be compared among various habitats within the Basin to identify responses of birds to restoration efforts (Drewein et al. 1996).

All restoration and monitoring projects should be initiated as soon as possible. If these projects are delayed, recovery of waterfowl populations in the Mono Basin also will be delayed, and evaluation of restoration efforts will be incomplete because of a lack of comparative baseline data. A scientific review team should evaluate restoration on an annual basis for adaptive management adjustments if monitoring calls for such action.

Landscape Challenges

From March 1993 to March 1997, Mono Lake has risen some 7.1 feet. Currently, the CSWRCB is deciding what additional restoration efforts, beyond raising the lake level to 6,392 feet, are needed for waterfowl habitat. Although several of the described efforts could yield substantial improvement, we do not expect restoration efforts will entirely compensate for waterfowl habitat losses resulting from transbasin diversions.

Degradation of wetlands in arid environments is not restricted to western North America. Lake Sevard in the former Soviet Union has fallen more than 45 feet because of diversions to major tributaries. The Aral Sea has diminished from greater than 26,200 to about 14,000 square miles of surface area. In an effort to irrigate some 19 million acres of crops, about half in cotton, the two major tributaries of the Aral Sea, the Syr Dar'ya and the Amu Dar'ya, have been virtually dried up. Salinity levels have tripled in the Aral Sea, and all 24 species of native fish have disappeared (Micklin 1991). In the Great Basin, both Owens and Winnemucca lakes had been totally dried by water diversions prior to 1950. A review of the biological, limnological and historical changes (primarily induced by humans) in eight of the most important saline and alkaline Great Basin lakes describes how these changes may have affected the lakes' ability to support breeding and migratory birds during the past 150 years (Jehl 1994). Based on this review, Jehl (1994) concluded that only Mono Lake, Pyramid Lake and perhaps the Great Salt Lake will likely remain largely unchanged in their ability to support current population levels of migratory birds well into the next century. This prognosis of the future availability of suitable saline and alkaline Great Basin lake habitats highlights the significance of restoring and maintaining Mono Lake's ecologically diverse wetland habitats for future use by waterfowl and the other avifauna that depend on these unique and increasingly threatened wetlands. If corridors of quality waterbird habitats are to exist in western North America, hydrologic integrity must be restored to these wetlands and enhancement of historical pathways that are currently degraded must be a priority.

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Perceptions of Releases of Captive-reared Mallards, with Emphasis on an Intensive Program in Maryland

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The release of captive-reared mallards historically has been a popular response to declining waterfowl populations. In the early 1990s, Maryland was the only state to have a legislatively mandated mallard release program and a large private release program in state licensed Regulated Shooting Areas (RSAs) (Maryland annotated Code 10-906). At their peak in the late 1980s, the Maryland Department of Natural Resources (MDNR) and private groups released about 40,000 and 100,000 mallards per year, respectively. Dorchester County had the highest number of mallard releases on RSAs (82,000) (L. Johnson personal communication: 19??) and on public wetlands (7,400) (L. Hindman personal communication: 19??) in Maryland.

Maryland Department of Natural Resources

The MDNR began operational releases of mallards in 1974 under a legislative mandate that authorized Maryland's duck stamp. Fifty percent of the proceeds from the sale of state duck stamps was earmarked for the MDNR mallard release program, with the goals of improving local hunting and, secondarily, increasing local production (Hindman et al. 1992). MDNR released up to 40,000 birds annually between 1974 and 1993, when the program was ended. MDNR purchased five- to seven-week-old ducklings that were nonstop trucked to Maryland (24 hours), unloaded, given access to water and distributed to releases sites within 24 hours. Birds were released in groups of up to 400 per site in late July to mid-August on estuarine marshes. They received no supplemental food or care after release (Hindman et al. 1992).

Regulated Shooting Areas are private properties where captive-reared birds are banded, released and harvested by RSA owners and their guests (Maryland DNR Title 08, Subtitle 03, Chapter 09). The U.S. Fish and Wildlife Service (USFWS) allows such regulated releases under Federal Regulation 50 CFR 21.13. Releases on RSAs may be of flighted or free-flying mallards. The flighted mallards are typically released from a tower and shot immediately; whereas the free-flying mallards are released weeks to months before shooting takes place. Released mallards must be toe clipped before four weeks of age and banded or marked in some other approved manner. Prior to issuance of an RSA permit, the MDNR is responsible for determining that the operation of an RSA will not conflict with any reasonable prior public interest. RSAs must be at least 50 acres (20.2 ha) to have flighted mallard releases and at least 200 acres (80.9 ha) to release and harvest free-flying mallards or upland game.

The most commonly stated goals of RSA operators are to improve hunting for themselves and their guests, relieve hunting pressure on wild ducks, provide habitat for wild waterfowl and increase the local breeding population. RSA permittees and their guests are allowed to take marked birds by shooting, without regard to state and federal bag limits. For RSA hunters, this bag limit exemption includes mallards marked and released on any RSA in Maryland. Sunday hunting, which is illegal in Maryland, is allowed on RSAs, but only for flighted mallards due to inability to differentiate wild versus captive-reared mallards.

Release of captive-reared mallards on RSAs became widespread in Maryland after a federal opinion in 1985 allowed liberated captive-reared birds on a registered property to remain the property of the landowner. Prior to this ruling, some individuals, RSA operators and others released mallards, but such birds were counted as part of the normal bag limit when harvested. The number of RSA permits in Maryland increased from 15 in 1985 to 132 in 1990 (Figure 1). In 1994, 71 of 131 active RSAs in Maryland were in Dorchester County. This concentration of RSAs may have been responsible for the increasing mallard populations in mid-winter surveys conducted by MDNR from 1985 to 1992 in Dorchester County (Figure 2).

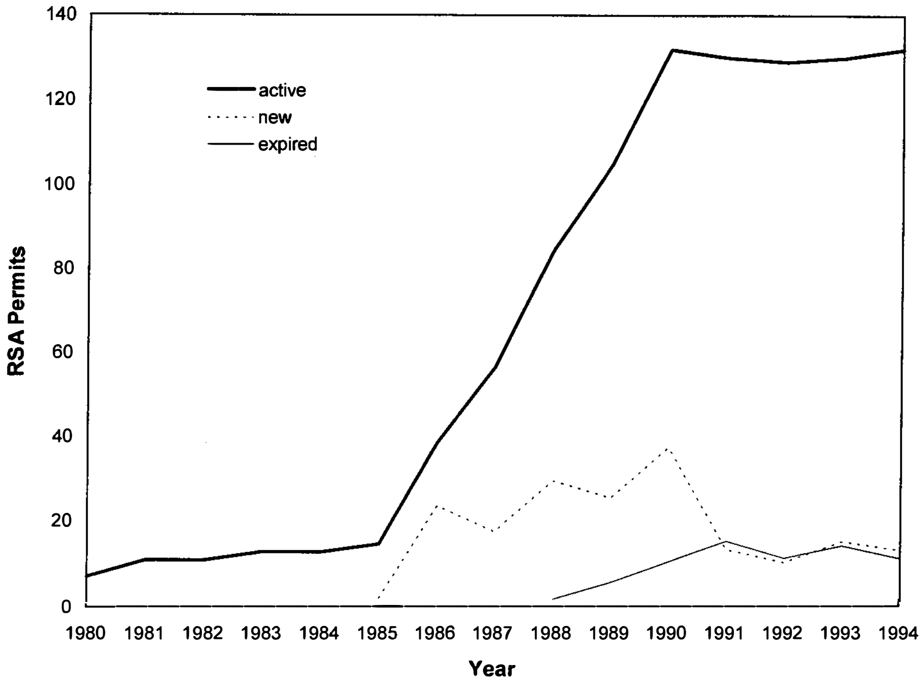

Figure 1. The number of Regulated Shooting Area permits in Maryland, 1980 to 1994.

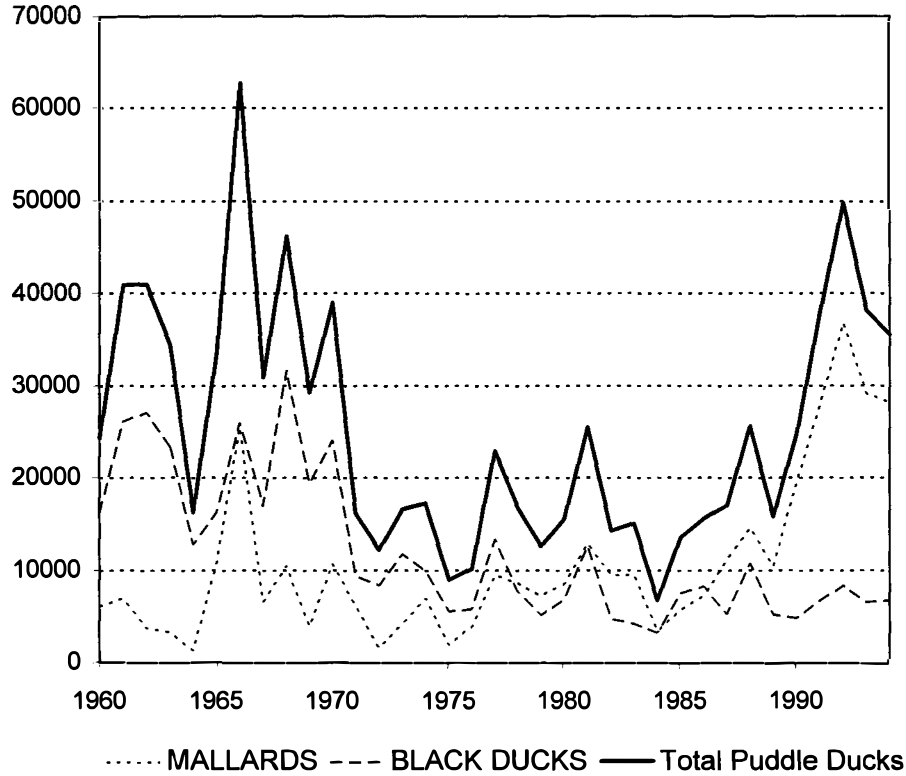

Figure 2. Midwinter waterfowl surveys of Dorchester County, Maryland, 1996 to 1984.

We report on the characteristics of the RSAs in Dorchester County and their affect on hunters on RSAs, non-RSA private properties and Wildlife Management Areas in the county. We also summarize the status of mallard releases and opinions of biologist regarding mallard releases in other states.

Methods

Harvest Surveys

We checked waterfowl bags at exit points of Dorchester County Wildlife Management Areas for two days during each of the three segments of Maryland's waterfowl seasons (October, November and December) in 1991 to 1993. We recorded species and sex, and examined all mallards for bands and/or toe clips. State mallards prior to 1993 were toe clipped and banded with state bands. In 1993, state mallards had both halux removed, but were not banded. Some state mallards in 1993 may not have been double toe clipped and therefore would not be identifiable. RSA mallards had one hind toe clipped and were banded with private bands that varied between RSAs.

Mail Surveys

Surveys were mailed to Dorchester County hunters and RSA owners to solicit opinions about the release programs. Dorchester County hunters were identified while monitoring exit points from Wildlife Management Areas in 1992 (as above), Maryland Duck Stamp sales (only hunters who reported Dorchester County addresses), and contact cards placed in blinds on private properties accessible by boat. These three lists included 435 individual hunters. A second copy of the survey was mailed to nonrespondents two months after the first survey was mailed. We promised anonymity to respondents except for a code placed on each survey so that we could determine who had responded. Survey questions that inquired about harvest had five answers with ranges of numbers that respondents could circle. Questions about how duck releases influence the quality of hunting had five answers ranging from strongly positive to strongly negative. Questions about whether RSAs should be subject to bag limits, should the state release ducks, and would you or have you hunted on an RSA had yes or no answers. Hunters could respond yes or no when asked whether RSAs meet the following goals: removed pressure from wild ducks, provide habitat for wild ducks, boost wild mallard populations and improve hunting around RSAs. Hunters could rate the importance (1 to 5) of the following impacts of released mallards: breeding with black ducks, increasing predator populations, competing with wild ducks, having low survival and spreading disease to wild ducks. Hunters from the Maryland duck stamp list were asked "Are you associated with an RSA" and possible answers were "owner, employee, club member or guest." Questions of RSA operators dealt only with RSA mallards and included questions about numbers of birds released and RSA size and management. Prior to the hunting season, we requested that RSA owners keep records of their harvest. The questionnaire for state waterfowl biologists focused on regulatory issues in their state and the potential effects of releases, but had two additional potential effects to rate (five-point scale of importance), namely: released mallards breeding with wild mallards, and makes sportsmen believe releases enhance regional populations. Chi-square tests were used to test for differences in hunting experience, harvest, and opinions between the three sampled groups surveyed and between hunters, RSA operators and state flyway biologists.

Results

Harvest

We examined 1,980 waterfowl from 1,987 hunters on WMAs. Captive-reared released mallards were a major portion of the harvest on Maryland wildlife management areas (Figure 3) and RSAs. State-released mallards represented 25 percent of the harvest during the two-day October segment of the hunting season, but decreased to

10 and 7 percent in November and December, respectively (Figure 3). There was also a decrease in the proportion of state mallards in the bag and in the total harvest of state mallards each year from 1991 to 1993. State mallards were 30, 18 and 6 percent of the harvest in 1991, 1992 and 1993, respectively. RSA mallards were 6, 10 and 4 percent of the harvest on WMAs in 1991, 1992 and 1993, respectively.

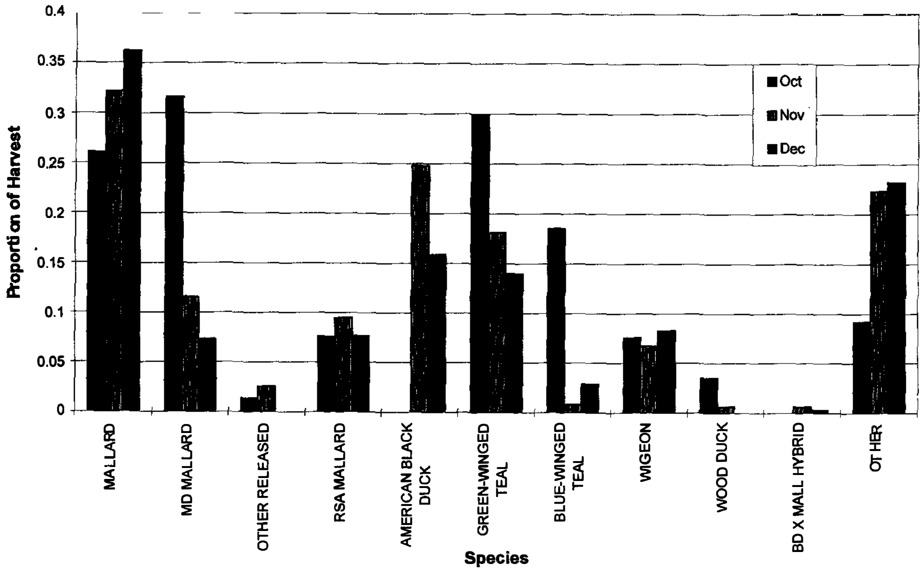

Figure 3. Proportionate harvest of ducks on Wildlife Management Areas in Dorchester County, Maryland, 1991 to 1993.

Mail Surveys

Hunter survey. We received 265 responses, 48 percent of the three original lists of hunters. The three sampling frames differed only in frequency of hunting in Dorchester County and ducks harvested. Hunters from the WMA list hunted public land in Dorchester County more often (Chi square = 27.96, df = 2) and private land in Dorchester County less often (Chi square = 80.94, df = 2) than hunters from the other two frames. They also had begun hunting in Dorchester County more recently (Chi square = 53.79, df = 6) although 59 percent had been hunting in Dorchester County for at least six years. WMA hunters also killed fewer total waterfowl, state-released mallards and RSA-released mallards ($p < 0.01$). The opinions of these three groups did not differ regarding the state mallard releases ($p > 0.05$). However, the hunters from the duck stamp list were more likely to feel that RSAs had a negative impact on their hunting than were WMA hunters or those from private blinds ($p < 0.01$).

Of the 49 respondents from the Maryland duck stamp sale list, 11 were associated with RSAs. Ten of the 11 respondents who were associated with an RSA in some way (club member, guest or employee) had killed at least five RSA mallards. Nine of these 11 (82 percent) had killed at least 20 ducks during the last season. Only 13 percent of the 38 hunters with no association to an RSA killed at least 20 ducks. Hunters associated with RSAs and those not associated with RSAs did not have differing opinions (Chi square, $p > 0.1$) regarding the effects of the release programs or whether RSA hunters should have a limited bag.

Of the non-RSA hunters, 64 percent (n = 253) felt that RSAs had a positive effect on the quality of their hunting and 49 percent (n = 265) at least occasionally focused their hunting near an RSA. Sixty percent (n = 264) said they would be interested in hunting on an RSA. The majority (> 60 percent) felt that the RSAs were effective in achieving their goals, but 68 percent felt that RSA hunters should be subject to bag limits. Fifty-two percent killed no RSA mallards during the previous season, but 18 percent killed at least five RSA mallards. Most hunters (68 percent) felt that the state release program had a positive effect on the quality of their hunt. A majority (79 percent) were in favor of the state continuing the release program, although 50 percent of respondents (n = 265) did not kill a single MDNR-released mallard during the previous season. Eleven percent killed at least five state mallards the previous season.

The potential for diseases to be spread to wild populations was perceived by hunters as being the most serious problem with mallard releases, with 43 percent (n = 251) considering disease to be very serious (Table 1). Only 27 percent (n = 249) felt that the potential for hybridization with American black ducks was a serious concern.

Table 1. Percentage (total) of respondents that believe the following potential results of mallard releases are serious concerns.

Survey group	Black duck hybridization	Increase in predators	Competition with wild waterfowl	Low survival of releases	Spread of disease	Hunters' belief that releases will boost populations	Breeding with wild mallards
Hunters	26.9 (249)	17.5 (251)	11.5 (252)	35.0 (250)	43.4 (251)	(0)	(0)
RSA operators	11.5 (26)	53.5 (28)	4.0 (25)	(0)	25.9 (27)	(0)	(0)
State flyway biologists	30.4 (46)	2.27 (44)	6.8 (44)	11.1 (45)	63.0 (46)	47.9 (48)	29.2 (48)

RSA operator survey. Owners of 31 of 64 RSAs active in Dorchester County in 1992 responded to our surveys. The average size of the RSAs in Dorchester County was 529 $\pm$ 416 acres (214 $\pm$ 169 ha) (mean $\pm$ SD). These RSAs totaled 23,952.5 acres (9,693 ha) and included 776 acres (314 ha, 3.2 percent) of cropland and 1,215 acres (491 ha, 5 percent) of impoundments dedicated to waterfowl management. Thirteen RSAs that provided records had released 13,050 mallards. Other than mallard releases, predator management was the most common management practice on RSAs, with 78 percent of RSA managers using some form of predator management, typically trapping of raccoons (*Procyon lotor*) and red fox (*Vulpes vulpes*). RSA mallards represented 81 percent of the duck harvest on surveyed RSAs with free-flying mallards. This figure is supported by limited counts we made on RSAs and at a local picking house where RSA mallards represented more than 95 percent of the RSA harvest. Our counts were made during the December season when teal (*Anas crecca* and *A. discors*) and wood ducks (*Aix sponsa*) had migrated out of the area.

Nine of 29 RSA owners felt that RSAs should be subject to some bag limit. The response from these nine to the question "What bag limit would you consider to be too low to be worth the expense and trouble to continue to operate an RSA?" was 5.5 ± 2.0 (mean $\pm$ S.D.). The response to this question from the 20 who felt there should be no limit was 7.2 ± 5.2 (mean $\pm$ S.D.). Half of the RSA owners answered that they would quit releasing mallards if they lost the bag limit exemption on released mallards, while 30 percent indicated that they would not change their operations in any way.

Technical section survey. Flyway technical section representatives from the 49 continental states responded to a survey about mallard releases in their states. Eleven states outlaw releases of any type. Twenty-nine states offer licenses that allow the release of captive-reared mallards, but seven of these allow only tower shoots. Of the 29, 27 allow the harvest of released mallards without bag limit restrictions. Nationwide, about 2,191 properties are currently licensed to release mallards in 22 states. Many permits are in Minnesota (1,108), Texas (301) and Indiana (46), where permits allow release of both upland game and waterfowl, so it is unknown how many permittees release mallards. RSA and duck releases are most prevalent in the Atlantic Flyway (Table 2). Records of the number of mallards released are lacking in most states, but estimates indicate that at least 278,000 mallards are released annually in the U.S. Half of these are released in flighted shooting operations and, although records are lacking, most of these mallards are likely harvested.

Table 2. Captive-reared mallard regulations and releases by flyway from survey of flyway technical section biologists in each state.

Flyway	States	Offer licenses for release	Offer bag exemption	RSAs (permits)	Non-licensed releases	Outlaw all releases	Releases Flighted	Releases Stocking	Total releases
Atlantic	17	13	13	548	66,500	1	100,830	54,775	222,105
Mississippi	14	8	7	1,184	2,500	2	27,300	8,501	38,301
Central	9	3	4	321	500	3	2,200	0	2,700
Pacific	9	4	3	11	0	4	11,235	1,800	13,036

Factors that most concerned flyway biologists about releases of captive-reared mallards were hybridization, spread of disease and influence on hunters' attitudes (Table 1). Spread of disease was most often (64 percent, n = 48) given as a serious concern in all flyways. A second issue that was frequently (48 percent) a serious concern was that releases would make "sportsmen believe that released ducks can enhance regional populations." Concern over hybridization with American black ducks was highest in the Atlantic and Mississippi flyways, with 47 and 31 percent, respectively, listing these as very important concerns. Conversely, concern about released mallards breeding with wild stock mallards was highest in the Central Flyway, where 44 percent of biologist responded that it was a very important concern.

The concerns of flyway biologists and hunters differed in several aspects (Table 1). The flyway biologists were more concerned about the effect of releases on wild waterfowl populations. They were more concerned about released mallards hybridizing with black ducks (Chi square = 10.4, df = 4) and the spread of disease (Chi square = 15.7, df = 4). Hunters were more concerned about increases in predator populations (Chi square = 28.00, df = 4) and low survival of released mallards (Chi square = 32.5, df = 4).

RSA operators were more concerned than both hunters and state biologists about releases increasing predator populations (Chi square = 34.9, df = 6). RSA operators were less concerned than hunters and state biologists that mallard releases would increase hybridization with black ducks (Chi square = 20.1, df = 6) or outbreaks of disease (Chi square = 14.0, df = 6). Concerns about released mallards competing with wild waterfowl were low and did not differ among groups (Chi square = 7.6, df = 8).

Discussion

Hindman et al. (1992) used band recoveries and information from the U.S. Fish and Wildlife Service Parts Collection Survey to examine the contribution of state releases to the waterfowl harvest statewide in Maryland. State mallards constituted less than 5 percent of the bag during the early 1980s. Because of the concentration of releases it is not surprising that we found that state mallards are a larger portion of the harvest in Dorchester County, Maryland. This concentration probably also improved hunter attitudes about the MDNR and RSA release programs. It is doubtful that people who hunt areas that did not receive large releases would have the same attitudes.

State-released mallards were primarily harvested during the October season. Mallards that survived to the October season were relatively tame and probably quite vulnerable to hunting mortality (Brakhage 1953, Schladweiler and Tester 1972). Many hunters commented about the state mallards' lack of fear of boats or people and how they decoyed easily. The decrease in the state-released mallards harvested between years was probably due to the lower numbers released in later years. This decrease in harvest of state-released mallards suggests that state releases do not have a long-term effect on harvest and that harvest of state birds depends on continued releases. A similar decline in harvest was observed in Maine after releases terminated in 1974 (Corr and Spencer 1977). Hindman et al. (1992) found that 79 percent of the recoveries of state mallards occurred in the first hunting season after release.

Although state mallards were a small component of the harvest on WMAs, hunters in the area had a positive impression of the program. Many people hunted Dorchester County WMAs only during the October season (personal observation) and, therefore, were likely to have an opportunity to kill a state mallard. Their opinions were likely to be shaped by the high harvest of state-released mallards during this season. We only recorded a hunter's name the first time we encountered him/her, so we could not separate respondents who hunted only during the October season from those who hunted all three seasons. The impressions of hunters on public land toward the RSA programs were also favorable, though few people on public land harvested RSA mallards. The impressions of hunters from the state duck stamp list differed in accord with their harvest of RSA mallards. Those who harvested more RSA mallards were more likely to have a favorable opinion of the RSA program.

The differences between opinions of hunters and flyway biologists may reflect the basis of their concerns. Biologists were more concerned about factors such as hybridization and disease that affect wild populations. Hunters were more concerned about increased predator populations and the survival of released mallards, which are factors related to the effectiveness of the releases.

The number of RSA permits in Maryland appears to have stabilized at about 130 operations (Figure 1). The number of permits allowed to expire has approximately equaled the number of new permits issued annually since 1991. The number of mallards released annually has decreased from a peak of about 100,000 in the late 1980s to 38,000 in 1993 (L. Hindman personal communication: 1994). The MDNR mallard release program ended in 1993, largely due to high mallard mortality prior to the hunting season (MDNR unpublished data).

Private release programs have not become established in several states where licenses are available. The restriction of hunting time (Delaware), location (Louisiana) or other parameters appears to limit the popularity of releases in some states. Several states that allow releases also discourage such licensing. Interest in releases appears to be lacking in other states (Tennessee and Washington). In states where licenses are issued, there is little monitoring of releases or harvest on registered properties.

Acknowledgments

We are indebted to personnel of the Maryland Department of Natural Resources involved with the state release program, especially the staff at Fishing Bay Wildlife Management Area and those responsible for flying the mid-winter waterfowl surveys. The Grand National Waterfowl Hunt Club, U.S. Fish and Wildlife Service (Office of Migratory Bird Management), MDNR, and Louisiana State University Agricultural Center provided financial support for the project. We thank the staff at Blackwater National Wildlife Refuge for much logistical support.

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Urban Canada Goose Management: Policies and Procedures

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Extirpated during European settlement over most of its former southern breeding range, the Canada goose (*Branta canadensis*) was reestablished in the midwestern and eastern United States and Canada (Nelson 1963, Dill and Lee 1970, Cooper 1978, Lee 1987, Zenner 1996). First released in urban/suburban environments in the 1940s, the species was breeding in several midwestern and eastern cities two decades later (Hawkins 1970). Since then, Canada goose populations including metropolitan flocks have grown at phenomenal rates. Ankney (1996) reported breeding Ontario Canada geese grew exponentially—from fewer than 1,000 in 1967 to 190,000 in 1994; Zenner (1996) estimated Mississippi Flyway giant Canada goose (*B. c. maxima*) numbers at 1 million in 1996, mostly from reestablished flocks. Goose problems have been reported in Anchorage, Vancouver, Seattle, Denver, Chicago, Kansas City, Milwaukee, Winnipeg, Toronto, Boston, Washington, D.C., and other urban centers (Laycock 1982, Nelson and Oetting 1982, Cooper 1987, Conover and Chasko 1985, Ankney 1996). Complaints include droppings on golf courses, docks and swimming beaches, parks, and residential yards (Conover and Chasko 1985, Cooper 1987); water quality reduction (Manny et al. 1994); and aircraft hazards (Cooper 1991, Dolbeer 1996).

Urban Canada goose management approaches can be divided into short-term redistribution techniques and long-term population and habitat management procedures. Short-term techniques prevent or reduce goose use of a specific site from hours to several weeks. Redistribution has been attempted by prohibiting artificial feeding; hazing using humans (Aguilera 1989), vehicles, dogs, swans, swan or dead goose decoys, and sounds (Mott and Timbrook 1988); erecting access barriers such as wire, rope or bird-scare tape fences; and taste aversive chemicals (Conover 1985, Cummings et al. 1991, Belant et al. 1996). Long-term approaches include population reduction by decreasing reproduction or survival, removing geese, and habitat reduction. Reproduction has been inhibited by embryocides (Baker et al. 1993, Christens et al. 1995), egg removal (Wright and Phillips 1991) and vacsectomization (Converse 1985). Populations have been reduced by sport hunting, shooting (Cooper 1991), capture and relocating of goslings and/or adults (Blandin and Heusmann 1974, Martz et al 1983, Cooper 1987), and capture and processing for human food.

This paper describes Minnesota urban goose management policies and presents data for the Metropolitan Twin Cities Area (Metro) goose population. The Twin Cities

Area is a 6,076-square kilometer midwestern urban complex with 2.5 million residents and more than 3,000 lakes and wetlands covering 37 percent of the area. The Metro population growth, human tolerance, complaint types and levels, and the efficacy of short- and long-term management procedures are discussed.

Policies

Extension assistance with short-term management procedures has been provided by the Minnesota Department of Natural Resources (MNDNR), U.S. Department of Agriculture Animal Damage Control (ADC) and the Minnesota Extension Service at the University of Minnesota (UM). The long-term population management program was adapted in 1982 from MNDNR urban deer control policy (MNDNR 1994). This policy required that where a hunting harvest cannot be used to manage a wildlife population, the local governmental unit (LGU), usually a city council or township board, establish population goals, select control procedures, and fund the operational and evaluation phases of the program. The MNDNR, U.S. Fish and Wildlife Service (USFWS), ADC, Minnesota Department of Public Health, Minnesota Department of Agriculture (MNDA) and the UM provided technical input. The USFWS approved capture and transport permits, and MNDNR approved capture sites and trapping permits, and arranged for and relocated or processed the geese. The UM has provided operational assistance and evaluation under contract with the LGUs.

A goose hunting policy was adopted in 1994. Based on open space, Metropolitan Area municipalities were classified by the potential for hunting: class 1—open space too limited for safe shotgun discharge; class 2—open space patchy, but some areas that might be hunted safely; and class 3—extensive open space where shotgun hunting can be done safely. Priorities were established for removal of problem geese based on the potential for a hunting harvest; these were: class 1—highest priority; class 2—high priority at public swimming beaches, roads and airports, medium priority at locations within areas that cannot be hunted safely, and low priority at other locations; and class 3—high priority at public swimming beaches, roads and airports, and low priority elsewhere. Class 2 or 3 municipalities prohibiting the discharge of shotguns were required to assess the potential for hunting prior to requesting approval of a trap and relocate or trap and process program.

Goose Population and Complaint Surveys

Hawkins (1970) found Canada geese at four Metro sites in 1968 and Cooper and Sayler (1974), repeating Hawkin's survey in 1973, reported mostly free-flying geese at 13 sites. By 1984, the goose flock expansion precluded individual flock counts, and a stratified random survey based on the MNDRN's protected wetland database was used. Protected wetlands included type 3, 4 and 5 wetlands (Cowardin et al. 1979) larger than 1.1 hectares and lakes. The water bodies were stratified by county and wetland type, and 10 percent of the type 4 and 5 wetlands and lakes were selected randomly. Selected wetlands were visited during the June to July molt period and the birds were counted. The survey was repeated in 1994 with an equal partitioning of the sample into hunted and unhunted wetlands and lakes. Shoreline in mowed grass or pasture was estimated to the nearest 25 percent. From these data, a Twin Cities population growth model was developed, the influence of shoreline goose numbers assessed, and, using the wetland inventory and published data on Canada goose nest densities, the Canada goose carrying capacity of the Metro estimated.

Goose complaint site data were recorded from 1982 to 1996. These sites were classified by predominate human use, the season when the problem occurred, location and primary complaint (droppings, damage, water quality, hazard, etc.). The human tolerance threshold—the number of birds that prompted the initial complaint—was determined by counting the birds at the site when the first complaint was received.

Evaluation of Management Procedures

Because the Metro program has emphasized population management rather than short-term redistribution techniques, the methods used to evaluate methods differed. Data on short-term efforts were from interviews of individuals using a technique. In contrast, population management efforts were intensely studied, particularly capture and relocation, and capture and process.

Trap and Relocate

When the city of Minneapolis first requested assistance in 1982, the MNDNR elected to use trap and relocate to reduce a 500 plus city park flock. After the city developed and approved a plan, flightless geese were drive-trapped, loaded in trucks and moved to a holding pen. One hundred and ninety-five immatures were banded and relocated 32 kilometers southwest of the site, and the remaining adults and young were released in Oklahoma (Cooper 1987). Since that time, trap and relocate or trap and process have been used at 195 sites in 47 cities.

To evaluate the effectiveness of relocation, molt period populations were compared and the return rates of relocated, leg-banded geese determined. Oklahoma was selected as the initial release area. Adults geese were shipped to Oklahoma annually until 1992. Limited numbers of adults (<300) were transported to Kentucky and Mississippi in 1989 and 1990, and larger (500-1,500) groups went to Mississippi and Kansas during the 1992 to 1994 period, and to Kansas in 1995. Except for 1984, when immatures were sent to Oklahoma, goslings were released in Minnesota, South and North Dakota, and Iowa. Return of relocated birds to capture sites was determined by banding, and subsequent reading of leg bands with spotting scopes, from trap recaptures, and from leg band recoveries. The effect of goose removal on goose numbers at problem sites was determined by comparing molt populations at sites after 1 to 10 years of removal. Because nearly all geese present at the sites were captured (Table 1), linear regression slopes (b coefficients) were used to estimate population changes.

Table 1. Adult (A) and immature (I) Canada geese captured and removed from Twin Cities, Minnesota, flightless goose capture efficiency and mortality during trapping or transport, 1982 to 1994.

Year	I	A	Total	Capture Percentage[a]	Mortality I	Mortality A	Mortality Total	Mortality Percentage
1982	195	261	456	99	2	0	2	0.44
1983	0	0	0					
1984	361	492	853	96	0	0	0	0.00
1985	507	396	903	99	1	1	2	0.22
1986	636	379	1,015	99	2	0	3	0.30
1987	740	375	1,115	97	1	0	1	0.09
1988	1,714	864	2,578	99	1	1	2	0.08
1989	1,680	1,294	2,974	97	2	1	3	0.10
1990	1,766	1,054	2,820	96	1	0	1	0.04
1991	1,685	1,196	2,876	96	3	1	4	0.14
1992	3,005	1,248	4,253	98	2	1	3	0.07
1993	2,224	1,083	3,307	99	1	1	2	0.06
1994	2,834	1,352	4,186	98	1	0	1	0.02
1995	4,747	2,189	6,936	96	6	2	8	0.12
1996	3,982	2,256	6,239	97	1	1	2	0.03
Total	26,076	14,439	40,515		25	10	35	0.09

[a]Percentage of flightless geese present that were captured.

Trap and Process

By 1992, states releasing adult geese indicated that they were approaching population goals and that future releases would be curtailed. In 1995, the MNDNR asked other state wildlife departments if they planned future releases of adult Canada geese. Only Kansas indicated an interest in adults and only for 1995. Concurrently, MNDNR Area Wildlife Managers reported that rural Minnesota Canada goose populations were expanding and there would be limited gosling release sites in the future. Thus, if population control through removal was to continue, an alternative to relocation would be needed for adults by 1996 and for goslings a few years thereafter. Because we found that citizens and city council members frequently suggested that "eating the surplus geese" would be an acceptable alternative to relocation, we conducted a food shelf feasibility study in 1995 and 1996.

The objectives of the processing 1995 pilot were to determine the likelihood of contaminants, costs, social acceptability of slaughtering geese, the demand and utilization of goose meat by food shelves, and the management and funding needs for an operational goose processing program. In 1996, the feasibility of finishing (holding the geese until body feather molt was complete) was evaluated. Adult geese from the most industrialized area of the Twin Cities were also tested for contaminants.

The 1995 study involved butchering 200 adult geese and donating them to food shelves. One-hundred male and 100 brood-patch (Hanson 1959) female adults were randomly selected from the 2,189 adults captured. Two USDA-approved waterfowl processors were located, including one willing to process birds in summer. Twenty-two birds were used to test the processing equipment and procedures, 75 geese were slaughtered in July and 103 in September. With USFWS approval, an additional 125 adult geese were processed in January 1996. These geese had originally been designated for relocation to Kansas, but Kansas later declined to take them and an alternative site could not be found. Weight gains and food consumed by the birds were determined and used to compute costs. To assess the social acceptability of the proposal, the plan was given wide media coverage and public responses were documented.

Because we believe that immature geese, captured at three to seven weeks of age, cannot be effectively processed immediately after capture, and because we found that adults processed in September had excessive pin feathers precluding whole carcass utilization, 614 adult and 154 goslings were selected at random, wing clipped, and placed on a fenced, 16-hectare pasture with two well-water ponds. These birds were processed in mid-November 1996.

Three brood patch females were chosen randomly from a group of 36 adults captured at Pigs Eye Lake in St. Paul. Pigs Eye was the only Metro Area industrial location where geese were considered a problem. Breast muscles and liver samples were analyzed by the Minnesota Department of Agriculture's contaminants laboratory for PCBs, mercury and organochlorine pesticides.

Special Hunting Seasons

In response to the growth of resident Canada geese in the U.S., the UFWS approved experimental special early and late hunting seasons in 1983. In Canada, Ontario began late season hunting in 1984 and early hunting in 1991 (Zenner 1996). Minnesota initiated experimental early and late seasons in the Metro Area in 1987; these seasons became nonexperimental in 1991. Early seasons occurred during the first 10 days of September, prior to the arrival of migrant geese, with a five-bird bag limit. Late seasons have also lasted 10 days, beginning in mid-December with a two-bird limit. Harvest data for these seasons were gathered by the MNDNR by mail survey.

Results

Policies

The Twin Cities Canada goose program policy requiring local units of government to implement urban goose management programs has remained unchanged for 15 years. While legal challenges occurred in 1982, 1993 (MNDNR 1994) and 1996, none have stopped or modified the program. The requirement that LGUs with adequate open space for hunting permit shooting as part of a goose management plan has resulted in three cities and two county park systems opening or keeping open portions of their jurisdictions to goose hunting.

Population Growth

Hawkins (1970) reported 480 geese in the Metropolitan Twin Cities in 1968, Cooper and Sayler (1974) found 1,500 birds, and Cooper (unpublished data) estimated the population at 14,000 in 1984. An exponential model fit (Figure 1) to these data was highly significant ($P < 0.001$). Similar growth of a reintroduced Canada goose population in Ontario was reported by Ankney (1996). Determination of the carrying capacities of the Ontario and Twin Cities populations would require unrestricted growth in the future, which is unlikely given the conflicts with human activities at current levels. However, if nest habitat is the limiting factor—we believe it is—then an approximation of the Twin Cities maximum population can be made using the wetland area available for nesting, typical Canada goose nest densities and the ratio of total geese to nesting pairs. Canada geese use type 3, 4 and 5 wetlands plus the lake shorelines for nesting (Cooper 1978). Assuming that Metro Area geese will nest at densities similar to those recorded for *B. c. maxima* and *B. c. moffitti* breeding in the Midwest

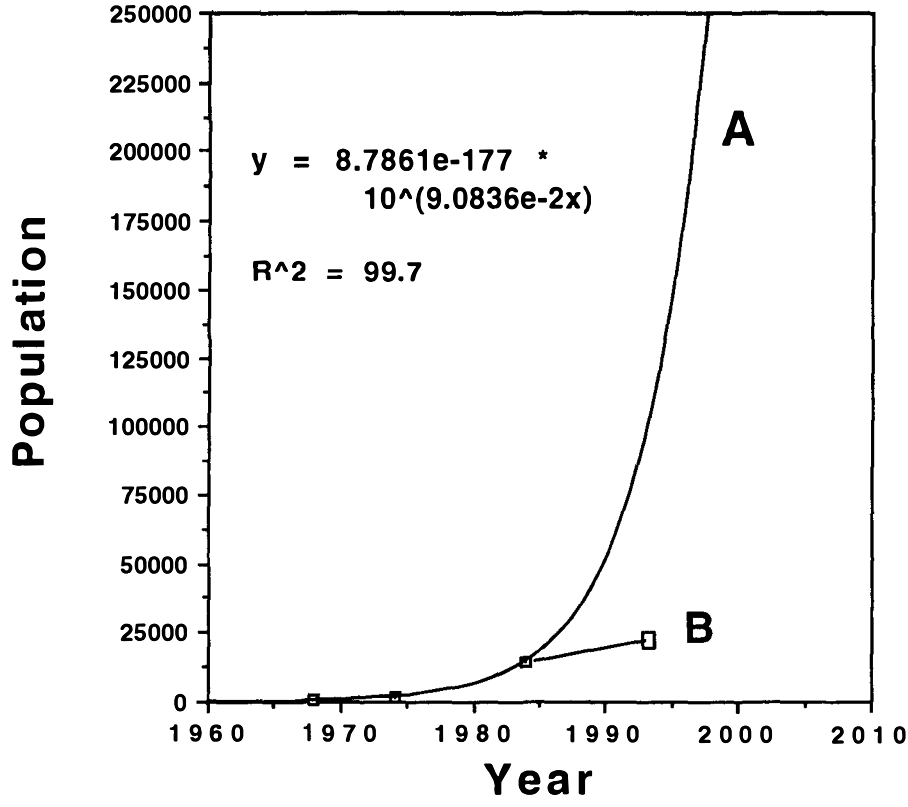

Figure 1. Metropolitan Twin Cities Area Canada goose population growth (A) projected without control, and (B) actual population with control, 1968 to 1994

and western U.S. and Canada, where the average nest density approaches three nests per hectare (Cooper 1978). With 39,343 hectares of types 3, 4 and 5 wetlands in the Twin Cites, we estimated that the area could support 118,000 breeding pairs, or a summer population of 472,000 geese (236,000 adults plus 236,000 young), assuming a conservative production of two goslings per nesting attempt (Sayler, 1977). If the birds were to nest colonially, as they do on islands (Ewaschuk and Boag 1972), then the maximum population would be higher. Moreover, because Canada geese do not breed until two or three years of age (Cooper 1978) and these nonbreeding birds make a molt migration to northern areas in summer (Zicus 1981, Fashingbauer 1993), the fall populations when the molt migrants return typically are twice that of summer. Thus, if the summer population were to approach a half million geese, the fall population likely would be more than 1 million.

Geese were found on 107 of 254 (42 percent) wetlands randomly surveyed in 1994. The amount of open shoreline, estimated to the nearest 25 percent, ranged from none (36 percent), 1 to 25 (30 percent), 26 to 50 (11 percent), 51 to 75 (19 percent) and 76 to 100 (4 percent). Wetlands with geese had a significantly higher ($P < 0.05$) amount of shoreline mowed or pastured than those without geese (Figure 2). To assess the relationship between the length of shoreline habitat and geese using the wetland, we computed shoreline length as circumference of a circle with an area equal to that of the wetland. Shoreline grass-pasture length then was calculated by multiplying the circumference by the percentage of shoreline in mowed or pastured grass. This yielded a minimum shoreline estimate for the respective wetlands inasmuch as few of the water areas were round. We found a strong relationship between the amount of grass shoreline and the number of geese at the site (Figure 3).

During the 1994 survey, 2,313 geese were counted on the 254 wetlands sampled. The expanded population estimate was 25,000 birds; less than 25 percent of the level predicted by the exponential model (Figure 1). Geese were found most frequently on type 5 wetlands (47 percent) and lakes (42 percent), and least often on type 4 marshes (28 percent); group sizes averaged 25 birds on type 4, 28 on type 5 and 34 on lakes, and were not significantly different ($P > 0.05$). Goose densities per square kilometer of wetland and lake were significantly higher ($P < 0.05$) in the cities and towns closed to hunting (61/km^2) than those open to goose shooting (22/km^2).

Goose Complaint Levels

Goose complaints were received for 391 locations during the 1982 to 1996 period, and 176 of these sites were visited at the time of the complaint. Summer brood-rearing period problems were most common (94 percent). The 23 fall complaints came primarily from golf courses (11), athletic fields (3) and airports (3). Most complaints came from residential sites (52 percent), followed by parks (17 percent), golf courses (16 percent), swimming beaches (10 percent) and corporate grounds (6 percent). The number of geese causing a complaint was highly variable, ranging from 4 to 456 and averaging 70 birds (SD = 62). Among complaint classes, commercial sites had the lowest tolerance threshold (59) and beach areas the highest (87); ANOVA showed no

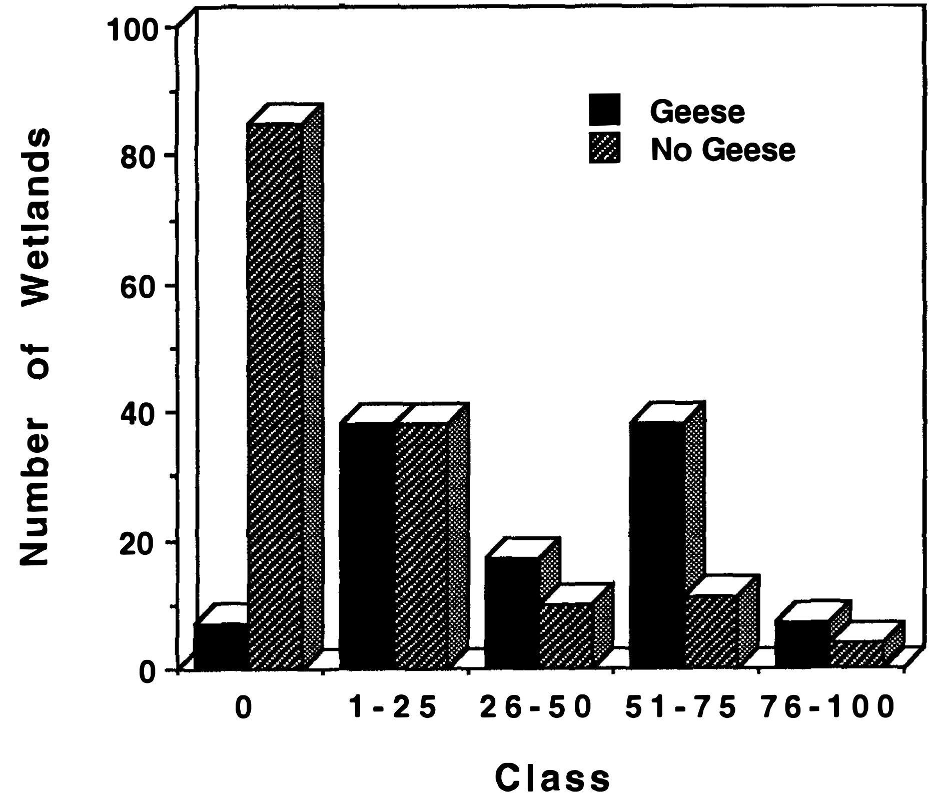

Figure 2. Percentage of wetland shorelines in mowed grass or pasture for wetlands with and without Canada geese, Twin Cities, Minnesota, June 1994.

significant differences ($P > 0.05$) between class means. Regression of threshold by year indicated no relationship ($P>0.05$), suggesting that the public has become neither more or less tolerant over time. Complaints per year were cyclic, with peaks in 1988 and 1993 caused, we believe, by increased media coverage in the late 1980s and the during a legal suit in 1993.

Goose Redistribution Techniques

Short-term goose redistribution methods were recorded as low (no or little effect), moderate (worked but the geese returned) and high (birds were displaced and stayed away). Of the 12 techniques used, 8 were rated low, 2 moderate and 2 high. Fences, both permanent and temporary, blocking access during the brood-rearing period in June and July were most effective (Table 2). Harassment with dogs during brood rearing was moderately successful, whereas dogs, particular border collies, were highly

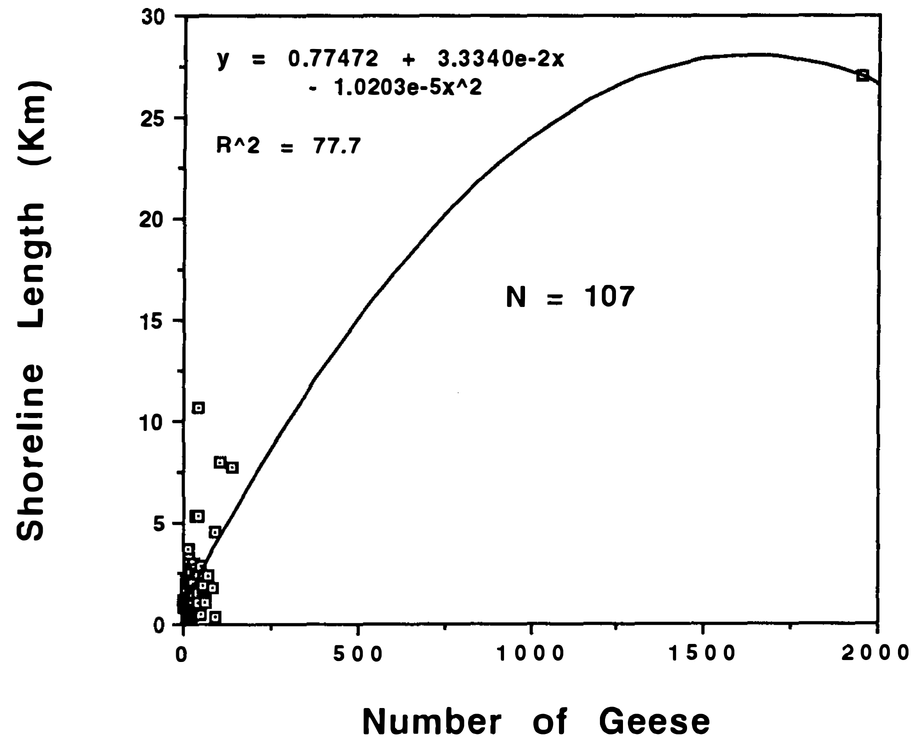

Figure 3. Relationship between the number of Canada geese and the amount of shoreline in mowed grass or pasture, Twin Cities, Minnesota, June 1994.

effective on flying birds in fall. Geese avoided areas sprayed with methyl anthranilate, but the effect lasted less than three weeks and the material was expensive ($396/ha/treatment).

Productivity Reduction

The effectiveness and costs of egg removal as a population control procedure were measured during the 1990 to 1996 period. Nest searching by two-person teams was done on three type 5 wetlands totaling 278 hectares. Searching was done by walking, wading and canoeing. When a nest was found, the clutch size was recorded and the stage of incubation determined from egg laying or by floatation. To prevent renesting (Cooper 1978), egg removal was delayed until at least the 18th day of incubation. We located 342 nests and removed 1,745 eggs over the seven-year period (Table 3). Two of the three sites were fenced, thus the proportion of nests not found could be estimated from the broods observed. Over the period, eight broods were observed. Assuming a 75-percent nest success (Sayler 1978), we estimated that 97 percent of nests were discovered.

Table 2. Ranking of effectiveness of short-term goose redistribution methods used in the Metropolitan Twin Cities, Minnesota, 1982 to 1996.

Method	N	Ranking[a]
Decoy—dead goose	1	L
Decoy—swan	156	L
Feeding ban	94	L
Fencing—electric	4	H
Fencing—permanent	15	H
Fencing—temporary	182	M
Habitat modification	15	L
Harassing—dog	8	M
Harassing—people	310	L
Harassing—vehicle	93	L
Live swan	7	L
Methyl anthranilate[b]	3	L

[a]L = low effectiveness, M = moderate effectiveness and H = high effectiveness.
[b]Rejects-It.™

Table 3. Canada goose nests and eggs found and time spent searching by two-person teams, Gun Club Lake, Mother Lake and Wood Lake, Twin Cities, Minnesota, 1990 to 1996.

Year	Nests	Eggs	Hours	Eggs per hour
1990	39	202	96	2.1
1991	43	218	119	1.8
1992	38	195	25	1.6
1993	45	216	175	1.2
1994	42	162	144	1.1
1995	110	626	171	3.6
1996	25	126	176	0.7
Total/mean	342	1,745	1,006	1.7

Trap and Relocate

A total of 40,515 flightless geese were trapped and removed from the Twin Cities between 1982 and 1996 (Table 1). Trapping efficiency averaged 98 percent (range = 96-99 percent) of all flightless geese present. Cities undertaking relocation control increased from 1 in 1982 to 36 in 1996, and trapping sites increased from 1 to 104 (Figure 4). Capturing and relocating geese reduced populations significantly. The procedure was most effective for urban concentrations and least for rural populations. The geese found at a capture site decreased rapidly during the first five years, then more slowly in subsequent years. Overall, after five years of continuous removal, the population typically was 60 percent lower, and after 10 years, an 80-percent reduction was attained (Figure 5). Relocation was most effective at urban sites, where a 75-percent decline occurred in five years, whereas suburban and rural populations declined by 40 percent.

In 1982, 195 immatures were banded and relocated from Lake of the Isles to Carver Park Reserve 32 kilometers southwest of the trap site, and 265 adults were banded and sent to Oklahoma. In 1984, 230 immatures and 439 adults were banded and shipped to Oklahoma, and in 1985, 257 adults were banded and sent to Oklahoma. Other immatures were released at Minnesota sites 80 plus kilometers from the capture site in 1985 and subsequent years. Leg bands were placed on 256, 200 and 489 of these birds in 1984, 1985 and 1986, respectively.

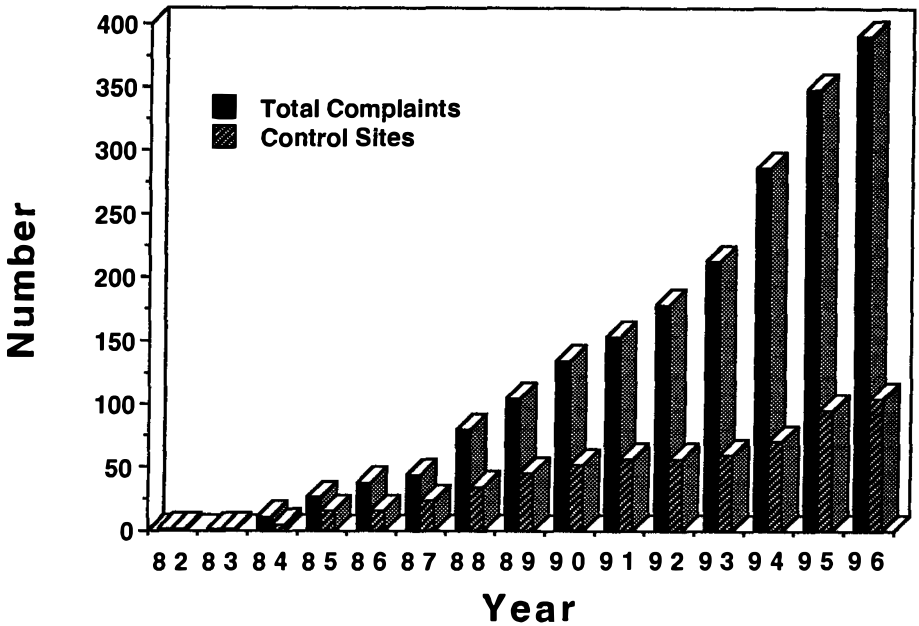

Figure 4. Accumulative complaint locations and Canada goose removal sites, Twin Cities, Minnesota, 1982 to 1996

The rate of return of relocated geese to the capture sites was lowest for immatures and highest for adults. Of the 195 flightless goslings relocated to Carver Park, 8 of 195 (4 percent) were observed or trapped at Lake of the Isles. Nine of 256 (4 percent) of the immatures released in Oklahoma in 1984 returned to the capture sites, and none of the 945 immatures released in Minnesota from 1984 to 1986 was retrapped or observed in the Twin Cites to date. In contrast, 57 (22 percent), 186 (42 percent) and 62 (24 percent) relocated adults were observed, retrapped or recovered in the Twin Cities. Based on a 71-percent annual survival rate (Oklahoma Department of Conservation unpublished data) and assuming that all relocated geese returning to the Twin Cities were encountered, the proportions of relocated adults returning were estimated to be 42 percent, 80 percent and 42 percent in 1982, 1984 and 1985, respectively.

Trap and Process

The processing of Twin Cities Canada geese for human food was approved by the U.S. Fish and Wildlife Service in 1995. A total of 325 adult geese were trapped and slaughtered in 1995, and 1,770 in 1996, including 154 immatures. St. Paul and Minneapolis foodshelf distribution centers agreed to distribute the frozen goose products, provided the geese were processed in either a USDA- or MNDA-inspected plant. The distribution centers also agreed to hand out a postage-paid client questionnaire. The questionnaire asked the client whether he/she had eaten goose in the past 10 years, how the client ranked the product's taste (0 = lowest, 10 = highest), and if he/she would use the product again. Distribution center operators indicated that they had difficulty obtaining donations of high-protein products and that the centers would take "all" the goose products we could supply. The client survey was small, 17 in 1995 and 36 in 1996, due to the confidentiality maintained at food shelves, but the results were clear. Most (88 percent) clients had not eaten goose in the past 10 years, they rated the taste at 8.4 (range 6-10) in 1995 and 8 (5-10) in 1996. Sixteen (94 percent) 1995 clients and 32 (89 percent) 1996 clients indicated that they would eat the goose product again.

In 1995, the 125 geese held in a 1.5-hectare pen consumed 8 kilograms of food per month and required 8 hours of care per month, or about $6 per goose to hold until September. Geese pasture rental and labor from July until November 1996 cost $6 per bird. The processing plant costs ranged from $6 to $8 per goose, thus, the total costs per goose for holding and/or processing was from $6 (process in July), to $12 (feed and process in September), to $14 (pasture and process in November). Yields varied by the product produced. The birds butchered in July 1995 were made into ground breast and boneless breast. These products averaged 0.7 kilograms per bird. The 103 birds processed in September 1995 were packaged as whole breasts and legs because abundant pin feathers precluded an acceptable whole carcass product. This group yielded 1.6 kilograms of meat per bird. The 125 geese butchered on January 11, 1996 were packaged "in the whole" with giblets and weighed an average of 4.1 kilograms each. The geese processed in the summer and fall of 1996 were whole-carcass products; the July products averaged 2.7 kilograms, while the November geese yielded 3.2 kilograms per bird.

A literature search for potential contaminants was conducted prior to the 1995 processing and indicated that, except for those from heavy industrial areas, the geese posed no human health risk (Keefe 1996). The Minnesota Department of Health concurred with this conclusion. Because an industrialized area was added in 1996, the tissues of three brood-patch females trapped at this location were analyzed by MNDA. Breast muscles and livers were tested for PCBs, mercury and organochlorine pesticides. None were found at detection levels of 0.025 ppm for PCBs and pesticides, or at 0.125 ppm for mercury.

Habitat Reduction

Based on the relationship between the number of geese using a wetland and the shoreline in mowed grass or pasture (Figure 3), it was clear that a modification of the shoreline habitat would reduced the number of geese at a site. Furthermore, if sufficient shoreline was converted from grass, the population could be limited. Using areas of the 3,081 Metro wetlands, we estimated that the Twin Cities have a minimum of 3,550 kilometers of shoreline. Based on estimates of grass shoreline made at 227 wetlands in 1994, one quarter (25.1 percent) of the shoreline is in mowed grass or pasture. This means that about 888 kilometers of shoreline would have to be converted to alternative vegetation. Because we observed geese leading broods through up to 70 meters of cattail to graze on grass beyond the wetland edge, we assume that at least this width of shoreline vegetation would have to be converted to nongrass plantings.

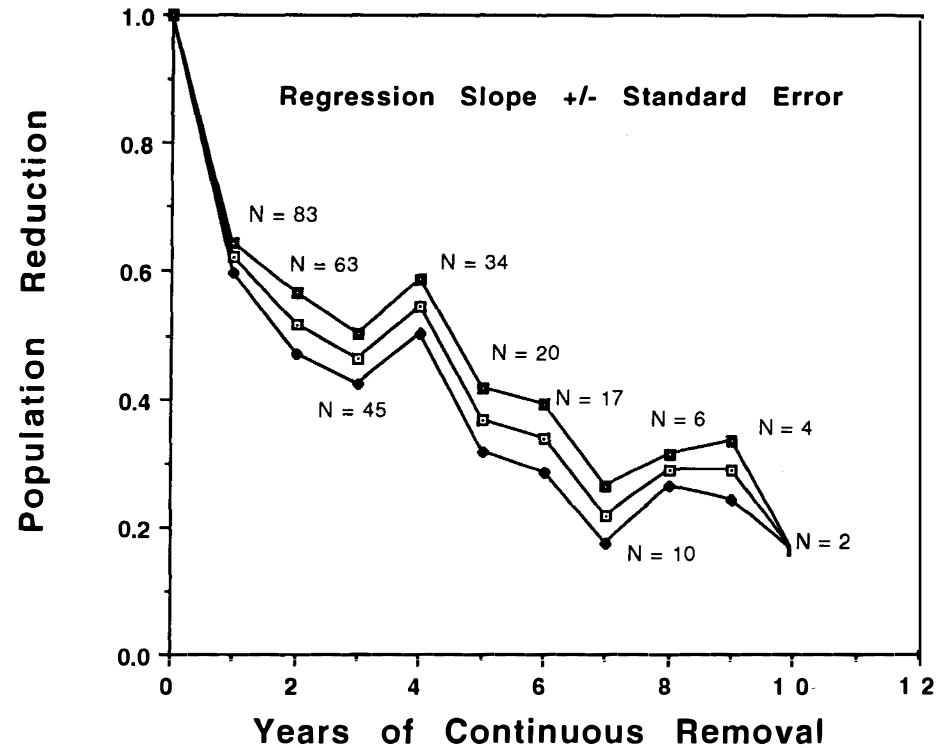

Figure 5. Canada goose populations at removal sites after 1 to 10 years of continuous goose removal, Twin Cities, Minnesota, 1982 to 1996.

Hunting

Kill data from the MNDNR surveys indicate that goose harvest during the early September special season ranged from 2,782 to 9,979, and late season harvest from 376 to 895 (Table 4). Because the latter was incorporated into the regular goose season extending from on or near October 1 to mid-December, there were no data after 1992. However, if the harvest were similar to that of the 1978 to 1991 period, from 9,000 to 10,000 additional geese were killed during the special hunts. Combined with removals of 6,000 geese per year in the past two years (Table 1), the impact of these seasons on the Metro goose population has been significant.

Table 4. Canada goose hunting harvest during special Metro Area September and December seasons, Twin Cities, Minnesota, 1987 to 1994 (Minnesota Department of Natural Resources data).

Year	September	December	Total
1987	4,443	783	5,226
1988	2,818	491	3,309
1989	2,782	376	3,158
1990	4,673	392	5,065
1991	5,497	895	6,392
1992	83,25	[a]	[a]
1993	9,532	[a]	[a]
1994	9,979	[a]	[a]
Total	48,049	2,937	50,986

[a]Late season incorporated into the regular season framework in 1992 and thereafter.

Discussion

The policy requiring local government decision making and funding, we believe, is the key to the success of the Metro Twin Cities goose management program. It has thwarted attempts to stop or delay any of the 737 captures done in the past 15 years. Phone or personal public contacts with agency personnel and recent legal actions have been sufficient to test the policy. When someone was opposed to a management practice, the individual was directed to the appropriate city official. Demands to manage sites not approved by a city have been processed in a similar manner. To date, no city has terminated a removal program because of citizen opposition. In 1993, a suit by People for Ethical Treatment of Animals (PETA) ended in a court review of the program and an environmental assessment (MNDNR 1994). Neither program administration nor operational procedures were altered as a result of the suit.

Short-term goose redistribution techniques have limited success. Of 12 techniques evaluated, two worked consistently. Fencing kept adults and broods off sites in summer, and harassment by dogs in both summer and fall. The latter appears to be highly successful for fall concentration on golf courses and athletic fields.

Egg removal eliminated 97 percent of the production on three large wetlands, but the procedure was expensive. An average of 1.7 eggs were found per hour. At a nest search cost of $10.85 per hour ($8/hr wage plus travel and equipment), it costs $6.38 per egg destroyed. Compared with an average cost of $10 per goose for capture and relocation and $24 per goose for trap and process, egg destruction appears more cost effective. However, removing an egg does not reduce a population as quickly as removing an immature or breeding adult. We developed a composite life table to make the comparisons. Starting with 1,000 eggs, a nest success of 75 percent, an egg success (eggs hatching/successful nest) of 97 percent (Sayler 1978), 75-percent gosling survival to capture time (six weeks of age) (Sayler 1978), 75-percent immature and 85-percent adult annual survival rates (Cooper unpublished data), we computed the number of eggs represented by each immature and adult trapped. Each egg destroyed represented 0.55 immatures at capture, equivalent to a cost of $11.60 per immature. Because urban geese have high survival, the average age of a breeding adult is nine years, thus each egg destroyed represents 0.08 breeder, equivalent to a cost of $80 per adult reduced. Over the years, we have captured 1.8 immatures per adult (Table 1), therefore, using this age ratio, we estimated an overall cost of $36 per goose reduced by egg destruction.

We believe that by requiring the cities and towns to pay for the capture and transport, the scale of the removal has been damped by economics. While complaints have increased rapidly since 1982 (Figure 4), the number of trap sites has grown more slowly and appears to have stabilized (Figure 6). For example, these data suggest that in the absence of a charge, we would have had to remove nearly four times (397: 101) as many geese in 1996.

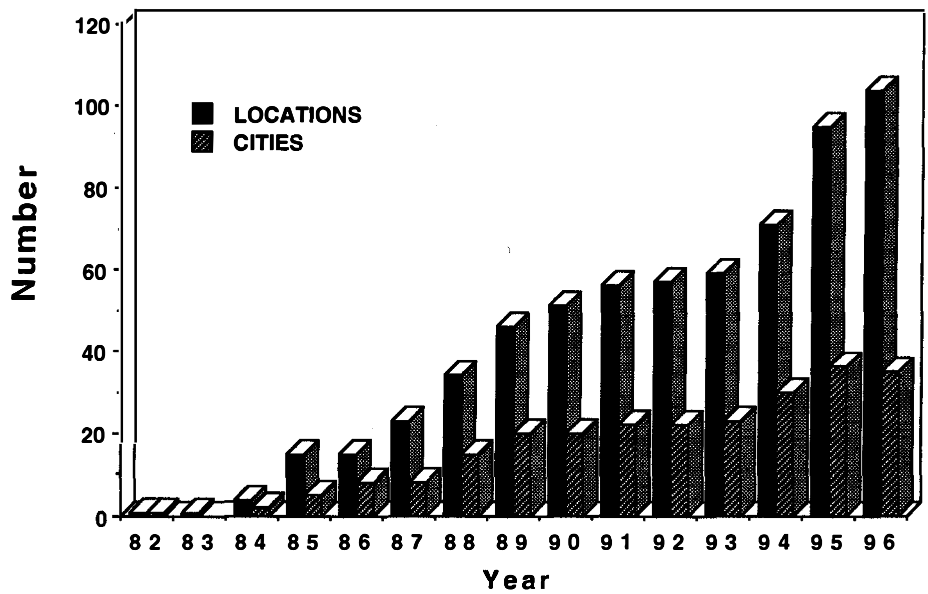

Figure 6. Number of removal locations and cities doing Canada goose removal, Twin Cities, Minnesota, 1982 to 1996.

The relocation results document that the procedure can reduce populations of Canada geese in metropolitan communities. However, the efficacy varied widely and typically took five or more years to attain a 50-percent reduction in bird numbers. The effectiveness apparently was influenced by the available nest sites, degree of isolation from other goose concentrations and return of relocated adults. Isolated sites with limited nesting habitat showed a progressive population decline. Sites with excellent nest sites (islands) continued to attract breeders even when surrounded by urban development, whereas rural sites with an abundance of nesting habitat and adjacent breeding populations showed a slower decline. The return rate of relocated adults suggests the expected population reduction would be more than twice that observed if none returned to breed. This was clearly demonstrated by the fact that relocated adult females constituted 50 percent of the breeding females captured in some years. Therefore, the processing of adults should improve the removal effectiveness by an equal proportion.

Sport hunting was the least costly population management method for cities (Table 5), however, 77 percent of the Metro Area is closed to the discharge of shotguns. Hunting does appear to have had a major effect on populations. The hunted zone goose density was three times lower than in the unhunted portion of the Metro Area. While the density difference might reflect differences in the expansion of the breeding geese from the establishment location (Cooper 1978), it is unlikely. Only 3 of 13 goose establishment sites found by Cooper and Sayler (1974) were in the unhunted zone . As human densities increase, hunting will undoubtedly decline, but at present, it is an important component of the management program.

Table 5. Estimated costs of Canada goose population management methods, Twin Cities, Minnesota.

Procedure	Cost per bird reduction
Sport hunting	$0
Relocation	10
Process for food	24
Destroy eggs	45
Sterilization	$\geq$100[a]
Habitat modification	Very high

[a]Estimated from University of Minnesota College of Veterinary Medicine.

Habitat Reduction

Habitat modification to redistribute geese, while limited at present, may have some potential for alleviating goose damage. But as a population control tool, we doubt that enough shoreline could be converted to unmowed grass to limit the goose population at an acceptable level. To do so would impact most wetland and lakeshore residential lawns and beaches, many parks, athletic fields, golf courses and so forth. It is unlikely that such a change would be acceptable to the public. Moreover, if there were major reductions of mowed grass, the geese would simply concentrate on the remaining habitat where mowed grass is integral to human use, e.g., golf courses, athletic fields, etc.

Summary

Canada goose populations have expanded exponentially in many North American urban areas. Without intensive population management programs, this expansion will continue and so will goose-related problems. Fencing and harassment with a dog appear to be the only effective short-term methods of reducing goose damage at sites. These techniques simply redistribute the birds and, more often than not, result in new problems elsewhere. Population-limiting techniques have long-term effects and, based on our findings, can reduce the population growth rate and perhaps stabilize the population (Figure 1). Hunting, trap and relocate, trap and process for human food, and egg removal or destruction can reduce population expansion. Sport hunting is least costly but limited to areas where it can be done safely. However, our findings suggest that hunting is currently an important goose management tool in the Twin Cities. Geese breeding in unhuntable urban/suburban locations can be managed by egg and live goose removals. Molting goose groups can be located and trapped at about 25 percent ($10/$36) of the cost of locating and destroying eggs. With relocation rapidly becoming a nonoption, the processing of geese for human food appears to be the economical alternative. Even with additional costs of holding and processing the birds, the food shelf program still is estimated to cost 67 percent ($24/$36)less than egg removal or destruction.

Based on our experience in managing the Metropolitan Twin Cities Area geese, we believe that this species, with its many aesthetic qualities, can be maintained at levels that are least harmful to human enterprise, and at reasonable costs.

Acknowledgments

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An Evaluation of a Multidisciplinary Problem: Ecological and Sociological Factors Influencing White-tailed Deer Damage to Agricultural Crops in Michigan

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White-tailed deer (*Odocoileus virginanus*) damage to agricultural crops is a problem for Michigan farmers. When deer cause damage to agricultural crops, even if the only goal was to reduce crop damage to the satisfaction of farmers, the task would be difficult due to the complexity of interacting ecological and sociological parameters involved. A typical management response to deer depredation problems would be to reduce deer numbers and/or the use of crops by deer using control measures such as fencing or repellents. Unfortunately, reducing crop losses rarely is the only goal of deer management and farmers are seldom the only stakeholder to be satisfied. Conflicts among stakeholders escalate the problem to include social issues. For example, stakeholders other than farmers often disagree with the need and/or means to reduce deer numbers. These issues expand management targets beyond deer population and crop use by deer to include all stakeholders involved in the controversy. For example, some states compensate farmers for losses to increase tolerance toward crop depredation and maintain relatively high deer numbers.

The prevalent strategy for reducing deer numbers as a means to control crop depredation assumes linear relationships between numbers of deer, extent of crop depredation and intolerance of losses by farmers. This is a general relationship, but not without exceptions. Relatively low numbers of deer within a region can heavily impact some crops when they become locally abundant (Braun 1996). Further, the same number of deer may cause major crop losses on one farm and only slightly impact production on another farm of the same type. The multiple factors which intervene between deer population size and crop losses might offer some means to refine current management strategies.

Even the increased intolerance to losses cannot always be predicted from the extent of crop loss. What is intolerable loss to one farmer may be a minor nuisance to another. Understanding what influences the response of farmers to crop losses may suggest more effective means to work with them. Similarly, an understanding of other stakeholder perceptions may be essential to manage the issues associated with strategies to reduce losses.

To address the complex and chronic mixture of technical problems and social issues associated with the deer crop damage issue in Michigan, we created an interdisciplinary research team to determine whether refinements to the standard management approaches might be possible (Figure 1). The team included wildlife scientists who examined the habitat attributes hypothesized to influence the intensity of crop depredation within areas of differing deer densities, and the deer population dynamics and movement patterns throughout the study area. Social scientists examined the economic factors to define the problem more fully and look for the contribution of actual losses to producer tolerance of deer depredation. In addition, an issue management approach was taken that included a study of the attitudes and perceptions of farmers,

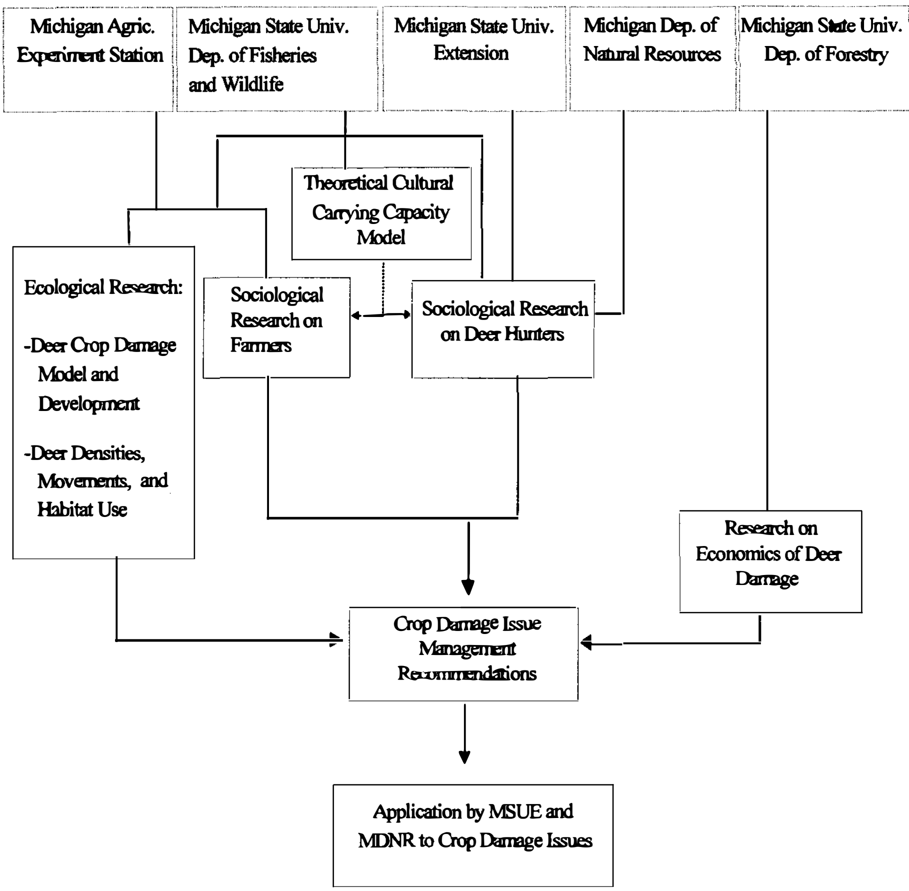

Figure 1. Schematic of collaborative research on deer crop damage in Michigan.

hunters and professionals from the Wildlife Division of the Michigan Department of Natural Resources (MDNR) and Michigan State University Extension (MSUE) who have responsibility for managing the issues. A revised model of Cultural Carrying Capacity (Minnis 1996) provided the basis for the study of stakeholder attitudes and perceptions.

To conduct this multidisciplinary project, each group of scientists first had to complete their individual components of the research project. Once we had a greater understanding of the ecological and socioeconomic factors and issues associated with deer crop damage, we were able to develop management recommendations that integrated information from each discipline (e.g., ecology, sociology and economics). Developing and implementing management recommendations that are based on the disciplines associated with the deer crop damage issue will help reduce crop damage intensities while providing stakeholders with an opportunity to have ownership in managing the issue.

Methods

Deer Damage Model Development

Estimates of crop losses caused by white-tailed deer and vegetation sampling were used to determine which ecological factors could be used to predict amounts of crop loss and patterns of loss in agricultural fields (Braun 1996). Replicated exclosures, paired with areas open to foraging, were used to estimate crop losses in red kidney bean and alfalfa fields from 1993 to 1995. Red kidney bean crop losses were evaluated in relatively high and low deer density regions of Michigan. Alfalfa was evaluated only in a high deer density region, and tart cherries only in a low deer density region. Annual deer density estimates in the high deer density area ranged between 20 to 40 deer per square mile (8-15/km^2) and averaged 12 deer per square mile (5/km^2) in the low deer density area. Crop losses were assessed in relation to deer density, crop management practices, composition of plant communities within geographic areas around agricultural fields and relative deer habitat quality around agricultural fields. The size of the geographic areas evaluated around fields was based on the mean daily movement distance of 1.2 miles (1.9 km) for radio-collared deer in this region (Sitar 1996). Geographic areas around replicated agricultural fields of the different crop types were sampled for various deer habitat attributes. These data were used to quantify relative deer habitat quality around agricultural fields using a deer Habitat Suitability Index model (Bender and Haufler unpublished model modified by Braun 1996).

Population Dynamics, Movements and Habitat Use of White-tailed Deer

Deer were trapped in mid-January to early April in 1994 and 1995 in wooded areas adjacent to agricultural fields with reported crop damage (Sitar 1996). The sex and age of all captured deer were recorded and all deer were marked using ear-tags. Bucks and does of various ages were radio-collared to determine movements, habitat use, home range sizes and seasonal migrations. Over-winter estimates of population size were determined from pellet group counts (Ryel 1971) conducted each spring after snow melt. Causes of mortality for radio-collared deer were classified as natural (including predation, disease and drowning), legal and illegal harvest, road kill, starvation, crop permit harvest, and unknown causes.

Hunters and Farmers: The Socioeconomic Aspects of Crop Damage

Michigan farmers and deer hunters were surveyed in seven counties throughout the state that reflected a range of crop damage issue intensity (Minnis 1996, Peyton et al. 1996). Two questionnaires were mailed, one to hunters and one to farmers. One sample of deer hunters lived and hunted in a study county ("Live Ins"); the other lived in a Metropolitan Area (MA) but hunted deer in one of the study counties ("Live Outs"). Adjusted response rate for the 792 returned surveys was 65.2 percent. For the farmer questionnaire, mailing lists of contacts were obtained from MSUE directors and agricultural agents in the study counties, and 2,134 questionnaires were mailed. Response rate for eligible recipients (e.g., active farmers) was 49 percent. No important nonresponse bias was found in either the hunter or farmer surveys.

Several questions on the farmer questionnaire dealt with perceived damage caused by deer. On the farm level, respondents were asked to estimate yields and losses due to deer foraging. There were sufficient data to analyze financial losses for alfalfa, corn, soybeans, table beans, cherries and Christmas trees. Field-level production loss data (Braun 1996) were used to compare perceptions of damage with actual physical damage and financial losses. Crop loss data were summarized by crop, and probability distributions were developed. These data were combined with reported crop price data and analyzed using a simulation model. Losses were compared with the costs of different control methods (including estimates of efficacy) to determine which controls might be most cost effective for reducing losses.

Results

Deer caused statistically significant production differences for alfalfa and red kidney bean harvests (3 to 11 percent losses) in the high deer density region (Braun 1996). Deer did not cause statistically significant crop losses of red kidney beans throughout the low deer density region. However, many of the individual bean fields in the low deer density region had statistically significant production loss, indicating that local deer foraging can impact agricultural production levels. Tart cherry production in fenced areas was not greater than in unfenced areas.

The proportion of wooded vegetation types, agricultural crops and human development adjacent to agricultural fields influenced production losses in alfalfa and red kidney bean fields. Ecological variables that were identified to predict crop losses were associated with specific deer habitat attributes (e.g., availability of spring foods, distance of agricultural fields to deer wintering areas), relative deer habitat quality around crop fields and crop field characteristics.

Specifically, crop losses of alfalfa and red kidney beans were greater when areas around agricultural fields were at least 61 to 65 percent wooded, when wooded vegetation types contained highly selected deer food, such as aspen (*Populus* spp.) and abundant spring foods, and when forest stands which provided winter cover for deer were within 990 feet (302 m). Browsing of tart cherry trees was greater when areas around orchards had more herbaceous open lands (12 percent), higher quality spring foods provided by other agricultural crops and more upland forests (34 percent) relative to agricultural areas. The availability of herbaceous forage in openings and the relatively high quality of cherry twigs as browse could have attracted deer to local areas within a relatively low deer density region of Michigan. The predictive models described by Braun (1996) indicate that ecological factors other than deer density influence crop loss and that the issue must be addressed based on characteristics of the landscape surrounding agricultural fields.

Thirty-seven landowners cooperated with this component of the project during 1993 and 1994. During these years, 5 out of 31 alfalfa growers received Summer Shooting Permits and approximately 42 percent were used. During 1993 and 1994, red kidney bean growers in the high deer density study area were issued a total of 88 Summer Shooting Permits of which 23 percent were used.

In 1992 and 1993, 31 alfalfa growers used 62 percent of the Block Permits issued by the MDNR to control deer numbers in the fall. In the high deer density area, during these years, 5 of 14 red kidney bean growers were issued a total of 135 Block Permits of which 53 percent were used.

During 1994 and 1995, 107 individual deer were captured and marked with ear tags and a radio-collar (n = 73) or just ear tags (n = 34) (Sitar 1996). Approximately 30 percent of these deer were adult or yearling does and approximately 3 percent were bucks. Buck and doe fawns each made up 33 percent of the trapped deer. Slightly more than half of the collars were distributed to fawns of both sexes, approximately one-third were issued to adult does and the remainder were issued to yearling bucks.

Most of the collared deer (65.5 percent) in 1994 and approximately half (48.8 percent) in 1995 made spring migrations. The remaining deer were nonmigratory. Most (80 percent) spring migrations of collared deer occurred before May 1 each year. Migration distances ranged from 1 to 25 miles (1.6-40.0 km). Mean migration distances for does and bucks were approximately 5 miles (8.0 km) and 8 miles (12.9 km), respectively. More than half (56 percent) of the migratory collared deer traveled to forested lands for the summer, while the remainder of the migratory deer established summer ranges in adjacent agricultural areas. Deer migrating to forested lands in spring traveled greater average distances (8.5 miles [13.7 km]) than deer migrating to agricultural areas (1.9 miles [3.1 km]).

Fall migration of collared deer began on October 8 in 1994 and peaked on November 29. In 1995, fall migration began on November 4 and peaked on November 19. More than half of the collared deer had completed fall migration before the end of firearm deer season (November 15-30). Home range size of collared deer averaged 815 acres (330 ha). Nonmigratory deer remained in agricultural areas year-round.

Greater than 70 percent of the collared migratory deer used the same wintering area in successive years, whereas more than 90 percent used the same summer range from year to year.

Deer used vegetation types differently throughout a 24-hour period and among seasons. Croplands and openings were used more frequently at night and wooded areas were used more frequently during the day and evening. Nonmigratory deer spent more time in crop fields and openings and less time in aspen and pine (*Pinus* spp.) than did migratory deer. As expected, deer in nonagricultural areas were located more often in wooded areas and less often in agricultural fields than deer migrating to croplands.

Over-winter deer densities estimated from pellet-group counts ranged from 6 deer per square mile ($2.3/km^2$) to 9 deer per square mile ($3.4/km^2$) across the study area. During the study, 45 radio-collared deer died. Legal harvest (37 percent) and natural mortality (24 percent) accounted for most of the known losses. Six deer (12 percent) were illegally harvested and five (10 percent) were hit by vehicles. Unknown causes of mortality were attributed to seven (14 percent) of the collared deer. Bucks made up 84 percent of the legal harvest mortalities and 67 percent of the illegal harvest mortalities.

Most deer hunter respondents lived in the southern half of lower Michigan (58 percent rural, 22 percent small town, 20 percent urbanized area). Four percent of the hunter respondents were full-time farmers, 6 percent were retired farmers and 25 percent were part-time farmers. The typical farmer respondent averaged 53 years of age, had a high-school diploma and some college or technical training, had farmed in a study county for approximately 30 years, and earned 64 percent of the household gross income from farming. Most (69 percent) were full-time farmers (spent >50 percent of their working time engaged in farming activities) and 70 percent were deer hunters (Minnis 1996, Peyton et al. 1996).

Stakeholders associated with the deer damage issue disagree on crop loss issues, issues associated with programs to control loss, optimal deer population sizes, and credibility of the MDNR agency and professionals. Subgroups (segments) of hunters and farmers also held differing views. Differences were found when farmers were segmented into hunting full-time farmers, nonhunting full-time farmers and hunting part-time farmers. For example, part-time farmers tended to be more critical of programs to control damage and more tolerant of crop losses than full-time farmers. Important hunter segments were Live Ins versus Live Outs and nonmembers versus members of hunting organizations. Live In hunters and members of hunting organizations were more critical of crop damage control programs.

Crop loss issues were viewed as important deer management issues in Michigan. Most hunters (65 percent) indicated that crop damage was as important or more so than other deer management issues. Half of the full-time and 23 percent of the part-time farmers reported their 1994 crop losses were an intolerable problem. Losses in local regions may be unrelated to statewide trends. Although 1994 was the worst for a majority of respondents, each year since 1986 was identified by at least some farmer respondents as their "worst case of crop depredation by deer."

Much of the controversy focused on the Summer Shooting and Block Permit systems. Most farmers and hunters believed deer numbers could be managed effectively using the statewide antlerless permit system so that special permits would not be necessary. Evidently, few understood that this would increase conflicts by excessively reducing deer numbers in some areas to achieve management goals in others. Deer hunter respondents generally disapproved of special permits but tended to be less disapproving of Block Permits than of Summer Shooting Permits. Live Ins and members of hunting organizations were more disapproving of both permit systems. Deer hunters' approval of permits was influenced by their evaluation of agency administration of the program and, to a lesser extent, by their perceived access to permits and land, attitude toward antlerless harvest and perceived effectiveness of the permit systems. Hunters who were full-time farmers were significantly more approving of Block Permits than part-time or nonfarming hunters.

Desirability of the perceived number of deer in an area was an integral part of the crop damage issue. Tolerances for perceived low numbers of deer varied across counties among hunters. Twice as many member as nonmember hunters viewed numbers of deer in their hunting county as intolerably low. Full-time farmers were more likely than part-time farmers to view numbers to be intolerably high (48 percent versus 23 percent).

Most farmers reported some damage by deer. To keep these results in perspective, Michigan's reported annual per acre yields often vary by a greater percentage than those associated with deer depredation (Michigan Agricultural Statistics Service 1996). In this project, financial losses were calculated for alfalfa, corn, soybeans and table beans, with additional crop loss information presented for cherries and Christmas trees.

For alfalfa, 157 farmers reported losses ranging from 0 to 2 tons per acre (0-4.5 mt/ha); the upper range represents a 50-percent loss. Average alfalfa loss was 0.19 tons per acre (0.43 mt/ha) valued at approximately $13 per acre ($32/ha), representing an average loss of 4.7 percent. About 20 percent of the farmers had losses exceeding $20 per acre (>$49/ha). For grain corn, 246 farmers reported damages of up to 60 bushels per acre (3,765 kg/ha). The average damage was 6.4 bushels per acre (402 kg/ha) valued at about $15 per acre ($37/ha), representing an average loss of 6.5 percent. About 25 percent of the farmers had losses greater than $20 per acre (>$49/ha). For soybeans, 106 farmers reported losses ranging from 0 to 30 bushels per acre (0 to 2,017 kg/ha) (i.e., 75 percent damaged). The average loss level was 3.2 bushels per acre (215 kg/ha) valued at almost $19 per acre ($47/ha), representing approximately an 8-percent loss. About 30 percent of the farmers had losses greater than $20 per acre (>$49/ha). For table beans, 29 farmers reported higher losses than for other crops analyzed. The average loss was 145 pounds per acre (162 kg/ha). The average loss was $29 per acre ($72/ha). About 55 percent of the farmers had losses exceeding $20 per acre (>$49/ha).

Christmas tree growers (n = 40) reported an average loss of 21 trees (1.9 percent) damaged per acre (52 trees/ha). Over a rotation, this is approximately $20 per acre per year ($49/ ha/year). Cherry growers (n = 65) reported an average damage of 125 pounds (3.2 percent) per acre (140 kg/ha).

Given the range of possible financial losses, it is important for farmers to recognize financial costs associated with control measures. The $20 cut-off point, noted above, provides a context for the following description of control costs. Little is known about the efficacy of many control measures, so professional judgment provides a means to combine control costs with efficacy for comparison with potential losses. In this project, farmers' costs for controls were estimated for hunting, fencing, harassment devices and repellents. Longevity for fences and other devices and frequency of treatment also affect financial results and were considered. Maintenance, labor and nonfarmer costs were not included, so financial comparisons between losses and treatment costs were limited. However, for many controls, costs are considerably higher than average losses estimated and therefore not worthwhile. Aside from "free" Shooting Permit hunting, Block Permits are relatively inexpensive at about $1 per acre ($2.47/ha). When considering longevity (and excluding labor, maintenance and considerations of high initial capital cost), temporary fencing costs on average approximately $4.50 per acre per year ($11.12/ ha/year). Multiple-wire electric and woven-wire fences cost $22 and $31 per acre per year ($54 and $77/ha/year), respectively for a 60-acre (24.3 ha) field. The latter types of fences may be useful for farmers experiencing high losses, but would not be financially appropriate for most farmers. Harassment devices range in efficacy. For example, cracker shells strategically used may be more effective than stationary gas canons. Most repellents are, on average, more expensive than other control methods discussed.

Benefits, Impacts and Recommendations

The intent of this multidisciplinary project was to generate ecological and sociological information that would help in the long-term management of crop damage problems and issues in Michigan. We explored the ecological dimensions and found methods to fine tune damage control policies and programs. Our investigation of sociological dimensions provided clues as to how the intensity and disruption of associated issues among stakeholders could be reduced.

Improvements in our ability to manage deer, control depredation on crops and manage the issues associated with the problem have been outputs of this project. For example, data on deer behavior suggest that early seasonal migration movements from summer forest habitat to winter range bordering agricultural lands can impact the effectiveness of Block Permits. Many of the deer targeted by Block Permits would not be the cause of extensive agricultural losses in the summer. The finding that characteristics of habitat types influence crop loss also suggests means of fine tuning damage control strategies. Although herd reduction may be critical for damage control in many instances, when adjacent habitat is relatively poor and agricultural areas provide quality foods, even small numbers of deer can impact heavily on agricultural crops.

Hunters and farmers were found to share many of the same concerns about deer and deer management, but differed in priorities and in their perceptions of the crop loss and means to control losses. Thus, there are both common ground and differences to be addressed in managing these issues. Important segments of hunters and farmers were found which differed from one another in their perspectives and this provides an important tool for working with the conflicts. The sociological studies support many recommendations regarding the management of these issues.

Our study has provided benefits beyond the goal of crop damage control in Michigan. The study on deer movements was useful when bovine tuberculosis was discovered in the northeastern lower peninsula of Michigan and has provided the basis for research aimed at containing the outbreak. The sociological study resulted in a refined theoretical model of cultural carrying capacity and suggests some measurement methods that have potential for continued monitoring of conflict over crop damage and its control. The theoretical and measurement approaches have implications for managing other types of wildlife issues in Michigan and elsewhere.

Our recommendations are based on an integration of the ecological, sociological and economic components of this study (Braun 1996, Minnis 1996, Peyton et al. 1996, Sitar 1996). These recommendations are guidelines for implementing the results of the project to enhance attainment of the general benefits described earlier.

- Because deer damage on individual agricultural fields is influenced not only by deer densities but also the quality of the habitat surrounding agricultural fields, natural resource managers and farmers need to use population and habitat management techniques to curtail damage while still providing deer for recreational activities. For example, farmers may alter cropping activities within specific fields based on features of the landscape that predispose crops to relatively more damage by deer (planting higher value crops away from wooded edges when possible).
- The use of Antlerless Deer Permits, Block Permits and Summer Shooting Permits should be coordinated to control local deer numbers. Summer Shooting Permits should be emphasized and used as early as possible in the growing season before the most detrimental damage is done. Restricting the use of these permits within a specified time period (early in the growing season) may increase their effectiveness for damage control. Fall Block Permit use should be timed prior to fall migration so that deer responsible for crop damage are harvested and deer that summer in noncropland areas are less susceptible to permit harvest. Altering Deer Management Unit boundaries to reflect deer seasonal movement patterns may also enhance the ability to reduce the number of deer causing depredation problems. Improvement of habitat quality away from agricultural areas may also aid in reducing deer movements into crop fields.
- Opportunities for education and communication efforts could reduce misperceptions and enhance tolerance among stakeholder segments for other points of view. Examples include the involvement of all stakeholder segments and agency field professionals in discussions of policy questions regarding Summer Shooting and Block Permit Programs. Continually updating stakeholders on deer harvested with these permit systems would provide a realistic context for evaluating the impacts of these depredation permits. Stakeholders must also understand the diversity of views that exist among segments of their own groups concerning the deer crop damage issue.

- Use of a survey to measure stakeholder tolerance of deer density offers a means for continued monitoring of crop damage issues around the state.
- The revised Cultural Carrying Capacity model could be a useful tool in management efforts, especially if the measurement tools are further refined.
- Farmers with high production losses should consider more costly control measures in addition to low-cost Summer Shooting Permits and Fall Block Permits.

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Special Session 6. *Ecosystem Health in Contemporary Landscapes*

Cosponsored and coordinated by The Wildlife Society

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Opening Remarks

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The concept of ecosystem health has been used with increasing frequency to support widely different goals, priorities and management strategies for natural ecosystems. Three paradigms of ecosystem health stem from early philosophical differences within the conservation movement of the early 1900s. The philosophical basis for the ecosystem health paradigm utilized is based on social values and determines, to a large extent, what desired outcomes are described and which management treatments are proposed in the name of ecosystem management.

The concept of land or ecosystem health dates back to Aldo Leopold's land ethic, described in several essays found in *A Sand County Almanac*, as well as some of his earlier but only recently published works. The concept of ecosystem health has found common usage today, despite the fact that the term *health*, in a literal sense, can only describe the condition of an individual organism (Callicott 1992). Analogies should be drawn cautiously between ecosystem and organism health. Since health best describes the condition of individual organisms, not ecosystems, there is danger in carrying the metaphor of ecosystem health too far. Costanza et al. (1992: 4) describe the dilemma of utilizing the health concept, "The ecosystem health paradigm...uses a broad medical model, even while recognizing that the parallel between medicine and environmental protection does not always hold." As a result of the medical model metaphor, which tends to define health negatively, that is, by the absence of disease, there has been a tendency to evaluate the health of ecosystems based on the health of individual ecosystem components or species. For example, as discussed by Langston

(1995: 150), "To gauge the health of the forest, people tended to focus on the health of trees. If they saw something killing a tree, that must be bad, even if they knew a few dead trees were not necessarily a major problem."

Single-species views of ecosystem health do not take into account the complexity of ecosystems and rely heavily on human valuations of what is desired from an ecosystem. According to Rapport (1992: 145), "Such criteria provide necessary but insufficient conditions for determining the health status of ecosystems. Ultimately, as in human medicine, such determinations hinge on human values. That is, what is 'desired' or 'healthy' must also take into account social and cultural as well as ecological values. These values may differ markedly among various segments of society." Values are cultural phenomenon that affect scientist and nonscientist alike. Janovy (1985: 23) describes this relationship between scientists and social values in his book, *On Becoming a Biologist*, "Although scientists proclaim intellectual neutrality, social climate can never be eliminated as an influence on the practice of a profession." Social or cultural values have had a significant impact on determinations of what constitutes a healthy ecosystem.

The values expressed by scientific reformers of the late nineteenth century were based on fears of a timber famine as a result of previous overcutting in the eastern forests and the belief that scientific forestry could save the forests. George Perkins Marsh published *Man and Nature* in 1864, which raised the threat of an approaching timber famine. According to Langston (1995: 102), "Marsh argued that to prevent timber famine and preserve civilization, science must be introduced into the forests. He was the first to reason that the only way to save the forests was to transform them to regulated forests." This concept of saving the forests through timber harvest formed the basis for a utilitarian conservation ethic, perhaps most clearly described by Gifford Pinchot in *Breaking New Ground* (1947: 32), "The purpose of Forestry, then, is to make the forest produce the largest amount of whatever crop or service will be most useful, and keep on producing it for generation after generation of men and trees." The concept of forestry as tree farming was first espoused by Gifford Pinchot (1947: 31) who wrote, "Forestry is Tree Farming. Forestry is handling trees so that one crop follows another. To grow trees as a crop is Forestry. Trees may be grown as a crop just as corn may be grown as a crop." This concept of forestry led to a definition of forest health based on the health of individual trees. As summarized in Peters et. al. (1996: 2), "Traditionally, the term 'forest health' has been used in a limited, utilitarian sense by professional foresters to refer to the growth and vigor of trees...."

At the same time Gifford Pinchot was developing a utilitarian conservation ethic, an alternative was emerging from John Muir. Karr (1992: 224-225) described this conservation dichotomy: "Gifford Pinchot's consumption-oriented 'resource conservation ethic' called for harvests to provide the greatest good for the greatest number of people for the longest time. The central theme was the utilitarian value of natural resources for harvest by humans. In contrast, the 'preservation ethic' of John Muir suggested that spiritual needs should take precedence over material needs. Muir advocated designation of wilderness areas to fulfill those spiritual needs." Muir was joined in his preservation approach by Bob Marshall, a forester with the USDA Forest Service who defended protecting large areas as wilderness. Marshall argued that, "The most important factor that tends to break down the wilderness...is the mistaken application of the good old utilitarian doctrine of the greatest good for the greatest number in the long run" (Frome 1962: 186).

Aldo Leopold's early thoughts on wildlife management, laid out in *Game Management*, were consistent with the prevailing view of nature as stable and in a state of equilibrium. This equilibrium could be manipulated by controlling selected "factors," such as food, cover or predation, thereby affecting wildlife populations. Leopold's opening statement in *Game Management* is similar to Gifford Pinchot's description of forest management. Leopold (1933: 3) defined game management as follows: "Game management is the art of making land produce sustained annual crops of wild game for recreational use." By 1935, Leopold began shifting away from an implicit belief in a utilitarian approach to resource management. This shift was first observed following a trip to Germany where he studied German methods of forestry and wildlife management. He concluded in *Wilderness,* one of his papers resulting from that trip, that "The Germans are now making a determined effort to get away from cubistic forestry—experience has revealed that in about the third successive crop of conifers in 'pure' stands the microscopic flora of the soil becomes upset and the trees quit growing, but it will be another generation before the new policy emerges in landscape form" (Flader et al. 1991: 227).

Leopold expanded on this critique of utilitarian forestry, particularly as brought to the United States from Germany by Gifford Pinchot, in a plenary address given to a joint meeting of the Society of American Foresters and the Ecological Society of America in 1939. His address concluded that, "Forestry is a turmoil of naturalistic movements. Thus the Germans, who taught the world to plant trees like cabbages have scrapped their own teachings and gone back to mixed woods of native species, selectively cut and naturally reproduced....The 'cabbage brand' of silviculture, at first seemingly profitable, was found by experience to carry unforseen penalties: insect epidemics, soil sickness, declining yields, foodless deer, impoverished flora, distorted bird populations" (Flader et al. 1991: 271).

As Leopold moved away from a utilitarian approach to land management, he began to develop the concept of land health as an integral part of conservation. In *Conservation: In Whole or in Part?* he defines conservation as follows: "Conservation is a state of health in the land. The land consists of soil, water, plants, and animals, but health is more than a sufficiency of these components. It is a state of vigorous self-renewal in each of them, and in all collectively. Such collective functioning of interdependent parts for the maintenance of the whole is characteristic of an organism. In this sense land is an organism and conservation deals with its functional integrity, or health" (Flader et al. 1991: 310).

In keeping with the thinking of the time of the importance of maintaining the individual parts of an ecosystem, Leopold described the condition of land health as associated with a full complement of native species, "Stable health was associated geologically with the full native community which existed up to 1840. Impairments are coincident with subsequent changes in membership and distribution" (Flader 1991: 318). This conclusion that land health was tied to saving all the parts of an ecosystem was best summarized in *A Sand County Almanac*: "...a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning. It assumes, falsely, I think, that the economic parts of the biotic clock will function without the uneconomic parts" (Leopold 1949: 214).

Along with Bob Marshall and John Muir, Leopold also embraced the concept of wilderness, becoming one of the founders of The Wilderness Society. Leopold viewed wilderness as a natural laboratory for the study of land health, maintaining that "A science of land health needs...a base datum of normality, a picture of how healthy land maintains itself as an organism....The...most perfect norm is wilderness" (Leopold 1949: 196).

Finally, Leopold began to understand the importance of ecosystem function in a healthy system. He describes this concept in *Conservation: In Whole or in Part?*: "Conservation is usually thought of as dealing with the *supply* of resources. This 'famine concept' is inadequate for a deficit in the supply in any given resource does not necessarily denote lack of health, while a failure of function always does, no matter how ample the supply. Thus erosion, a malfunction of soil and water, is more serious than 'timber famine', because it deteriorates the entire land community permanently, rather than one resource temporarily" (Flader et al. 1991: 311).

These three early conservation themes (utilitarian conservation as described by Pinchot; the preservation of large natural areas espoused by Muir, Marshall and Leopold; and the land health concept of Leopold to save all the parts and preserve function) have led to three approaches to the definition of ecosystem health. A definition based on the utilitarian approach to conservation, defined by outputs or products, can be found in publications such as the USDA Forest Service's *Healthy Forests for America's Future: A Strategic Plan*, which states that "...a desired state of forest health is a condition where biotic and abiotic influences on the forest (for example, pests, atmospheric deposition, silvicultural treatments, and harvesting practices) do not threaten resource management objectives now or in the future" (USDA Forest Service 1993: 4). A focus on management objectives tends to lead to a view of natural agents that could decrease resource yields (insects, disease or fire) as unwanted factors to control or eliminate from the ecosystem, rather than as natural components or processes within an ecosystem.

An alternative approach to defining ecosystem health is based on the theory that ecosystems are structurally and functionally like organisms, in addition to an equilibrium theory of ecology, that systems when disturbed will return to a stable equilibrium or balance point. The application of these two theories results in the concept of normative health for ecosystems as described by Ehrenfeld (1992: 137): "Because communities have fixed identities, because they are normative like organisms, we can easily apply the normative idea of health to them: if they are functionally and structurally similar to their abstract ideal, they are healthy; if they deviate significantly, they are sick." This normative ideal for ecosystems leads to the desire to preserve ecosystems as they were during some time in their past: their abstract ideal. This argument is used as a basis of the preservation philosophy of conservation in supporting the need for large blocks of wilderness and managing ecosystems for predisturbance conditions.

More recently, as the role of disturbance in ecosystem development has become better understood, a new ecological paradigm has replaced the old theory of the "balance of nature." As described in Pickett et al. (1994: 76), "The new paradigm in ecology can be represented by an informal metaphor of the 'flux of nature'. Such an admittedly nonscientific phrase has connotations of change, variety, and dynamism, rather than stasis and fixed equilibrium points, which are the unfortunate baggage of the hoary 'balance of nature' metaphor." This theory of natural flux or change within ecosystems leads to a different focus when attempting to define a condition of ecosystem health which takes dynamism into account. One working definition, developed at a workshop on ecosystem health in 1990, was proposed by Costanza (1992: 9): "An ecological system is healthy and free from 'distress syndrome' if it is stable and sustainable—that is, if it is active and maintains its organization and autonomy over time and is resilient to stress. Ecosystem health is thus closely linked to the idea of sustainability, which is seen to be a comprehensive, multiscale, dynamic measure of system reliance, organization, and vigor." This definition is harder to describe specifically than the previous two, since it recognizes that ecosystems evolve over time and are influenced by both natural and cultural effects. Stability is not an endpoint in this definition, but a relative state that may change over time. Under this definition there is no one reference state or set of outputs that define a healthy system.

Pickett et al. (1994: 76) used the term contingency to describe the relative condition of an ecosystem when he stated, "...the behavior of an ecological system depends to some degree on its unique past, specific spatial setting, and current influences. Contingency means that restoration ecologists will have a variety of reference states to choose from. Contingency establishes a whole range of systems, not just one 'climax' or predisturbance state." What this means from a management standpoint is that there is no one way to manage for ecosystem health, since the condition of health is contingent on a number of external factors, while the definition of health is dependent, to a large extent, on the values of those creating the definition. The dilemma for restoration ecologists or ecosystem managers is deciding which definition to use and which reference state will produce the values desired, while maintaining the resiliency and sustainability of the system. As described by Pickett et al. (1994: 76), "...there are many ecological and societal reasons to choose certain reference states, including aesthetics, commodity production, ecosystem services, and species protection among others. But the point is that restoration ecologists must choose, and nature provides a range of ecologically valid system states."

If a range of ecologically valid system states exists, how is a land manager to choose which state is best? There probably is no one best state, nor one state that fits all the value systems of potentially interested parties. Perhaps the best that can be achieved is an ecological state that is resilient, relatively stable and can resist perturbations while providing desired values, whether these are commodity outputs or intrinsic conditions. In any case, underlying value systems lead to accepted definitions of ecosystem health, which, in turn, determine management treatments and outcomes, which produce different resource outputs.

Today's session, *Ecosystem Health in Contemporary Landscapes*, is designed to examine alternative ways of defining or thinking about ecosystem health, and based on these different philosophical approaches to the health concept, describe approaches to management and management outcomes that may result. The session is not intended to find the "right" definition or approach to the ecosystem health question, but rather to explore consequences resulting from differing philosophies. The first three papers offer different perspectives of the ecosystem health concept to begin the dialogue. The remaining papers include three case studies, examining the results of specific projects designed with different underlying philosophies or concepts of ecosystem health, and one index for measuring ecosystem health on a broad scale.

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Defining Ecosystem Health in National Parks

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The National Park Service (NPS) currently manages some 378 separate units classified in 20 unique categories (national parks, national monuments, national seashores, national recreation areas, national historic sites and districts, national rivers, national preserves, etc.). Most of these discrete units are managed in accordance with site-specific goals set out in unit-specific enabling legislation or omnibus park bills. The generic management policies governing the units managed by NPS are contained in the *Management Policies* (NPS 1988). This document contains the basic servicewide policies, and adherence to them is mandatory unless precluded by unit-specific objectives or policies established by Congress or waived by the Secretary of the Interior, Assistant Secretary for Fish, Wildlife, and Parks, or the Director of NPS. Recommended procedures for implementing the policies are contained in the NPS servicewide guideline series (e.g., *NPS-77 Natural Resource Management Guideline* 1991). The guideline procedures are generally discretionary, except for a relatively few mandatory processes, most of which are mandated in statute.

But it is important to understand that many NPS units have Congressionally mandated management objectives which, at times, may conflict to varying degrees with the general servicewide policies. Some of these include provisions for sport hunting, trapping and commercial fishing; long-term protection of *exotic* species (such as horses and ponies); authority to sell *surplus* wildlife; and provisions for *subsistence* hunting, fishing and gathering (including cutting trees for shelter and fuel). Many NPS units contain artificial water impoundments which are operated for deterministic downstream objectives, thus compromising historic flow regimes and the restoration of native fishes. Many contain rivers flowing in, out or through them which are regulated by the Army Corps of Engineers or the U.S. Bureau of Reclamation. And some have been subjected to stabilization attempts by humans (such as some national seashores) to proscribe the physical evolutionary forces that would otherwise change them markedly in the short term.

The purpose of this preface is to alert the reader to the fact that the documented servicewide policies of NPS (1988) represent an idealistic set of *default* policies which are brought to bear when specific policies and objectives have not been established in law for a given unit. And, though the policies are mandatory, they are obviously impacted by the realities of limited science, limited funds and logistical possibilities. With these facts in mind, let s take a closer look at the NPS policies which most affect the agency's potential to embrace and manage for the emerging concept of ***ecosystem health***.

[1]The opinions expressed in this paper are solely those of the author and do not represent the official position of the National Park Service or any other organization.

The *Management Policies* (NPS 1988) state: "The natural resource policies of the National Park Service are aimed at providing the American people with the opportunity to enjoy and benefit from natural environments evolving through natural processes minimally influenced by human actions."

Minimal human influence may seem like a widely acceptable and defensible management objective for the natural resources of NPS units, yet in recent decades, it has generated a constant stream of internal consternation and external criticism for the agency. The problem lies in defining how much influence is truly *minimal*. The acceptable (i.e., minimal) level of human influence on any given NPS resource is most often undefined in specific policy. This approach provides a wide degree of management discretion which, for many decades, served the agency and its resources well. There now appears to be a call by some scientists for more clearly iterated, ecologically defined management objectives (Wagner et al. 1995).

Some of that concern stems from implications of the general natural resource management policies which have been in effect since 1988. And one flash point seems to be in the use of the term *natural* and its derivatives.

The policies (NPS 1988) also state: "...change (will) be recognized as an integral part of functioning of natural systems. The National Park Service will not seek to preserve natural systems in natural zones as though frozen at a given point in time."

At first look, terms such as *natural processes*, naturally evolving, and *natural systems* seem familiar and discrete enough to have valuable uses in policy. But, in fact, they are highly problematic because they invoke the *Dualism of Nature* (Soule 1995). That is, on the one hand they presuppose that there exist both natural, and *unnatural* (or nonnatural) processes, systems and evolutionary processes, yet every dictionary this author has reviewed defines *nature* as the entire material (i.e. physical) universe, including all the forces that shape and maintain it. Use of the adjective *natural* logically begs the question of **where is the boundary between *natural* and *unnatural*?** And if the term is used pervasively in mandatory servicewide policy, there must be implied a clear and present difference between good (i.e., the *natural*) and bad (i.e., the *unnatural*), else the policy becomes ambiguous.

The obvious natural *dualism* comes in the connotation that the influences of humans on their environment are *unnatural*, while those of every other species and physical process in the universe are, indeed, *natural*. And this concept is extended in the presumption that, at some time in the historic past, North American ecosystems existed in some natural state of grace which was immediately sullied when humans of European origin set foot on the continent. Resultingly, the environmental influences of European derived humans on America, and thus on the national parks, are *unnatural*, while the influences of 10,000 years of habitation by Native Americans are *natural*.

The policies (NPS 1988) go on: "Naturally evolving plant and animal populations, and the human influences on them, will be monitored to detect any **unnatural changes**" (emphasis added).

But how would one define an *unnatural* change among *natural* evolutionary processes and the human influences on those changes? Again, usage in policy of the terms *natural* and *unnatural* implies the existence of an absolute, definable boundary between the two. I would suggest that NPS needs to revisit the dichotomy and consider the utility of defining that boundary in light of the science which has emerged in the last decade.

But how does all this relate to the concept of *ecosystem health* in the NPS? The term is not yet in general use among NPS natural resource managers, and may never be, for several reasons. First, it appears that the term *ecosystem health* stems from the industrial term *forest health* which has come into vogue in recent years. Usage is mostly as a relativistic term to describe variance of forest conditions from deterministic management objectives. For example, a plantation of a genetically engineered tree species being cultivated for pulp fiber may exist in the absolute blush of *forest health*, even though the entire forest is composed of a single, arguably *unnatural* species. That *health* status could be diminished by *natural* events, such as insect infestation or windstorms, causing widespread accumulation of worthless deadwood. So forest health seems to denote a condition in **compliance with the deterministic objectives of humans**.

The term *ecosystem health* has been used interchangeably, but perhaps incorrectly, with the term *ecological integrity*. Norton (1992) described the latter as total *native diversity* and the patterns and processes that maintain it. The latter term is often used by conservation biologists and environmentalists as an umbrella objective suggested for adoption by almost everyone, but this apple-pie term is not without its own set of problems. But the most significant variance with the term *forest health* is that *ecosystem health* implies a condition of **compliance with the nondeterministic objectives of *nature*.**

Among conservation biologists, the term *native diversity* refers to the diversity of ecosystems and the constituent plant and animal communities, populations, guilds, species and even genetics that were present at some time in the past. Species that were not present during the defining reference period for *nativeness* are generally termed *exotics* and are definitely *non gratae* in national parks. Traditionally, NPS has not used the term *reference period* for national parks, opting instead to utilize some undefined pre-European contact period or the date the unit was created. The actual NPS (1988) policy definition of *native* animals is: "...all animal species that as a result of natural processes occur or occurred on lands now designated as a park."

Here, again, is that problem word, *natural*. And, again, we have the dualism conflict because the policies go on to describe *exotic* species as: "...those that occur in a given place as a result of direct or indirect, deliberate or accidental actions by humans (not including deliberate reintroductions)" (NPS 1988).

To summarize, according to NPS policy, *native* species arrived through *natural processes*, while *exotic* species arrived through the actions of humans (presumably post European contact humans only, although this is not specified in the policy statement). Clearly, here, NPS policy differentiates between *human caused* and *natural*.

There are several important problems with this concept. First of all, in the definition of *native* species above, there is no definition as to **when** the defining occurrence took place. But, through convention, and the fact that post European contact human influence is considered *unnatural*, a pre-European human contact period is generally accepted, and the species occurrence data gathered through paleontological and palynological methods are accepted as *prima facie* evidence of *nativeness*. Also, there must either be an assumption that pre-European contact human influence (i.e., that of aboriginal Americans) was either insignificant or *natural*, whereas influence of post European contact humans is either undesirably significant or *unnatural*. If aboriginal ecosystem influences were *natural*, how then does NPS provide for *natural environments evolving through natural processes* (NPS 1988) without having all the *natural processes* present? Even if we assume aboriginal influences were truly *natural* but insignificant, we still have an *unnatural* situation where those influences have been excluded, for certainly those influences would have evolved along with the aboriginals in the ecosystem if given the time. The fact is, the arrival of European humans simply fast-forwarded the evolution of human influences on American ecosystems by a couple thousand years or so.

NPS is generally managing national parks for ecological succession of the components and functions found on-site prior to the arrival of European humans, except for the deterministic or accidental influences of **either** aboriginal humans **before** European contact or modern humans **after** contact. And, because it is tied to the concept of *nativeness*, ecological succession and, ultimately, evolution are continually compromised because NPS keeps replacing lost pre-European contact species and eliminating any new arrivals. So, even though NPS (1988) policy explicitly states "The National Park Service will not seek to preserve natural systems in natural zones as though frozen at a given point in time," the concept of *nativeness* locks the parks into, at least, a species complement set in soft concrete.

Recently, Michael Soule (1995) stated the following about the management of wildlands and wild waters:

> "Indeed, a century ago, a hands-off policy was the best policy. Now it is not. Given nature's current fragmented and stressed condition, neglect will result in an accelerating spiral of deterioration. Once people create large gaps in forests, isolate and disturb habitats, pollute, overexploit, and introduce species from other continents, the viability of many native species is compromised, resiliency dissipates, and diversity can collapse....Until humans are able to control their numbers and their technologies, management is the only viable alternative to massive attrition of living nature."

Soule is advocating management to mitigate the influences of modern humans and their technologies on the loss of native biodiversity. This admonition will certainly have mixed reviews among NPS managers. But, there is growing pressure from ecosystem partners and park neighbors to reexamine the hands-off approach in many corners of the NPS realm, as (1) ecosystem processes and components spill across park boundaries, in both directions, and temper stewardship under NPS policies or those of other stakeholders; and (2) the significance of the subsistence and cultural activities of aboriginal Americans continues to unfold.

But David Graber (1995), to the contrary, has claimed: "Management for biodiversity in national parks is incompatible with management for wildness because it requires heroic and intrusive interventions, depriving visitors of the subjective experience of wildness."

Graber is apparently suggesting that the interventions thought necessary by Soule (1995) to retain even remnants of native ecosystems will result in *objective* replacements for *true wildness*.

Albert Borgmann (1995) may have pioneered the resolution to this dilemma with:

> "...but this view (acquiescence to the decline of ecosystems) rests on a false dichotomy: natural vs. artificial, independent vs. managed. An alternative to ubiquitous artificiality is the admission of degrees of "reality." The criteria are genuineness, seriousness, and commanding presence. Thus the substitute for the dualism of natural and artificial is a new continuum: reality-hyperreality. And even if nature (reality) is to some extent a human invention, it can still be eloquent and inspiring and still can invigorate the notion of excellence. A general guideline: to save or restore a wild area's commanding presence and to guard its coherence with its environment and tradition."

The renown paleontologist-turned-philosopher Stephen Jay Gould once said (personal communication: 1991) to an incredulous group of NPS resource managers and scientists, "in the really big picture, does it [NPS natural resources management policy] really matter?" **Well, of course it matters!** Congress did not create the National Park Service and the 376 units of the National Park System to be managed according to the precepts of existential nihilism. The American public loves its national parks because of their *commanding presence* and the *notion of excellence* they inspire. It is unlikely most park visitors are interested in the debate over the appropriate use of the terms *natural* and *nativeness*. And most publics will accept reasonable management objectives laid out by NPS, whether they require a hands-on approach or not.

So it is incumbent upon the agency periodically to take a close and careful look at its basic policies and guidelines, and reconcile any conflicts with new and emerging science, history and social values. The concept of ecosystem management enjoins the NPS, with other ecosystem stakeholders, to consider the wide array of management objectives held by the neighboring land managers. Participating agencies must consider management alternatives that allow optimization of all ecosystem goals without compromising the unique mandates of ecosystem partners. Obviously, this is more easily said than done, but the challenge should take us well into the next century. The concept of *ecosystem health* is emerging as a way to synthesize an ecosystem vision that provides for accomplishment of unique individual goals, yet moves beyond to a more functional and sustainable landscape. Technology cannot yet predict the next period of worldwide vulcanism or the next asteroid strike, but a National Park System brimming with *inspiration* and *commanding presence* is, in all probability, sustainable in a human scale future. The agency needs to reconcile a few servicewide policies with contemporary scientific thought and human dimensions, to move into its second century with a *commanding presence* among resource management agencies. I hope we are ready to do it.

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Historical Changes in Western Riparian Ecosystems

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Prehistoric Period (Pre-Euro-American Contact—Before 1805)

Paleo-Environment

Archaeological evidence of the region suggests that the first Oregonians arrived near the end of the Pleistocene, when the world's climate was in transition from the cold of the glacial age to the warmth of the postglacial. Global and regional climatic shifts occurred several more times during the prehistoric period, altering local environmental patterns in the southern Columbia Plateau and northern Great Basin regions of Oregon, as well as in other areas of the West.

The postglacial epoch for the region is generally divided by western scholars into three Paleoclimatic periods; they are described as follows: the Anathermal Period (10,000-7,500 B.P.), characterized by cooler, moister conditions than today; the Altithermal Period (7,500-4,000 B.P.), marked by warmer, drier conditions than today; and the Medithermal Period (4,000 B.P.-present), exhibiting current climatic conditions (Pettigrew 1996, Aikens 1993, Antevs 1955, 1948). Paleoclimatic studies show, however, that extreme temperature and moisture fluctuations occurred even within these periods; during dry periods there were marked wet phases, just as there were dry phases during generally wetter periods (Aikens 1993, Mehringer 1977, 1986).

Paleoclimatic shifts produced small but significant environmental fluctuations that affected temperature, moisture, flora and fauna. The extent to which climatically induced environmental change over time might have affected the long-term human settlement pattern (i.e., the placement of hunting, gathering and occupation sites over a landscape) depends significantly on specific local topographic variables (Aikens 1993). Variations in topography (i.e., elevation, degree of slope, direction of exposure, stream courses and springs) regulate moisture production and the distribution of plants and animals in any given setting. Therefore, areas that are topographically diverse are generally also biotically diverse, offering greater opportunities for human exploitation than the more uniform landscape (Aikens 1993). The environment and its changes are unmistakably of great importance to human ecology, and some of the ways in which prehistoric communities were affected will appear below.

Paleo-Indian Period (prior to 10,500 B.P.)

The earliest people known archaeologically are believed to have been mobile foragers, hunting herds of large mammals (especially extinct forms of elephant and bison) that grazed on the vast tundra grasslands near glaciers. Their life way would have involved frequent movements by small family bands, erecting temporary dwellings near water and the animals they hunted.

Paleo-Indian people likely possessed a sophisticated level of specialized knowledge about the animals they hunted and a generalized knowledge about the availability of other key plant, animal and mineral resources necessary for their survival (Pettigrew 1996). Paleo-Indian sites discovered in Oregon, to date, are quite limited, but almost all have been situated along the edges of lakes, marshes and rivers, favorable locations for stalking the large mammals.

Early Archaic Period (10,500-7,000 B.P.)

The large herding mammals that were the focus of the earlier Paleo-Indian period disappeared from the landscape by 10,500 years ago due to changing environmental conditions. These changing conditions resulted in human groups of the Early Archaic period becoming less mobile and participating in a much more diversified economy than their Paleo-Indian ancestors. To take advantage of the widest variety of plant and animal foods, people of the Early Archaic established small, seasonal residential sites alongside riparian areas, critical habitat for fish, waterfowl, game and culturally important plants. The availability of fresh foods was of upmost importance, as food storage was not yet a relied upon practice. Population densities rose markedly in some areas during this period, possibly as a result of more stable food sources and the aggregation of populations.

Middle Archaic Period (7,000-2,000 B.P.)

The Middle Archaic Period witnessed the most dramatic cultural changes of any prehistoric period. Human populations not only grew to the highest recorded levels, but expanded in areas where winter scarcity earlier kept populations low or absent altogether. These developments are considered to be the result of a shift from temporary settlements and an orientation toward freshly gathered foods to more sedentary settlements and a growing reliance on storable items, including roots, seeds and salmon (Pettigrew 1996).

The warming, drying trends of the Altithermal Period during the Middle Archaic, forced people to adapt to dramatically changed environmental conditions. Environmental constraints stimulated new techniques to hunt solitary game animals and invest in the labor-intensive gathering of upland roots and seeds due to wetland resources being substantially reduced at this time. During this same period, where salmon were available (their availability might have declined during dry periods), increased fishing would have been highly adaptive, especially in concert with the achievement of drying and smoking techniques (Lebow et al. 1990).

By 5,000 B.P., the climate had begun to improve, and the newly adapted subsistence pattern was in place to take advantage of the renewed (albeit seasonal) abundance. The first pithouse dwelling sites on the Columbia Plateau occur around this time. They would have been small, accommodating a single family or very small groups of extended families. Their placement, typically along riparian zones, would have allowed residents to exploit local resources. These residences would have provided a home base from which people would travel to important upland resource zones, where game animals and plant foods were abundant.

Late Archaic Period (2,000 B.P.-Contact)

Although archaeological evidence suggests that a riverine adaptation based on salmon fishing may have begun as early as 10,000 years ago along the Columbia River, it was probably not very important at that time. By 3,000 B.P., as the climate began to cool, salmon fishing had become a much more important part of the economy, and Columbia Plateau culture changed greatly as a result. Plateau people had learned to capture, preserve and store considerable numbers of fish, providing an ever increasing population with a dependable food supply. Salmon attracted a large segment of the human population to areas with substantial fall runs, particularly along the arid stretches of the middle Columbia River. Habitation sites began to expand geographically and large riverside villages were established. Seasonal exploitation of root grounds and other resources continued to be of critical importance to Late Archaic people.

Indian ways of life in the Columbia Plateau and Great Basin regions of Oregon had remained fundamentally the same for 10,000 years. What demonstrable changes did occur during that extensive time period can be traced to two factors: the environmental consequences of Paleoclimatic shifts, and transformations in foraging strategies and techniques as people adapted to their environment (Hunn 1990).

The Natural World

Prehistoric people had a specific knowledge of their world and how to live in it successfully, and had done so for thousands of years. As hunting-gathering and fishing people, they depended on nature's bounty for their sustenance, tracking the natural patterns and cycles of their environment and adapting to environmental changes as needed. The natural world was their pharmacy, grocery, department and hardware store, providing all the resources necessary to survive. The habitats in which these resources grew were, like the resources themselves, diverse and included in part: rivers (salmon, other fish species, harbor seals, lamprey, river mussels); stream banks (currants, ryeseeds, cow parsnip, willow); wetlands/marshes (cattails, tules, rushes, waterfowl); lithosolic patches (roots, such as bitterroot, lomatiums, onions and brodiaeas); dry fields (seeds, such as sunflowers, mustards and lily bulbs); wet meadows (camas, yampa); foothills (choke cherries, acorns, service berries, raspberries and wild roses); woods (pine nuts, cambium); and mountains (huckleberries). Found in association with any or all of these habitats were various forms of wildlife, including mammals and birds, that were pursued for their important role in the people's diet.

Visitation to many of these locations and the resources they offered was cyclical and somewhat altitudinal (Hunn 1990). That is, yearly gathering began in lowlands in the spring and transitioned toward the higher elevations as the seasons progressed, in what is often referred to as a "seasonal round." Harvesting activities had to be coordinated, and sometimes scheduling conflicts occurred. This was often the case with large game, which were best taken at the time of the fall salmon run.

Settlement patterns were strongly influenced by subsistence rounds, as well as climatic considerations and availability of natural resources. In the southern Columbia Plateau and northern Great Basin regions, life generally trended toward wintertime habitation of riverine lowlands and summertime camping in the uplands. Habitation sites were likely selected on the basis of availability of potable water and fuel, protection from the elements, and the proximity of important foods. If any of these elements were missing, settlements would probably not be established or would be relocated.

The land conservation ethic of the region's Native People played a critical role in the perpetuation of their ancestral life way well into the 19th century. For example, selective digging techniques were utilized during plant food harvesting, and the timing of both plant and animal harvests had to be considered carefully. There were incentives not to overharvest species so as to eliminate them from a particular area, but rather sustain their existence in known locations. Certain hunting and fishing practices also embodied elements of a conservation ethic, such as the tendency to catch primarily male salmon and trout on spawning beds. Fishing restrictions were also enforced for nights and specific days, thus allowing a certain portion of fish to pass (Hanes 1995).

American Indian perceptions in the region are best described by Dick (1990: 10): "Land is sacred as it has sustained Indian societies through the ages. Water is all important, being the 'giver of life,' and 'Indian foods' are inseparable from religion." Dick (1990: 8) further states that, "Water and food are energies you use in following the path to the other world." Ceremonies and religious stories honor the spirits of the fish, animals and plants and teach against overuse, as Indian peoples regard themselves as guardians or custodians of the land, rather than owners (Hanes 1995). American Indians are linked to their environment by careful observation, economic calculation, ritual monitoring, and mythical explanation (Hanes 1995, Hunn 1990).

Historic Period (Post Euro-American Contact—After 1805)

Euro-American Contact

Contrary to many beliefs of Euro-Americans arriving in the region in the nineteenth century, the interior Columbia Basin and adjacent lands were not pristine wilderness areas but ecological systems in which humans had been an active component for thousands of years (Hanes 1995, MacCleery 1994, Woolfenden 1993). Most Indian people manipulated or otherwise managed portions of their environments in various ways (Hanes 1995). They encouraged the resources they utilized and discouraged those that interfered with their needs (Barker 1996). Fire, for example, was liberally used by American Indians as a tool to maintain or select certain vegetative states or manage wildlife (Hanes 1995, Fowler 1986). Human groups also employed such activities as broadcast sowing of wild seeds, at times in concert with burning; transplantation of some vegetative species for the convenience of access and location, and the intentional and unintentional pruning of willows for basket fibers (Hanes 1995, Fowler 1986). In fact, Native Americans routinely utilized fire, water diversions, vegetative manipulations and group hunting strategies to significantly alter the composition, distribution and behavior of plant and animal communities (Barker 1996).

Both natural and cultural processes have been involved in shaping the region's ecology for millennia but possibly never more significantly than during the period of western expansion. With the arrival of ever-increasing numbers of Euro-Americans after 1800, the relative cultural and ecological stability of the prehistoric period began to erode (Robbins et al. 1994, Hunn 1990). Armed with unique cultural, social and economic qualities, the newcomers imposed dramatic cultural and biological alterations on the indigenous people and landscapes of the region (Robbins 1994).

In contrast to Native American culture, Euro-Americans developed a conceptual separation between humanity and the environment, where humanity was considered superior to nature and not bound by ecological limits (Barker 1996). This artificial separation between humans and the natural world inspired the belief that ecosystems could be used in any way desired without suffering long-term consequences (Barker 1996). Ex-president John Quincy Adams may have expressed this new belief system best when addressing the Oregon boundary question on the floor of the House of Representatives in 1846: "We claim that country—for what? To make the wilderness blossom as a rose, to establish laws, to increase, to multiply, and subdue the earth, which we are commanded to do by the behest of God Almighty" (Robbins et al.1994: 11, *Congressional Globe* 1846: 342). Perhaps the greatest motivator in transforming the human and natural world of the Pacific Northwest was the external market demand for the commodities derived from the region's resources (Robbins et al. 1994).

Exploration and Fur Trade

At the beginning of the 19th century the United States was a new nation and needed land and resources to grow. As a result, Euro-Americans became interested in the lands west of the Mississippi River and began to explore overland routes to the Pacific Coast. The first overland explorers to the Oregon Country were members of Lewis and Clark's 1805 expedition. Upon their return, Lewis and Clark reported to Congress that the region contained lands rich in natural resources and would be quite suitable for American settlement.

Among the resources reported was the rich fur supply in the Pacific Northwest. Both the Pacific Fur Company and the North West Company operated on the Columbia Plateau between 1811 and 1821. By 1821 the British Crown forced the North West Company to merge with its rival the Hudson's Bay Company. For the next 20 years the Hudson's Bay Company dominated the fur trade in the Oregon Country and across the continent.

To discourage competitors from entering the Pacific Northwest, the Hudson's Bay Company adopted a policy of trapping out the beaver on the region's eastern periphery. They deliberately created a "fur desert" and, as a result, a barrier to others. In some regions the beaver had literally been trapped out of existence, and as the resource was depleted, the trappers moved into new areas. The decimation of the beaver population occurred soon after Euro-Americans entered the Northwest, with consequences to riparian ecosystems that scientists are only beginning to understand today (Robbins et al. 1994).

Early explorers, fur trappers and traders developed an intimate knowledge of the land and its resources, and provided descriptions of America's western landscape during the contact period. They reported extensive stands of willows and alders, and wide, wet meadows along stream systems throughout the interior of the Columbia River basin.

During his explorations of Oregon's Crooked River country in 1825, Peter Skene Ogden (1950) wrote: "We have investigated this drainage and all the tributaries there too and find them to all be well lined with willow and aspin." He went on to write that "a greater place for beaver did not exist in this world." The Crooked River bottomlands were also impressive; Ogden reported grass as high as 7 feet (Ogden 1950). These conditions still partially existed into the late 1800s.

Overland Emigration

Glowing reports by the early explorers, trappers and missionaries about the resources and climate of the Oregon Country stimulated thousands of Americans to head westward in the 1840s. The migration began with several families in 1841 and 1842. By 1843 the first large wagon train left from the Missouri River headed for the Oregon Country with 500 people. Eventually, more than 350,000 easterners migrated west during the migration years between 1841 and 1866 (Schlissel 1982).

The overland journey was more than 2,000 miles long and took approximately four to six months of almost daily travel. The routes (mainly traditional Indian, fur trader or game trails) were dictated by geography as well as the availability of resources, such as water, forage for livestock, firewood and game. Trails were often crowded, with thousands of emigrants and their livestock passing by in a single day. Competition for resources and campsites was a constant problem.

Contaminated water was a significant problem created by the overlanders. Water supplies and cooking were mixed with milling and dead animals and their waste (Butruille 1993). Crowding along the trail, especially in heavy migration years, quickly polluted some rivers, springs and shallow drinking holes. As a result, "water sources became perfect breeding grounds for infectious diseases, such as typhoid, tuberculosis, malaria, dysentery, pneumonia, measles, smallpox, yellow fever, and worst of all, cholera" (Butruille 1993: 100). Emigrant Jane D. Kellog wrote, in early June of 1852, "There was an epidemic of cholera all along the Platte River. Think it was caused from drinking water from holes dug by campers" (Schlissel 1982: 59).

It was fortunate that many women were finicky about their drinking water and, according to author Irene Paden (Butruille 1993: 75), refused to drink water with "wiggle-tails" in it. So, they would kill the creatures by boiling the water for tea or coffee, unknowingly killing deadly germs in the process (Butruille 1993). Too often, however, they would drink the water unboiled.

Nineteenth Century Economic Trends

Mining

The discovery of gold in the 1850s attracted thousands of miners, camp workers and supporters to the interior of the Pacific Northwest. The rush of activity to extract minerals from the region's streams and mountainous slopes perpetuated the culturally induced transformation of western riparian ecosystems (Robbins et al. 1994). Mining, especially in the nineteenth century, was ecologically disruptive as mountainsides were sluiced away, watercourses polluted and silted, and riparian habitats destroyed (Robbins et al. 1994).

Placer mining had a tremendous impact on the natural environment. Shallow placer miners relied primarily on the pan and sluice to separate the heavier gold from stream bed sand and gravel. Once those deposits were exhausted miners turned toward more intrusive means of technology to reach the deeper deposits. These came in the form of hydraulic pipes, reservoirs and long canals. The pipes, or "giants," utilized in hydraulic mining after the 1860s, operated like large garden hoses to wash vast amounts of soil off mountainsides and into sluice boxes. The dredge, another placer mining innovation, was introduced about 1900. Dredges would collect sand and gravel from deeper bodies of water to be washed and the mineral extracted.

Lode mining was introduced to access the hard-to-reach ore deposits. This method of mining required digging into mountainsides to reach the gold-bearing vein of rock. The vein was then blasted or dug out to break up the ore and extract it from the mountain. The ore was then crushed and processed so the gold could be collected.

As a result of these various mining practices, streams were diverted, polluted, silted up, and made sterile of plant life and fish, and adjacent riparian zones were trampled and destroyed. Hydraulic and lode mining created huge scars on the land as they tore into mountainsides and increased erosion. They also left great piles of refuse deposits or tailings, as did dredging. Through the combination of these actions, it is claimed that some stretches of streams and rivers disappeared from the surface entirely and waters moved underground.

Mining settlements were often built on every bar or flat in the canyons and gorges being worked. Camps were typically tent sites, near wet ground where rivers had been diverted so that their gravel beds could be washed and sifted (Schlissel 1982). The rumor of a new strike higher up or farther down the river was enough to send men packing off to a better location. Miners would sometimes return to locations that previously went "bust" if improved technology made mining in that area profitable again.

Livestock Grazing

The need for beef and mutton to feed the thousands of miners, and the soaring beef prices in the mining districts started an eastward migration of stock raisers in the

1860s. In addition, the Homestead Acts encouraged settlement for agricultural purposes beginning in 1862. The Stockraising Homestead Act of 1916 expanded the acreage which could be claimed and reduced requirements specifically to support ranching and the grazing of cattle and sheep. The Homestead Acts lured entrepreneurs to claim millions of acres of open rangeland east of the Cascade Mountains. In a movement that reflected the mining push, stock raisers began driving large numbers of cattle and sheep onto the prairies and grasslands of eastern Oregon and Washington (Robbins et al. 1994). Cattle and sheep were grazing throughout the interior Northwest by the 1870s, with southeastern Oregon possibly supporting the largest and most spectacular herds (Robbins et al. 1994). The land-use practices of these early stockmen initiated a dramatic alteration in the grassland ecology in the interior Northwest (Robbins et al. 1994).

Ranching in the arid high desert was completely dependent on the grass and water resources of the region. As a result, ranchers were careful to acquire legal title to water and the best grasslands whenever possible, but they also tended to graze their cattle on the less desirable rangeland that belonged to the federal government. In their competition for use of public lands, overgrazing eliminated many native grasses in some parts of the high desert region as early as the 1880s. Overgrazing also damaged stream channels and riparian vegetation in many western basins. The larger cattle companies responded to the deteriorated range condition by developing ambitious programs of irrigation, desert "reclamation projects" and the production of nonnative grasses for hay, well before the twentieth century (USDA Forest Service and USDI Bureau of Land Management 1996).

Logging

The first large-scale cutting of the inland forests came as a result of nineteenth century mining endeavors. Timber was needed to construct mining camps and towns and such mining features as trusses for tunnels and wooden viaducts to carry water. The modest production capabilities of those early mills were sufficient to meet the demands of the nineteenth century boom-and-bust mining economy (Robbins et al. 1994). It wasn't until the completion of the transcontinental railroad in 1864, connecting the Columbia River basin to the Union Pacific Railroad, that the pace of the timber industry in the forests of eastern Oregon was accelerated (Robbins et al. 1994). The railroad provided a link to the resources, processing facilities and markets, allowing lumbermen to gain access to timber some distance from the manufacturing sites (Robbins et al. 1994).

At first, the easily accessible timber adjacent to fleeting mining communities and streams was cut, allowing the logs to be utilized on-site or floated downstream to local sawmills. Soon loggers had exhausted streamside supplies of timber and began harvesting stands from more distant locations. Landings were generally established near a river or stream where the logs could be deposited and then transported by water to the sawmill. Streams were heavily impacted by river logging with the construction of roads, railroads, splash dams, holding ponds and flumes. The very practice of stream driving logs was damaging to the streams and adjacent banks. River logging was less emphasized with such technological developments as the skidder, caterpillar tractor, log truck and chain saw in the early to mid-1900s.

Turn of the Century

Road Construction

In the early 1900s, road construction began to open the forests and rangelands of the Pacific Northwest. Constructed mainly through river valleys, riparian areas, flood plains and adjacent hillsides, the roads efficiently provided access but decreased the land's effectiveness as wildlife habitat and provided a new avenue for erosion and discharge of sediment into streams (USDA Forest Service and USDI Bureau of Land Management 1996).

Homesteading

Due to a period of heavier-than-normal rainfall between 1900 and 1920, people moved into the high desert areas of the West where they had not been previously. Rainfall and available land attracted large numbers of farming families looking for a new start. They had high hopes of growing wheat and making permanent homes. During these wet years, many believed that "rainfall follows the plow"—meaning that once crops were planted, the area would begin to receive more rain. At first their farming efforts proved to be very productive, but the period of greater rainfall was short-lived. After a very few years, the normal dry weather conditions reappeared (about 1920), and the crops soon failed.

As drier conditions returned, people began to dewater streams to irrigate the dry lands, thus improving their productivity (Armour 1977). This practice resulted in many other direct and indirect effects, however, including down cutting of channels, changes in flows and flow regimes, removal of obstructions that previously had buffered flows, and a tremendous loss of water from the development of poorly designed ditches. Many streams were completely dry during the summer months and were commonly overallocated. Fish and wildlife resources suffered tremendous losses during this period.

Dam Construction

Irrigation had been underway in parts of the Columbia River basin as early as the 1880s. Most of the nineteenth century projects were small, often consisting of hand-dug ditches that irrigated bottomlands of 30 acres or less. Passage of the Newlands Reclamation Act in 1902 established the Reclamation Service in the Department of the Interior. The Act deposited profits from the sale of western lands into a reclamation fund to support irrigation projects, allowing the federal government to underwrite the building of dams, canals and ditches beyond the capabilities of communities or the private sector (USDA Forest Service and USDI Bureau of Land Management 1996).

The giant federal projects on the Columbia River would appease those who believed that the "natural world of the free-flowing river had to be put to productive economic use to serve the larger social good" (Robbins et al. 1994: 28, Neuberger 1938, 1989). Those areas that supported "desert weeds and bushes, coyotes and rattlesnakes and prairie dogs" would be transformed into a land of "poplar trees, corn fields, farmhouses, and small communities" (Robbins et al. 1994: 28, Neuberger 1938, 1989). What resulted was, perhaps, the most spectacular and environmentally intrusive manipulation of western riparian ecosystems to date (Robbins et al. 1994). Societal debates continue today regarding the impacts of dams on riparian conditions, fish habitat and fish populations (USDA Forest Service and USDI Bureau of Land Management 1996).

Federal Land Management

1930s to 1960s

The Depression resulted in lower beef and sheep prices and the Dust Bowl was a testament to 50 years of land abuse. Congress was also being lobbied by a few far-sighted members of the livestock industry who recognized that changes were needed to perpetuate the forage resource. This effort resulted in the formation of the Grazing Service, which later became the Bureau of Land Management. The first legal attempt to reduce the substantial livestock numbers in the West came in 1934 with the passage of the Taylor Grazing Act (Kovalchick et al. 1991, Wilkenson 1992)

This was also the era of "fixing" creeks with technology (Elmore et al. 1994, Elmore 1992, Heede 1977). Equipment was cheap, especially after World War II. Efforts were made to straighten and shape streams manually. Banks were rip-rapped with logs, rocks and gabions, and bermed along the sides to "keep them where they belonged." Streams were literally shaped and moved where individuals, land managers and agencies wanted them to be to attain the goals and objectives they were setting for the land.

The placement of structures in streams began as early as the Civilian Conservation Corps (CCC) period (1933 to 1942) but didn't peak until the years between the 1960s through 1980s (Heede 1977, Elmore et al. 1987). Structures were introduced to riparian systems to combat the down-cutting of stream banks. It was estimated that approximately 80 percent of stream down-cutting had occurred by 1920 (Heede 1977, Leopold 1994). Although structures were thought to be the solution to this problem, Burchard Heede (1977) (Leopold 1994) found more than 80 percent of the projects constructed in the last 50 years had failed due to poor location, design and lack of maintenance.

Logging began again in earnest in the West during the 1960s, primarily because eastern and southern U.S. forests had already been harvested. By 1990 approximately 97 percent of the nation's forests present at the time of Euro-American settlement had been cut; we were harvesting the temperate rain forest twice as fast as the tropical rain forest (Thomas et al. 1990).

During the 1960s, public land managing agencies first realized that serious land abuses were still occurring as a result of improper livestock management. They responded by starting to readjudicate permits and reduce livestock numbers. Most of the reductions that were being implemented, however, were focused on the uplands, with little attention given to the consequences of livestock occupying riparian areas. Management philosophies that focused only on the uplands were based on university textbooks (e.g., *Range Management* by Stoddard and Smith) that referred to riparian zones as "sacrifice areas."

1970s to 1980s

The 1970s through 1980s were the years of stream protection (i.e., livestock exclusion) and the beginning of the riparian restoration movement (Heede 1977, Elmore et al. 1994). A lot was learned about the recovery potential of streams and adjacent riparian areas when excessive grazing pressure was managed or eliminated. However, not very much was learned about designing grazing systems that were compatible with riparian recovery because improper livestock management was almost always continued outside the exclosure (Elmore et al. 1994).

It was also during these years that land managers began to comprehend that upland condition had a direct impact on riparian condition. They were observing that the speed and clarity with which water came off upland areas had a dramatic effect on sediment transport and stream energy. As a result, the focus of livestock grazing was again shifted from riparian zones to the uplands. Unfortunately, the result of this management shift was the opposite of what was expected. Some riparian areas did improve with better livestock distribution, but most did not. In fact, under some of the new grazing systems, such as "Three Pasture Rest Rotation," many woody dominated riparian areas were severely degraded. The public quickly recognized the connection between improper grazing practices and riparian condition, forcing land managers to rectify their earlier actions (Elmore et al. 1994, Buckhouse et al. 1991). This was also the beginning of the era of designing livestock grazing systems at a watershed scale, incorporating both the uplands and the riparian system.

Management Summary

How do we measure successful riparian restoration after 11,000 years of human interaction? Should we attempt to restore riparian areas to some prior condition? If so, what time period would we pick: 100 years ago, 200 years ago, 1,000 years ago? Riparian ecosystem functions and processes can be restored without recreating an exact replica of the past. Elmore and Kauffman (1994) outlined five thought processes that should be addressed for restoration.

(1) We must consider the linkages and processes that are associated with full floodplain function—preferably the 100-year floodplain. This does not mean that we ignore the one- to three-year floodplain that is normally inundated approximately 70 percent of the time, but we combine the normal events with the expected

results of the 50- to 100-year events. Further, objectives should focus on the reconnection of the ecological linkages between uplands, flood plains and the aquatic zone. Land management activities that degrade or sever these linkages should be modified or discontinued.

(2) Riparian zones are extremely complex. The complexity is far greater than scientists and land managers are capable of understanding. We must manage riparian ecosystems within the context of the environment in which they are located, recognize their unique value and remember that what works for one may not work for another.

(3) Headwater streams have not received levels of management attention necessary to achieve landscape-level goals. We must recognize the importance of all stream systems, regardless of size, particularly in consideration of cumulative effects of land management in watersheds.

(4) Restoration activities within the stream channel and the riparian management zone should reestablish natural ecological processes and communities. Revegetation utilizing offsite or exotic species is similarly counter to goals of restoration of the inherent biological diversity of the riparian ecosystems. Approaches that sever linkages, retard recovery or degrade riparian stream function should be discontinued. These are usually engineering approaches that give scant attention to the ecological function of a riparian/stream ecosystem.

(5) We must manage to maintain connectivity across landscapes and minimize ecosystem fragmentation. No other landscape features are as effective as riparian zones in linking fragmented ecosystems.

Society has a responsibility to ensure that future generations have the opportunity to benefit from intact riparian/stream ecosystems. The restoration or maintenance of long-term ecosystem structure, function and productivity should be a primary consideration among land managers. We have learned much from the degradation that has occurred to watersheds and riparian ecosystems over the last century. This legacy has led us to a better understanding of ecosystem function and processes, and has identified needs for restoration. Now is the time to initiate management strategies that will allow our riparian and watershed systems to approach their productive potential. As Jack Ward Thomas (1996), previous Chief of the Forest Service, said, "We are where we are today and we can be no where else. The question is, where will we go from here?"

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Back to the Future—Is the Past a Guide to a "Healthy" Forest Landscape in the Northern Great Lakes Region?

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Forest health has become a much debated topic in the resource management and policy arenas. The issue of what defines "health" in a forest community is complex. A drought-induced infestation of bronze birch borer (*Agrilus anxius*) certainly leads to a decline in the health of the infested stand of paper birch (*Betula papyrifera*), yet the yellow-bellied sapsucker (*Sphyrapicus varius*) will benefit, so too might a white pine (*Pinus strobus*) understory released from the competition of the overtopping birch canopy.

Recent severe fires in the inland West have been suggested as being indicative of unhealthy forest systems (Morelan et al. 1994, Sampson and Adams 1993), largely as a result of human interruption of natural disturbance regimes. Periodic entry to harvest forest products and maintain stands in a condition that is presumed to be similar to natural stands has been promoted. Others (DellaSala et al. 1995, Peters et al. 1996) have suggested that large areas of undisturbed forest are required to ensure the presence of important components of healthy ecosystems and the maintenance of ecological processes.

A common thread that runs through many discussions pertaining to forest ecosystem health is the assumption that some "original" or "natural" condition is inherently more healthy than the current landscape condition. Given the relatively dynamic nature of most forest systems, "original" or "natural" conditions are unlikely. The objective of this paper is to suggest that estimates of past vegetative conditions must be qualified, spatially and temporally, rather than used to represent some "original," "natural" or "healthy" condition.

The Northern Great Lakes Region

In the northern Great Lakes states of Michigan, Minnesota and Wisconsin, disturbance has historically been an integral component of forest ecology. The frequency, intensity, extent and effects of wind (Canham and Loucks 1984) and fire (Heinselman 1973, Ahlgren 1974, Clark 1990) disturbance events are variable. Soil texture and drainage (Whitney 1982, Leitner et al. 1991) and local topography (Grimm 1984, Heiselman 1973) influence the degree to which a given landscape may be affected by fire or wind. The vegetative landscape has been relatively dynamic across much of this region since the most recent glaciation.

Estimates of Historical Vegetative Conditions

Various methods have been used to estimate the historical composition of the northern Great Lakes forest landscape. These methods typically rely on one or more of the following sources of information: (1) vegetation data collected during United States General Land Office (GLO) surveys, (2) fossil pollen and similar material, or (3) current composition of remnant tracts of old forest.

Curtis (1959) used GLO survey data to estimate the spatial distribution of various broadly defined forest communities in early Wisconsin. He developed an "importance value" (IV) to quantitatively assess the species composition of these communities using data collected in the 1940s and 1950s from relatively undisturbed sites. A species' IV is a measure of its relative contribution to the overall vegetative composition as measured on the sample plots.

These data suggest that 61 percent of Wisconsin's early northern forest was classified as mesic forest dominated by late successional species, such as sugar maple (*Acer saccharum*) (IV = 107) and hemlock (*Tsuga canadensis*) (IV = 79). Yellow birch (*Betula alleghaniensis*) (IV = 29) and basswood (*Tilia americana*) (IV = 16) were also common. Beech (*Fagus grandifolia*) (IV = 40) was a significant component of the forest on the relatively cool sites near Lake Michigan. In contrast, early successional species such as paper birch, quaking aspen (*Populus tremuloides*), big-tooth aspen (*P. grandidentata*) and black cherry (*Prunus serotina*) had IVs of 5 or less.

White and Mladenoff (1994) used GLO data to identify the likely presettlement (1860) structure and composition of a 23,700-acre (9,600 ha) tract of forest in northern Wisconsin. They suggest that 100 percent of this tract was old growth in structure and was dominated by stands of hemlock, northern hardwood or a mixture of the two types. The authors did not extrapolate their findings beyond the study area but Mladenoff (1996) suggests that, historically, large-stature hemlock dominated mesic forest sites in northern Wisconsin and the Upper Peninsula of Michigan.

Frelich and Lorimer (1991) analyzed data from remnant tracts of old forest on Michigan's Upper Peninsula. They suggest that, historically, old-growth forest covered 63.5 percent of this region. Their reconstruction assumes that wind was the principal agent of disturbance on this landscape.

Current Vegetative Conditions

The existing vegetation of northern Wisconsin and the Upper Peninsula of Michigan is dominated by northern hardwood (38 percent) and aspen/birch (23 percent) forest communities. Structurally, 65 percent of the forests of this region was classified as seedling/sapling or pole size during the most recent inventories (Smith and Hahn 1989, Leatherberry 1994, Schmidt 1993).

Effects of Recent Change

Late successional, conifer-dominated forest communities and their constituent fauna, such as blackburnian warbler (*Dendroica fusca*) and pine marten (*Martes americana*), have likely decreased as the forest composition of this region has changed over the past 150 years to one dominated by early and mid-successional stages of deciduous communities. Conversely, these changes have benefited species such as the golden-winged warbler (*Vermivora chrysoptera*), ruffed grouse (*Bonasa umbellus*) and white-tailed deer (*Odocoileus virginianus*).

If these recent changes in forest landscape composition, structure and patch size, which are a result of the settlement and the ongoing land use of this region, have led to a landscape with no historic analog, then it is reasonable to suggest that the long-term health of regional forest communities may be impaired. However, if these changes are consistent with changes that may have been caused in the past by natural disturbance regimes, then the current landscape may be no less natural (healthy) than previous landscapes. A thorough understanding of the data and the analytical techniques used to identify likely historical vegetative conditions is necessary to judge their predictive value across broad spatial and temporal scales.

Analysis of Data and Methodologies Commonly Used to Predict Historical Vegetative Conditions

General Land Office Survey Notes

During the mid- to late 19th century, GLO surveys were conducted in the northern Great Lakes region using a rectangular grid system. Survey instructions were modified on eight occasions between 1815 and 1855, after which survey procedures were standardized (Dodds et al. 1943). The degree to which surveyors adhered to specific instructions was variable (Stewart 1935, Bourdo 1956).

One to four "bearing" (witness) trees were used to mark township, range and section corners and "station" (line) trees were used to mark the lines between two adjacent corners. Typically, bearing and station trees were recorded by species and estimated diameter. Early survey instructions were variable; some required that trees nearest the established corner be recorded while others explicitly required the selection of large individuals of long-lived species. Uncommon or otherwise readily identifiable individuals typically may have been selected to aid the eventual relocation of surveyed corners (Bourdo 1956).

Numerous studies have used GLO data to reconstruct presumed historical vegetative patterns on landscapes in the Great Lakes region (White and Mladenoff 1994, Grimm 1984, Whitney 1986, Stearns 1949). The question remains—do the recognized biases associated with bearing and station tree selection compromise the accuracy of these reconstructions? Bourdo (1956) suggests that if selection bias is minimal and accounted for during analysis, GLO survey data can yield useful information regarding the vegetative composition of the landscape in question at the time of the survey.

Although original GLO survey notes can provide valuable insight into the vegetative composition of the Great Lakes region immediately prior to settlement by Europeans, these notes may not give an accurate representation of existing conditions prior to impact by Europeans. The difference between initial *impact* and initial *settlement* may well be significant.

Indeed, Curtis (1959) recognized the inherent danger of making assumptions about prehistoric vegetative conditions based on data from GLO survey notes. In *The Vegetation of Wisconsin*, Curtis states (1959: 464), "The vegetational records provided by the governmental land survey in the years from 1830 to 1860 reflect the changes that had occurred in the preceding 200 years under the influence of unstable and varied Indian populations, but they do *not* (emphasis added) properly indicate the prehistoric condition."

American Indian population size variability. There is little question that American Indian populations had an impact on the landscape during the millennia prior to European settlement. This impact may have been extensive due to a widespread use of fire to alter vegetation and encourage preferred food sources (Day 1953, Stewart 1956, Little 1974) or of only minimal consequence (Russell 1983, Brown and Davis 1973).

The commonly held misconception that during the 17th and 18th centuries the North American continent was a largely uninhabited wilderness, home to only a handful of "savages," was beneficial to those who required a defensible rationalization for settlement. Unfortunately, this rationalization is as inaccurate as it has been longstanding.

Historical demographers have provided numerous estimates of the total aboriginal population of North America in 1492, the significance of this date being obvious. These estimates range from 1.1 to 18.0 million (Kroeber 1939, Dobyns 1966, Denevan 1976). Although precise population estimates for the northern Great Lakes region are unavailable, this region did support population densities equal to or greater than those found elsewhere throughout eastern North America (Driver 1961).

Using depopulation ratios, Thornton (1987) suggests that the conterminous United States supported approximately 5 million American Indians in 1492. This population fell to a nadir of 250,000 in the late 19th century, however, the rate of decline was not constant. Crosby (1972: 37) states that "the most spectacular period of mortality among the American Indians occurred during the first hundred years [16th century] of contact with the Europeans and Africans."

The principal reason for this precipitous decline is well known. The introduction of disease, such as typhus, bubonic plague, measles, influenza and, in particular, small pox, against which American Indian populations had little or no immunity (the mortality rate for the small pox virus was estimated at 75 to 95 percent) decimated existing populations (Crosby 1972, Thornton 1987). Direct contact with European explorers or settlers was not necessary to facilitate the spread of these disease agents to American Indian populations. Interaction between tribes along well-established travel and trade routes ensured that virtually no population remained untouched.

Regardless of the degree to which American Indians altered the landscape of the northern Great Lakes region, it is reasonable to assume that a significant reduction in population size would lead to a concomitant reduction in the degree of impact on the vegetative landscape. Therefore, GLO survey notes recorded in the mid- to late 19th century document vegetative conditions two to three centuries after disturbance had been substantially reduced from prior levels.

Climatic variability. In addition, GLO survey records were generated at the conclusion of what is termed the "little ice age" (Swain 1978). During this period, approximately 1450 to 1850 AD, the climate in North America was significantly colder (2 to 4 degrees Fahrenheit: 1-2°C) than those periods which immediately preceded or followed (Bryson and Murray 1977). Although a relatively cold climate during the "little ice age" may have lengthened the interval between catastrophic fires, climatic variation during this period exacerbates efforts to delineate trends precisely. Bryson and Murray (1977) suggest that the climate of middle latitudes is the most variable during relatively cool periods.

Clark (1990) used charcoal stratigraphic analysis of samples from varved lake sediments and fire scars from recent tree falls to estimate fire regimes in northwestern Minnesota over the last 750 years. The 15th and 16th centuries were characterized by frequent fires. The fire interval during this period averaged 8.6 years. Fire intervals during the cool/moist, mid-18th and mid-19th centuries averaged 24.5 and 43.6 years, respectively. Fire frequency increased considerably during the warm/dry periods from 1770 to 1820 and again immediately following the "little ice age," 1870 to 1920, when fire intervals averaged 17.9 and 12.7 years, respectively. These data suggest that predictions based on climatic patterns are useful but precise estimates are difficult given the short- and long-term variability of climatic patterns.

Fossil Pollen Data

The analysis of fossil pollen data can identify broad changes in the spatial and temporal patterns of historical vegetation. Webb (1974a) documented changes over the past 10,000 years in the relative composition and distribution of deciduous and coniferous forest types in the northern Great Lakes region. These data show a general north-south gradient for many genera, with spruce (*Picea*), fir (*Abies*) and birch dominant in the north and oak (*Quercus*), elm (*Ulmus*) and ash (*Fraxinus*) dominant in the south. A temporal gradient was also evident. Pollen samples (10,000 to 8,400 years BP) were dominated by spruce and/or red pine (*Pinus resinosa*) or jack pine (*Pinus banksiana*). Pollen from red pine and jack pine can not be differentiated (Webb 1974a, Heide and Bradshaw 1982). More recent samples (3,500 years BP) show a marked increase in pollen from white pine, birch and hemlock. These trends are similar to those found by Wright and Watts (1969).

Although relatively broad spatial and temporal patterns can be identified using fossil pollen data, Birks (1981) cautions against using the "indicator species" approach to identify likely vegetative composition. This method assumes that genera currently commonly associated with genera that are dominant in the fossil pollen record were also likely common at that point in time. However, Overpeck et al. (1985) found historic pollen assemblages that had no modern pollen analogs. This may result from varying rates of postglacial migration for individual species, a disequilibrium between vegetation and climate or because there may be no analogs between modern and historic climates.

The use of fossil pollen data to quantify vegetation is complicated by variation in the production, dispersal and longevity of the pollen grains produced by different genera. Wind-pollinated genera, such as pine, birch and hemlock, typically produce copious amounts of pollen that are readily distributed across the landscape (Heide 1984). Faegri et al. (1964) found that pine pollen was a significant component of most samples even if few pine existed at the time of deposition. Insect-pollinated genera, such as basswood, maple and willow (*Salix*), are typically underrepresented in pollen rain and, therefore, in sediment deposits (Potzger 1942).

Webb (1974b) compared current vegetation with the current pollen record in lower Michigan and found that only beech and elm existed in the pollen record in proportion to their frequency on the landscape. In general, beech, elm, hemlock and spruce are proportionally represented in the pollen record, oak and pine are overrepresented, maple and basswood are underrepresented, and the pollen of aspen (*Populus*) and tamarack (*Larix*) is seriously underrepresented (Webb 1974b, Davis and Goodlett 1960, Heide and Bradshaw 1982).

Various ratios have been developed to quantify the relationship between the frequency of a genus on the landscape and the frequency of pollen from this genus in nearby sediments (Faegri et al. 1964). These ratios are useful unless a significant component of the forest landscape is comprised of genera that are seriously underrepresented in the pollen record. Such genera include those with pollen that is poorly preserved in sediments or those at the edge of their geographic ranges where relatively hostile climatic factors may affect pollen production.

The very poor representation of aspen pollen in either fossil or current records has been well documented (Erdtman 1935, Lichti-Federovich and Ritchie 1965, Faegri and Iversen 1964, Webb 1974b). This "blind spot" (Faegri and Iversen 1964) in the pollen record is due to the physical structure of aspen pollen grains. The exine (outer layer) of pollen grains is formed by one of the most resistant materials in the organic world (Faegri et al. 1964). However, the exine of aspen pollen grains is so thin that the grains are preserved only under virtually ideal conditions (Erdtman 1943, Cushing 1967). This phenomenon has significant implications for those areas, such as the northern Great Lakes region, where aspen is and likely was historically a significant component of the vegetative landscape.

Predictive Models

Recent studies have attempted to quantify historical vegetative composition of the northern Great Lakes region based on predictive models (Frelich and Lorimer 1991, Mladenoff 1996). Input data typically include presumed historical vegetative composition from point-in-time estimates, landform patterns, soil types and estimates of disturbance regimes based on existing tracts of remnant forest (areas not significantly disturbed during initial commercial logging of the region).

Point-in-time estimates of vegetative composition are inappropriate for extrapolation across significant spatial or temporal scales. Accurate data that can be presumed to represent historical disturbance regimes and, therefore, act as a baseline for comparison, are unavailable for fire and are limited by the age-class structure of existing forests for wind. The use of disturbance data from existing remnant tracts is further limited by the scarcity of such tracts in the region.

Three remnant tracts commonly used to provide input data for such models are the Porcupine Mountains Wilderness State Park, Huron Mountain Club and Sylvania Wilderness. The Porcupine Mountains and the Huron Mountains are located on the shore of Lake Superior on Michigan's Upper Peninsula and exhibit significant topographic relief when compared with the surrounding landscape. The highest points in the Porcupine and Huron Mountains are 1,380 feet (420 m) and 885 feet (270 m), respectively, above the Lake Superior shoreline. The Sylvania tract lies on a glacial end moraine with numerous small and medium sized lakes located on Michigan's Upper Peninsula. These areas were largely untouched by the initial logging of white pine that occurred in this region in the 1880s (Graham 1941) or by the hardwood logging of the mid-20th century.

These tracts can provide useful data regarding likely historical patterns of wind disturbance on similar sites in the same general vicinity. However, the proximity of the Porcupine Mountains and the Huron Mountains to Lake Superior and the significant topographic relief of all three sites, when compared with elsewhere in the region, affect fire frequency (Curtis 1959) and, therefore, render them inappropriate for use in the identification of likely fire regimes.

Conclusion

Data documenting the physical structure and species composition of past forest landscapes can provide valuable insight into local conditions at discrete points in time. However, the extrapolation of these data across broad spatial or temporal scales to identify some "original" or "natural" condition as a benchmark to measure ecosystem health or guide future management direction is inappropriate. As suggested by Ashby (1948), the most important decision made by ecologists occurs when they stop their car.

The structure and composition of the current forest landscape of the northern Great Lakes region clearly differ from those that existed in the past. Conversely, this landscape may be similar to that which existed at other points in time in the past, although current patch size is probably smaller than historical norms. The health of the northern Great Lakes forest landscape depends largely on which patient is examined and when.

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Wildlife Conservation and Ecosystem Health in the Interior Columbia River Basin

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Since the 1970s, considerable theoretical and empirical research has focused on the determinants of ecosystem structure and composition (Odum et al. 1996). Nonetheless, interplay between ecosystem theory and empirical verification or rejection has not progressed due to lack of readily accessible, broad-scale information (Lubchenco et al. 1991). We know little about the empirical determinants of ecosystem structure and composition because readily available and detailed information about an ecosystem's structure and composition is difficult and time-consuming to collect (Tilman 1996). Adding to the above theoretical and empirical complexity is the blending of ecological, economic and social goals under the generic term "ecosystem management," that acknowledges that people are integral to and dependent on functioning ecosystems, yet often cause ecosystem stress (Keystone Center 1996).

Recently, the theory and practice of ecosystem management has emerged as central to the national debate over how to sustain the health and productivity of our environment (President's Council on Sustainable Development 1996). The President's Council supports (1) collaborative approaches to protect, restore and monitor ecosystem resources; (2) a shift from managing single resources to managing an ecosystem for the full variety of life and the ecological processes—some of which operate over broad spatial and temporal scales; (3) the use of economic incentives to ensure resource stewardship; and (4) managing ecosystems for beneficial uses.

In July 1993, President Clinton directed the USDA Forest Service (FS) to develop a strategy for the management of forests east of the Cascade Crest in Oregon and Washington. A year later, the Director of the Bureau of Land Management (BLM) and Chief of the Forest Service extended the area under consideration to include the Upper Columbia River Basin, e.g., Idaho, Montana west of the continental divide, and northern portions of Utah and Nevada—in essence, the Interior Columbia River Basin (Basin) south of the Canadian border. Wildlife conservation within the Basin was to be guided by a scientifically sound and ecosystem-based strategy, to restore and maintain habitat needs of plant and animal species by moving toward desired landscape conditions on a broad basis and explore whether current management practices and habitat trends are consistent with long-term maintenance of ecosystem health.

In August 1996, an interagency working group was established to continue the evaluation of the status of terrestrial vertebrate species within the Basin that began with the work of Lehmkuhl et al. (1996) and Marcot et al. (in preparation). The goals were, first, to identify species in need of conservation action to meet legal and policy requirements. Second, given the lack of habitat and other natural history information for many species, refine the species habitat information that had been organized by Marcot et al. (in preparation) in the species environmental relations database. Third, characterize distribution and abundance of habitats for species and determine whether such habitats may serve as "sources" of individuals or "sinks" where populations may be expected to decline without regular immigration (Brawn and Robinson 1996). Fourth, spatially identify opportunities for wildlife habitat restoration across the Basin.

The working group in this effort takes advantage of extensive broad-scale information gathered within the Basin (Hann et al. in press, Marcot et al. in preparation). This paper, authored by the working group, compares the three major paradigms in natural resource conservation and their respective relation to wildlife conservation and ecosystem health. Further, it provides an overview of changed ecological conditions within the Basin and addresses two questions. What are specific wildlife conservation actions and opportunities at the regional scale? And, what lessons can be learned from integrating wildlife conservation with overall strategies for ecosystem health at the regional scale?

Natural Resource Conservation

The Three Paradigms

Regulated resource. Historically, natural resources on much of the public land in the United States and elsewhere have been managed under the paradigm of regulated resource management (Table 1), specifically, to maximize growth and yield and ensure a nondeclining flow and harvest at the time of maximum resource growth with harvest often dispersed across the landscape. Nondeclining yield is central to the Multiple-Use Sustained Yield Act (1960) and the National Forest Management Act (1976), and is required in forest planning on National Forest System lands. When the concepts of regulated resource harvest are applied without regard for all ecosystem elements and processes, the outcome can be one of economic failure—lack of sustained production of commodities (Aplet et al. 1993); ecological controversy—an increase in catastrophic fire (with both loss of economic resources and human life); and loss of biological diversity—an increase in numbers of threatened and endangered species.

Table 1. Three paradigms to conserve natural resources.

Regulated resource	Disturbance ecology	Conservation biology
Concepts		
Maximum growth and yield with constraints	Emulate natural disturbance	Bigger reserves better
Regulated nondeclining flow	Nonequilibrium landscape	Closer reserves better
Culmination of mean annual increment	Variable frequency of disturbance and harvest	Well-connected reserves better
Dispersed harvest patches	Variable size and frequency	Less fragmented better
Scale		
Stand/site	Community to regional ecosystems	Individual/population
Goal		
Economic return	Sustainability of diverse, resilient and productive ecosystems	Viability of native species

Conservation biology. In the 1970s, the field of conservation biology emerged. The most cited example of application of the concepts of conservation biology is by the Interagency Scientific Committee on the Spotted Owl (Thomas et al. 1990). Thomas boiled these concepts to a few rules for reserve-based conservation strategies (Table 1). However, there is growing recognition of the need to combine reserve-based strategies with other conservation strategies. There is also recognition of the need to refine some of the basic concepts of conservation biology. For example, under the rules of conservation biology, the goal of conservation biology—viability of species—is argued by Caughley (1994) to be approached at inappropriate spatial and temporal scales. Debate on other concepts, such as connectivity, is growing (Mann and Plummer 1995), particularly in reference to disturbance-based ecosystems (Johannesen and Imm 1996) and naturally heterogeneous systems, such as the coniferous forests of the Northern Rocky Mountains (Camp 1995).

Disturbance ecology. Aldo Leopold introduced both the land ethic and the ecological framework for disturbance-based ecosystem management (Norton 1991). Leopold (1933, 1936) had a strong sense of an ecosystem with the aggregate significance of the parts being greater than the sum. The aggregate, composed of producers and consumers, was organized to promote energy flow through all its levels. Land management was to keep energy pathways open through maintenance of ecological processes (such as fire) or the application of land-management practices that emulate natural processes. Only through the encouragement of natural processes or those that emulate such effects was the integrity of the ecosystem protected. Unfortunately, few recent conservation strategies have urged protection of the evolutionary and ecological processes that generate biological diversity and the isolating mechanisms critical for speciation to issues of ecosystem integrity (Orians 1996). The potential pitfalls of strategies without consideration of evolutionary and ecological processes are under increasing criticism (Tilman and Downing 1994).

The Interior Columbia River Basin

Vegetation

In the Pacific Northwest, there have been long-lasting controversies concerning the management of older forest ecosystems, aquatic ecosystems that provide habitat for anadromous fish and other natural resources. Completed in 1994, the President's Forest Plan for the Pacific Northwest addressed those issues and set the stage to identify existing and emerging resource issues on public lands within the Basin. The Basin—an area of 144 million acres, 30 million managed by the BLM and 45 million by the FS—is highly complex from an ecological perspective. There are a variety of vegetation types, e.g., the dry desert of the northern Great Basin, Rocky Mountain fire-dependent coniferous forests, Palouse grassland and shrubsteppe.

A meaningful definition of forest (and other ecosystem) health should include the "specific types and rates of ecological processes, and numbers and arrangement of structural elements that characterize diverse, productive, forest ecosystems in major biogeographic regions" that "span the gap between natural landscapes (i.e., preindustrial or presettlement characteristics)...and...society's objectives for the forest" (Kolb et al. 1994: 12-13). A healthy forest (and ecosystem) is viewed to have, among other characteristics, (1) active trophic networks to support productive forests in at least some seral stages, (2) resistance to catastrophic change and/or possess the ability to recover from catastrophic change at the landscape level, and (3) "a diversity of seral stages and stand structures that provide habitat for many native species and all essential ecosystem processes."

In the western United States, the combination of several decades of fire suppression and harvest preferences for ponderosa pine (*Pinus ponderosa*), western white pine (*Pinus monticola*) and larches (*Larix occidentalis* and *L. lyalliti*) have led to an increase in fire-susceptible but shade-tolerant species (Douglas-fir [*Pseudotsuga menziesii*] and the true firs [*Abies concolor*, *A. grandis*]) in the understories of many, if not most, open pine forests in the western United States (Sampson et al. 1994). The ecological result is twofold: the development of large patches and extensive areas of pest- and fire-susceptible forests; and a shift in the pattern of disturbance from one of relatively frequent low-intensity fire over small areas to one of stand-replacing fire spread over large areas.

Within the Basin change in succession and disturbance regimes, fire regimes and life form are estimated using historical simulated and current vegetation attributes (Table 2). In every major vegetation group, changes evident in succession, fire regimes and life forms have altered forest composition and structure. For example, in the Blue Mountains of Oregon, many landscapes historically dominated by early-seral stage ponderosa pine and western larch now host forests of grand fir, white fir and Douglas-fir. Moreover, current forest stands are more contiguous and consist largely of multistoried canopies dominated by fire-intolerant species. In central Idaho, large areas were once affected by mixed-severity fires creating a mosaic of single-story old-forest, forest at the stand initiation stage and montane shrublands. In contrast, today's landscape is dominated by forests of fire-tolerant species with multiple canopy layers. Extensive encroachment of ponderosa pine into grassland and shrubsteppe ecosystems is evident, particularly in the upper Klamath River Basin. In many areas, exclusion of fire has led to areal decline of aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta*) and increases in the extent of Engelman spruce (*Picea engelmannii*) and subalpine fir. There are other and often similar changes in forest composition and structure across the Basin.

Table 2. Percent similarities in current and historical patterns in successional regimes, fire regimes, and life form (herbaceous, shrub, conifer, deciduous etc.) within potential vegetation groups on ICRB FS and BLM lands. See Hann et al. (1997) for similarity calculations.

Vegetation group	Successional pathway	Fire regime	Life form
Cold forest	26	65	81
Cool shrub	23	69	89
Dry forest	20	20	74
Dry grass	21	65	69
Dry shrub	19	35	93
Moist forest	28	51	78
Riparian shrub	12	43	47
Riparian woodland	15	85	85

Beyond forest ecosystems, major forces, such as livestock grazing, fire and fire suppression, increasing numbers and extent of exotic species, and climate, have changed the shrubsteppe. Similar forces, especially agriculture, have decreased the area of wetlands, riparian areas and grasslands. In some areas, i.e., the Blue Mountains of Oregon, central Idaho mountains, Columbian plateau, Owyhee uplands and northern Great Basin, riparian areas are degraded by excessive livestock grazing and are no longer functional under normal hydrologic patterns. Exotic plant species, particularly in the shrubsteppe and grassland ecosystems, have increased the frequency of fire and adversely affected the distributions and abundances of native plant species.

Wildlife

The first of four working group tasks—a criteria to catalog wildlife species in need of conservation within the Basin—identified 209 species or species populations, approximately 45 percent of the terrestrial vertebrate species (n = 547) in the Basin. The criteria used was four-part: (1) include species for which there was judged to be any risk to viability of populations under any planning alternative within the draft Basin Environmental Impact Statement (EIS). Risk to viability was judged by professional panels. This criterion set a low threshold for species inclusion so that all species potentially at risk could be considered; (2) identify species whose habitats are projected to decline significantly under any alternative within the draft Basin EIS; (3) list species that were not assessed by Lehmkuhl et al. (1996) because of their limited distribution within the Basin; and (4) include species subject to appeal or litigation relative to FS and BLM land-management activities within the Basin.

Our remaining three working group tasks—the refinement of species habitat relationships, identification of source and sinks habitats, and mapping of such habitats—brought new challenges (Wisdom et al. 1997). We have attempted to group taxa to avoid a species-by-species conservation approach. The attempt to group species brought challenges in identifying both the variables on which to group and establishing an appropriate multivariate technique. Moreover, identifying similarities in habitat relationships requires a widely agreed to and accepted vegetation classification system which for the most part is unavailable. Complicating the mapping of habitats was the inability to be able to map certain key environmental correlates, e.g., rock faces and caves that go undetected at the scale of a region.

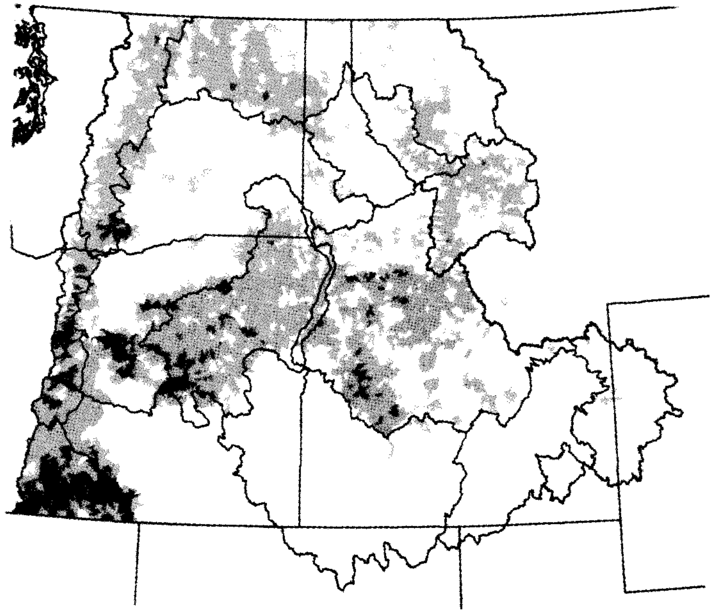
Nonetheless, Figure 1 displays preliminary results for both the historical and current distribution of source habitats for three species groups, one associated with older forests, one associated with the shrubsteppe and one with alpine. Overall, 44 species groups (ranging in species or species group membership from 14 to 1) have been tentatively identified that can be associated with terrestrial habitats. An additional 80 species are largely associated with wetland and riparian areas. The fine scale of wetland and riparian areas and habitat characteristics of lotic systems are difficult to map using available information and predictive tools due to their narrow, linear nature.

Wildlife Conservation and Ecosystem Health

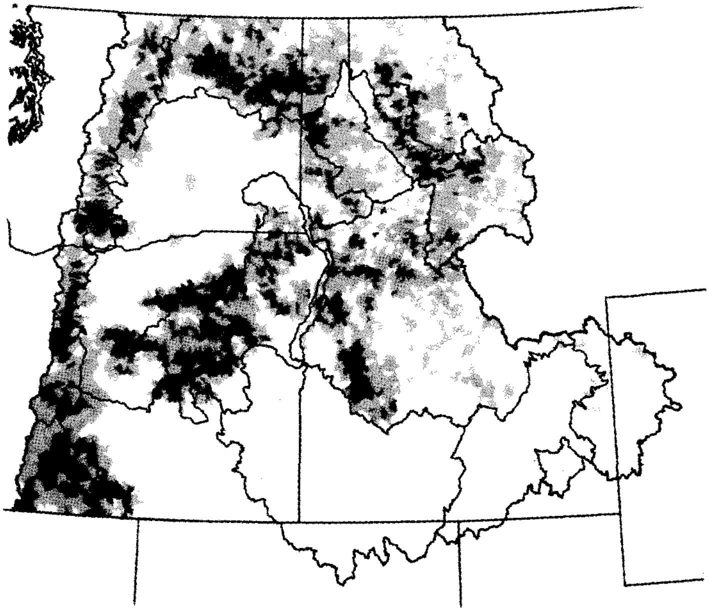
Discord or Harmony?

Conservationists can address various environmental problems along a broad continuum of spatial and temporal scales. Importantly, asking an ecological question at the wrong ecological scale may lead to the wrong answer in natural resource conservation (Murphy 1989). Applying the paradigms of natural resource conservation

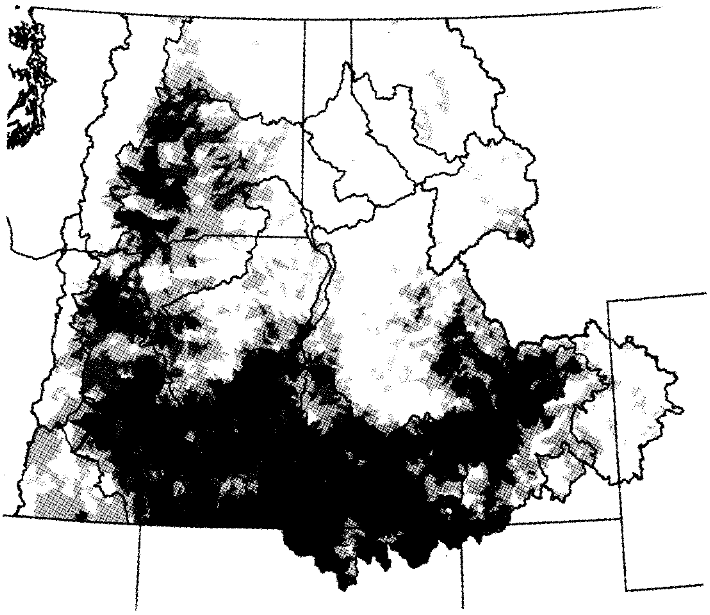
Current A



Historic A



Current B



Historic B

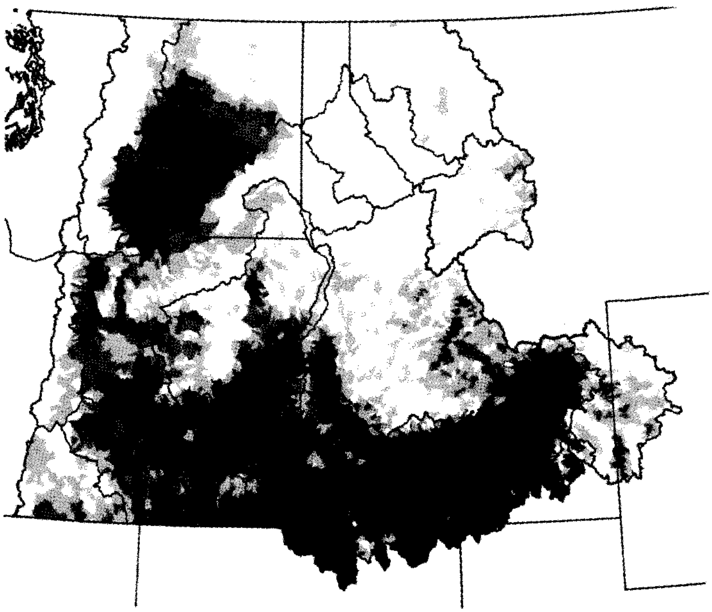


Figure 1. Comparison of estimated historic and current habitats for an (A) old-forest species group and an (B) shrubsteppe species group within the Interior Columbia River Basin. Habitats are illustrated in four categories, low (light shading) to high (dark shading) quality.

requires knowledge of the spatial and temporal limits of each natural resource paradigm to avoid errors in the conservation of natural resources.

The reasonably close agreement of the estimated change in certain disturbance regimes and life forms, and declines in forest- and shrubsteppe-dependent wildlife demonstrate the most insight in the relation between wildlife conservation and forest health. More than 80 species in need of conservation are associated in some life history requirement with either the stage of forest succession characterized by the presence of older trees or with specific structural components of this stage. Such habitat characteristics have declined in abundance and or distribution within the Basin. In addition, decline in the character and quality of the shrubsteppe within the Basin is reflected in the concern for more than 40 species associated with this ecosystem.

In the above case, recommendations to restore forest wildlife habitat may include the reintroduction or emulation of natural processes, principally fire. The frequency and intensity of natural fire does vary around a central tendency, the disturbance regime, and creates patches of habitat that vary in composition, structure and pattern. Nonetheless, restoration of natural processes must be regulated carefully to correct past treatments and conditions without creating new habitat bottlenecks. Management action will be needed to reduce the long-term and unnatural accumulation of fuels and canopy layers. This accumulation is an important factor influencing the change from low-intensity, frequent fire to the recent, destructive pattern of large and lethal fires. Correction of this accumulation may require active rather than passive management. In an environment that varies temporally at short intervals, organisms must cope with environmental conditions that change rapidly and frequently. Consequently, questions arise in such settings about the efficiency of forest reserves (Camp 1995), and connectivity (Harrison 1994) may require reinterpretation in such a system.

A primary factor associated with need for conservation action of wetland and grassland wildlife appears to be associated with declines in their respective habitats. Terrestrial habitats for many species—the pygmy rabbit and sage sparrow, among others—are also known to have declined in area. In contrast to general forest habitats of the Basin, habitats that are rare or unique may require the establishment of well-connected areas to ensure the resilience and viability of species and species populations. Conservation of these habitats may be more consistent with the steady-state concept that is seen as central to the concept of conservation biology (Mann and Plummer 1995).

Lessons Learned

Our understanding of forest and other ecosystems has evolved significantly over the last few years, including several significant contributions from the Basin (Lemkuhl et al. 1996, Marcot et al. in preparation). The practical appreciation of Basin information can be further improved if we do the following.

- Realize effects of environmental change on individuals are more easily detected than effects on populations. Either observing or predicting trends in wildlife populations and their habitats across broad temporal and spatial scales is the most effective approach to establish priorities in conservation.

- Recognize the dynamic nature of ecosystems and that ecological processes operate over a wide range of spatial and temporal scales and need to be considered within an ecoregion or other ecological context. Restoration in many vegetation types may require active management, including timber harvest (prior to the reintroduction of fire) and economic incentives, as suggested by the President's Council on Sustainability.
- Acknowledge that additional research is needed for development of reliable wildlife species' habitat relationships and conservation recommendations at the landscape scale and beyond. Sound ecological models and understanding at the landscape scale and beyond are essential and critical needs. In particular, there are increasing needs for reliable detection of environment influences of fire and other natural disturbances on wildlife.

Conservation paradigms are often the subject of theoretical debate. Actual evaluation of the natural biological and biophysical variability and capacities of ecosystems suggests that all paradigms must be considered in management decisions. We can begin the experimental and adaptive process through assessments, such as in the Basin, to ensure a policy that will guide the application of an appropriate mix of conservation paradigms, including components of the regulated resource, conservation biology or disturbance ecology paradigms.

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Wild Rice to Rip-rap: 120 Years of Habitat Changes and Management of a Lake Erie Coastal Marsh

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The proportion of original wetlands remaining in a landscape is a principal indicator of ecosystem health. In freshwater wetlands, system health (or wetland quality) can be indicated by the presence of aquatic vegetation, because most wetland functions are derived from processes requiring aquatic plants. Nutrient cycling, bio-accumulation of contaminants, flood storage capacity, and high-quality habitats for wetland fish and wildlife are all largely dependent on interactions between water and aquatic emergent vegetation.

In southwestern Lake Erie (SWLE), as in many shoreline areas of the Great Lakes, distribution and survival of aquatic emergents are influenced strongly by lake water levels. Prior to European settlement in the early 1800s, the boundaries of once-vast Lake Erie marshes advanced inland or retreated lakeward with long-term (e.g., more than 3 years) fluctuations in Lake Erie water levels (Langlois 1954). Currently, most remnant Ohio Lake Erie marshes have restricted upland borders and are enclosed by earthen dikes (Bookhout et al.1989).

How did we get from one extreme to the other, and were these actions warranted? What is the role of such structural marsh management in Lake Erie today? In the absence of data to address these questions, opinion has prevailed. Some wetland scientists question the need for artificial intervention in the natural hydrology of any wetland; others support intensive management to optimize benefits from a declining and degrading resource with increasing ecological and public demands. Myriad contentions exist between polarized viewpoints while essential concepts (e.g., what is "natural") and ecological parameters (e.g., assessing wetland values) remain insufficiently defined.

We present the first empirical data that document changes in SWLE wetland quality since the onset of European impacts in Ohio's lakeshore marshes. Our objectives were to quantify long-term trends in aquatic macrophyte presence, determine impacts of gross environmental changes and document the chronology of human impacts in a large coastal wetland of southwestern Lake Erie.

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Study Area and Methods

We applied a simple, vector-based GIS technique (Atlas®) to the analysis of a unique historical record of detailed maps (for years 1873 and 1894) and aerial photographs (1926, 1940, 1957, 1966, 1977, 1980, 1988, 1991) of a 2,000-hectare Lake Erie coastal marsh system (Winous Point Marsh, Ohio). The Winous Point wetland is located at the mouth of Sandusky Bay (Figure 1) and encompasses Muddy Creek Bay at the confluence of Muddy Creek, Sandusky River, Green Creek and South Creek. Winous Point Shooting Club, a duck hunting club operating since 1856, is the principal owner of the wetland we studied. A 50-year record of continuous, onsite wetland research and science-based management exists for the area.

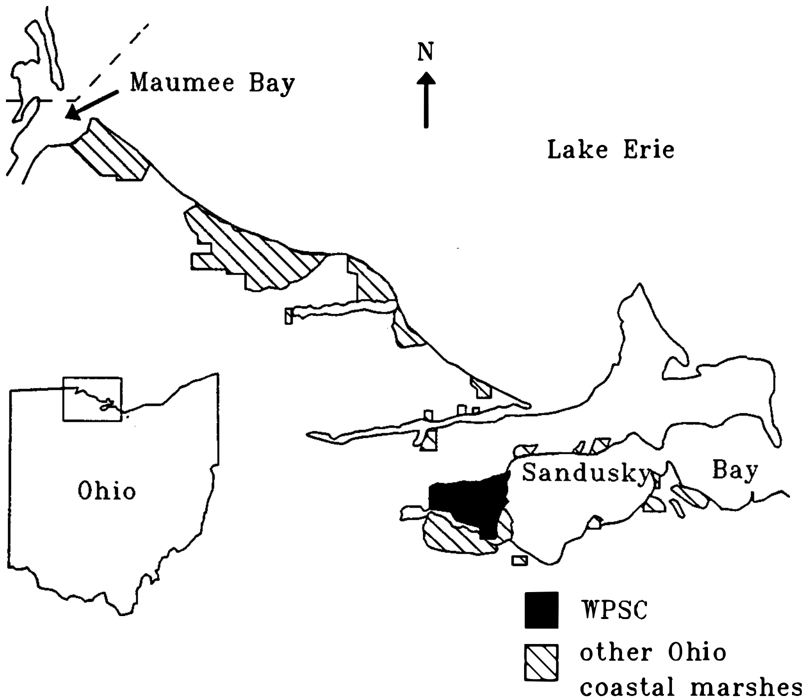


Figure 1. Location of Winous Point Shooting Club (WPSC) marshes near southwestern Lake Erie, Ohio.

The study area includes palustrine emergent and palustrine aquatic bed wetlands, and open water lacustrine wetlands. Dominant aquatic macrophyte species are cattail (*Typha angustifolia*), giant burreed (*Sparganium eurycarpum*), rose mallow (*Hibiscus *moscheutos*), softstem bulrush (*Scirpus validus*), smartweed (*Polygonum* spp.), wild millet (*Echinochloa* spp.), American lotus (*Nelumbo lutea*), common pickerelweed (*Pontedaria cordata*), eurasion watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potomageton crispus*).

Initial comparisons of the large (approximately 1.2 by 2 meter) hand-drawn maps with aerial photographs indicated precision sufficient to merit GIS analysis. Additionally, the maps depicted vegetation (common names) with borders, and survey delineations (section lines or corners) were present. Vegetation categories in the 1873 map legend were "Wild Rice," "Bulrush," "Lilies," "Reeds," "Flags & Grasses" and "Deer Tongue." The 1894 map categories were similar, but "Wild Rice" was deleted and "Rock Wall" was added. Buildings, roads and trees were indicated on both maps. We combined all aquatic vegetation types into the category "Emergents" for this analysis. The eight aerial photographs (general scale 1:5,000) permitted interpretation of gross vegetation types such as aquatic emergent or woody species. Each of the 10 images was digitized within a common border, using a series of control points referenced to sectional survey delineations and permanent structures on each image.

Gross habitat types (open water, aquatic emergent and other) were identified, their areas were mapped and their distributions were measured. The relative amounts of aquatic emergent vegetation and open water were determined for the entire wetland, and within diked, breached-dike and open wetland systems during the 120-year period. In addition to total area, we examined three polygons (West Marsh, South Marsh and central Muddy Creek Bay) with different histories of impacts (Figure 2). The West Marsh polygon had a history of additive artificial impacts (e.g., selective placement of rip-rap, dike construction, intensive water level control) and characterized a current-day SWLE diked marsh. The South Marsh polygon was a portion of open marsh with the fewest onsite impacts, highest land elevation, most protected exposure from storm erosion and, thus, characterized the best case scenario for an open, naturally existing marsh in SWLE . The central Muddy Creek Bay polygon was a large expanse of open marsh (more than 1,000 ha) that was primarily free of direct onsite impacts, but included two smaller, breached-dike areas (100 ha and 50 ha) that have been subjected to natural hydrologic effects for the past 40 years. This polygon best represented the standard condition of most open, naturally existing marshes in SWLE today, including those that are considered candidates for restoration. Polygons were selected based on consistency of impacts in an area over time, rather than uniformity of size among polygons. We accepted up to 5 percent distortion in polygon size when comparing the same polygon among years.

Another set of aerial photos (U.S. Department of Agriculture, 1980 to 1993), encompassing nearly half of the Winous Point wetland, was used to verify GIS-derived patterns. Additional maps (1820 and 1864) were examined for evidence of human settlement and to identify the upland boundaries of the wetland.

Results

We successfully documented gross changes (e.g., 100 ha) in emergent plant occurrence among the 10 images during 120 years, despite using different sources (i.e., historical maps and aerial photos) with observable but unknown distortion. Image variation is most apparent in comparisons of the perimeter of the images, which is inexact (Figure 3). Conversely, on the maps, the relatively uniform distribution of vegetation occurring within an area much larger than our study site aided the accuracy of initial determinations of emergent plants and open water. The entire study block could be moved several hundred meters in any direction without substantively changing the ratio of plants to water in 1873 and 1894. This uniformity largely compensated for any accuracy errors in comparing the old maps with the aerial photographs, which was a primary concern.

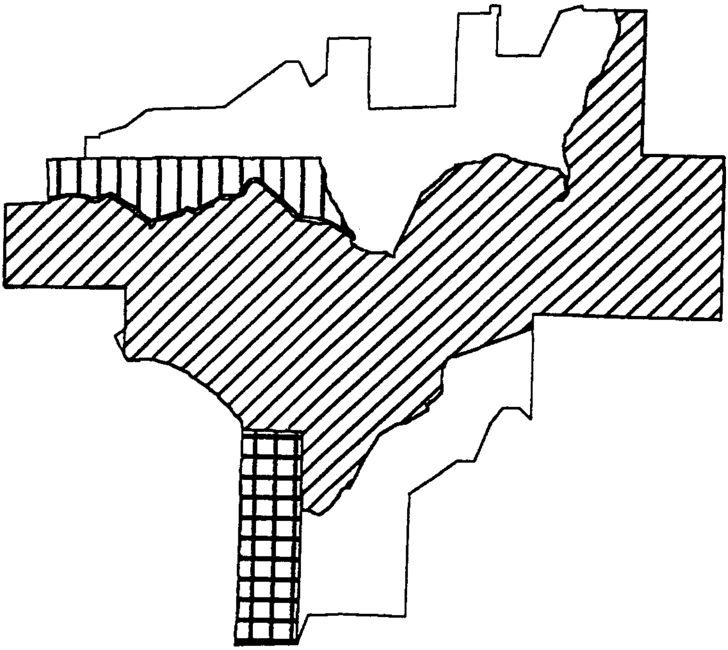
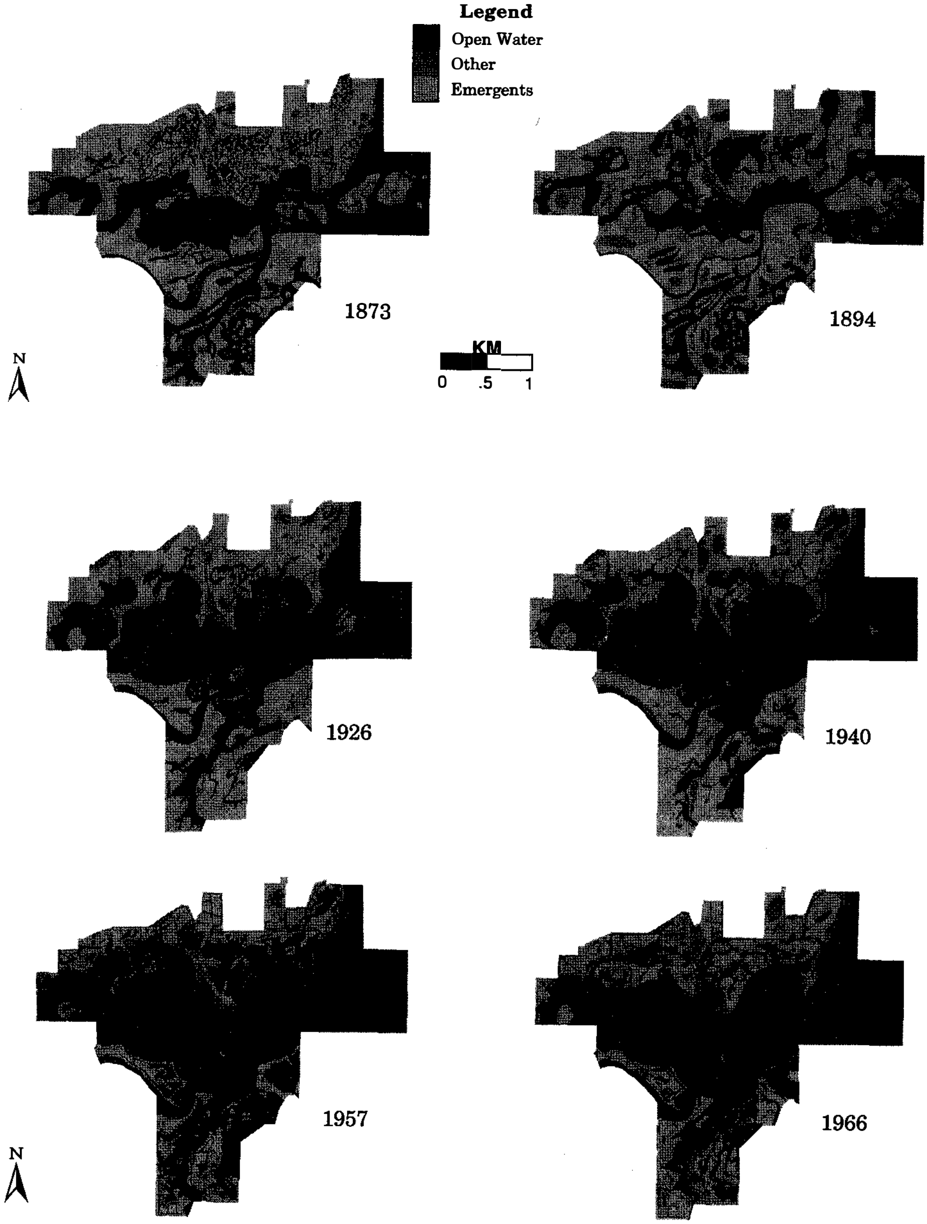


Figure 2. Three areas (and treatment effects) compared in the study: West Marsh (diked wetland, vertical hatching), Muddy Creek Bay (open wetland, diagonal hatching) and South Marsh (open, protected wetland, blocked pattern).

Clear trends emerged from the long-term habitat record for this 2,000-hectare wetland complex. In the open wetland system (central Muddy Creek Bay), emergent plant life declined by 95 percent from historical (1873 and 1894) to recent (1980, 1988 and 1991) periods (figures 3 and 4). Loss of emergent plants in the open marsh was greatest between 1894 and 1926, during a period of average to low water levels (Figure 5), but beginning about 25 years after the introduction of common carp in 1879 (Trautman 1981) (Figure 4). Emergent plant abundance has continued to decline in the open wetland since 1926. Declines of emergents in the breached-dike wetlands were similar to severe losses observed in the open system. Open water wetlands with



the most protected exposure and highest elevation (South Marsh polygon) exhibited 84-percent loss of emergents over the same period. Emergents in the South Marsh polygon increased following low water periods of the 1930s and 1960s, but have drastically declined since then. Loss of emergents in the protected open marsh (South Marsh polygon) was greatest between 1977 and 1980, following a then record-high

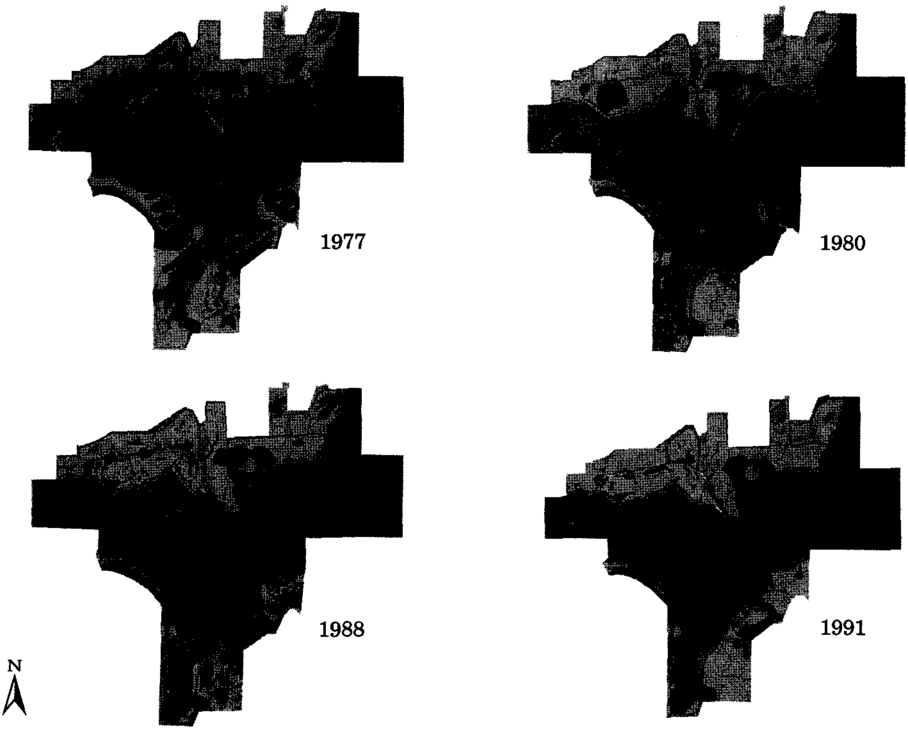


Figure 3. GIS-based habitat maps (1873 to 1991) of the Winous Point marsh. Map categories include emergent aquatic vegetation, open water and others (i.e., roads, dikes, stone walls, buildings and farmland).

water level period in the early 1970s. The proportion of emergent vegetation in diked wetlands (West Marsh polygon) remained relatively unchanged from levels in 1873 to1894, but fluctuated widely over the 120-year period, due alternately to breaching of dikes, or drawdown management, and control of carp.

A poignant example of the erosion incurred in open wetlands of this region is provided by Eagle Island, located on the easternmost portion of the study area. The original survey of the area in 1820 depicted Eagle Island as 134.42 acres (54.3 ha) (Bourne 1820). Historical reports from the late 1800s indicate that a significant portion of Eagle Island was a mature forest (typically requiring clay substrate in this region) that supported a large nesting colony of great blue herons (*Ardea herodias*) (Moseley 1973). Other representations from our 1873 and 1894 maps (a marshwatcher's house and a rock wall revetment) confirm that Eagle Island was once a prominent land form at the mouth of Muddy Creek Bay. However, by 1957, Eagle Island was eroded below the water line and all vegetation had disappeared. In the interest of determining its potential for recovery via natural reestablishment of marsh plants, we used GPS coordinates to locate the remnant island (we even found the rock wall). The current

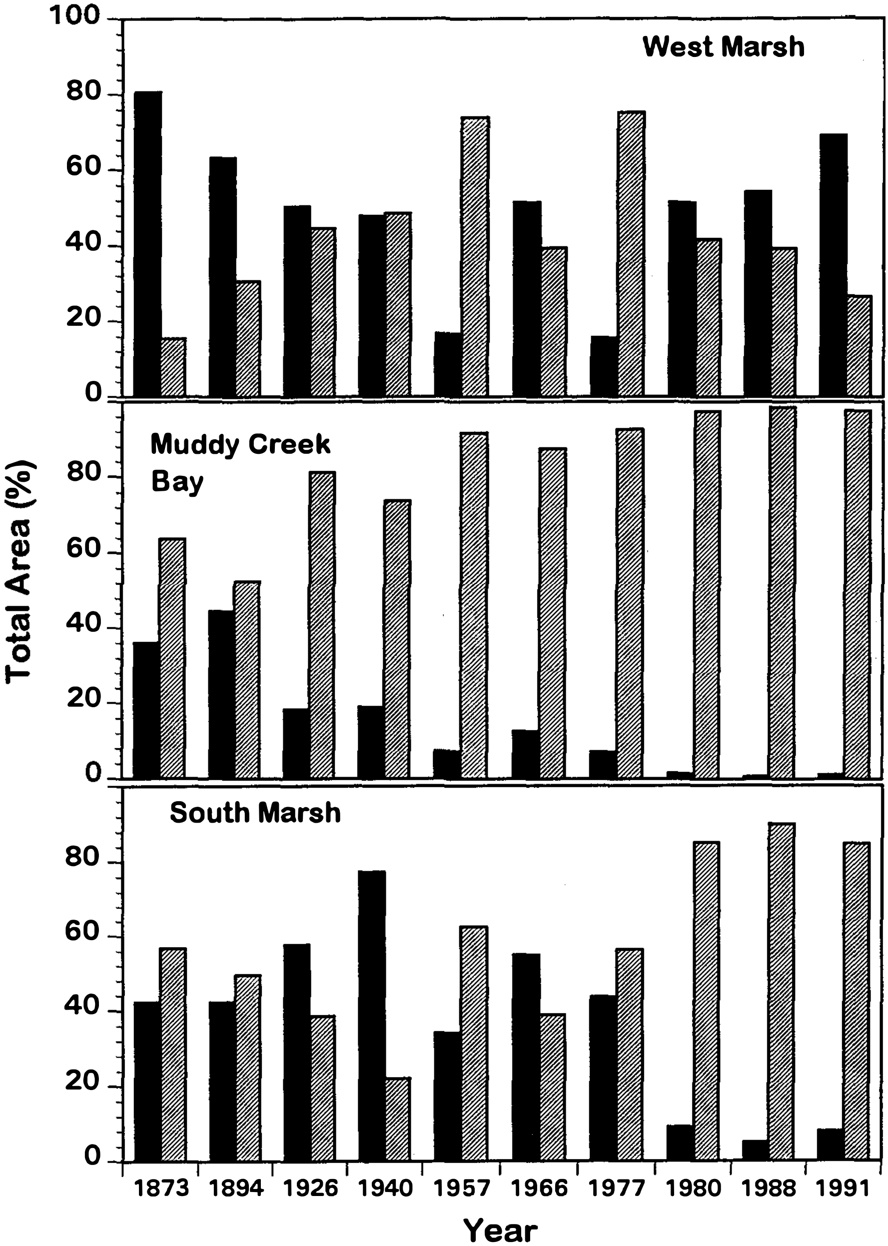


Figure 4. Percentage area of emergent plants (black) and open water (gray) in Winous Point marshes, 1873 to 1991.

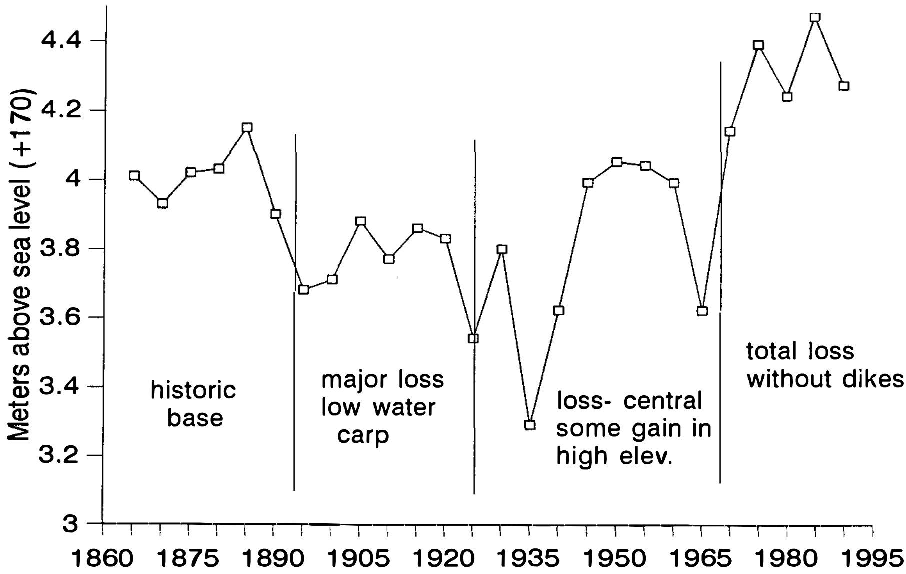


Figure 5. Lake Erie water levels (five-year means) and emergent plant trends in open marshes at Winous Point, 1873 to 1991.

average elevation of Eagle Island is more than 2 meters below the *100 year-average* level of Lake Erie. Since 1860, Lake Erie has never registered an annual average of more than 1 meter below that long-term average (U.S. Department of Commerce 1992).

We supplemented map and photo interpretations with accounts of local history to construct a gross chronology of human impacts on the wetland. Farms established along the wetland border prior to 1850 appeared to define the wetland's upland boundary since then. No landward reestablishment of the wetland was apparent in the 10 images we studied. Agricultural diking was predominant along the border of Muddy Creek Bay wetlands by 1926, and comprised a restricted upland border by 1940. The first large-scale attempt at wetland management was apparent in 1894; more than 5 kilometers of discontinuous rock walls had been manually placed from barges to protect marsh plant communities from erosion. After a period of continued marsh loss, the first bayfront shoreline diking was evident on the wetland by 1926. The extent of diking increased between 1926 and 1940. By 1966, contiguous diking of the wetland occurred, and incidence of interior diking increased with the advent of drawdown management practices. Few original dikes were observed to be built after 1970, although most dikes within the wetland were rebuilt to higher elevations since then, in response to record-high lake levels.

Discussion

Our analyses suggest that restricted upland borders of this wetland and the introduction of carp have exacerbated the destructive effects (and precluded the constructive effects) of sustained high water levels in Lake Erie. Large-scale effects of these influences were apparent in the late 1800s, have persisted since then, and have been intensified in recent decades by above-average water levels in Lake Erie. Despite massive wetland restoration efforts in Muddy Creek Bay, Ohio's second-largest coastal wetland complex, the current amount of aquatic emergent vegetation is approximately half of that existing in the late 1800s. Further, nearly all (98 percent) of the emergents present are growing in diked marshes. Emergent vegetation is rare and continues to decline in the open marsh systems we studied.

Conclusions and Recommendations

In a one-year study of aquatic macrophytes in Muddy Creek Bay, Sherman et al. (1996) proposed that the relative ability of a wetland to advance landward along an unrestricted upland border was a primary influence on marsh plant survival and distribution. Our GIS data, spanning 120 years and including, as a small component, the study area of Sherman et al. (1996), confirm their preliminary contentions. Further, we propose the collective consideration of the interaction of three influences (restricted landward advance, presence of carp in wetlands with clay substrates, and long-term, above-average water levels) as the Landward Advance Paradigm (LAP). We suggest that since 1900, the LAP has been the principal mechanism controlling the historical and current distribution and abundance of coastal macrophytes in SWLE, and likely has additional application in the Great Lakes basin. The marsh declines demonstrated by our data are consistent with historical losses in other Great Lakes wetlands with similar geomorphologies and ecosystem alterations, such as Green Bay, Wisconsin and Saginaw Bay, Michigan. The paradigm would obviously not apply to wetlands in which one or more components (e.g., clay substrates) of the LAP are missing.

Although trends in Great Lakes water levels are the source of great debate and consternation, we believe the argument is superfluous. Regardless of future water levels, our data indicate that the *effects* of the LAP in some large coastal wetlands *are probably permanent.* Also, the continuing loss of water retention capability of the Great Lakes watershed will likely facilitate further coastal marsh loss in all but the most severe scenarios of sustained declines in annual precipitation. The probability of such long-term regional drought (e.g., far in excess of the noted 18-month drought of 1988 to 1989) is extremely remote and would have drastic corresponding negative environmental consequences.

Coastal marshes with more than 95 percent of the emergent plant life permanently lost, as our data indicate, are hardly the desired condition for these potentially productive and increasingly degraded ecosystems. Alternatively, the benefits to wetland biota provided by diked wetlands in SWLE are well-documented and include less turbid water, preferred detrital habitats, greater vegetative and wildlife diversity, and nearly twice the net biomass production of open wetlands (Deroia 1989, Robb 1989, Riley and DeRoia 1989, Koneff 1992). Vegetation and water management strategies in diked SWLE wetlands provide rare, optimum habitats for a wide variety of wetland birds, reptiles, amphibians and mammals, and harbor the largest concentration of migrating black ducks (*Anas rubribes*) in North America (Tori et al. 1990). Currently, 20 species of Ohio-endangered wildlife are dependent on vegetation complexes found primarily in diked SWLE wetlands.

However, structural marsh management in SWLE has significant ecological deficiencies, including artificial hydroperiods and exclusion of some breeding of fishes. Control of water levels in diked impoundments inherently contradicts natural wetland dynamics. Yet, wetland managers and scientists must realize, without diminishing the importance of these detriments, that *provisions to accommodate the missing ecological components will constitute management for narrower ecosystem goals than those currently being provided.* For example, should we sacrifice the long-term broad benefits of managed wetlands to facilitate northern pike (*Esox lucius*) reproduction, or for uninterrupted hydrologic exchange within a highly altered watershed?

We believe the answer to the question should be based on the realization that no successful alternatives for maintaining aquatic macrophytes have been demonstrated in SWLE, but the deficiencies of diked systems have potential engineering and technological solutions that remain relatively unexplored. Selective fish-movement structures and partial water control regimes that progressively mimic natural hydrologies can be developed and implemented, but to date, emergent plants cannot be sustained any other way.

Despite the inherently unappealing nature of mechanical solutions to natural resource problems, a few efforts to address the engineering components of the issue have begun. But wetland policy makers, led by partisan approaches to wetland science, have chosen to proceed forward with derogatory speculations and increasing restrictions for structural marsh management. We suggest wetland resource stewards defer potentially damaging decisions affecting a broad spectrum of wetland biota until these and more substantial experiments have concluded, and indicate practical application and cost. Additionally, the data needed to develop engineering solutions for SWLE marshes (e.g., fish species movements, case-specific nutrient dynamics) are largely unavailable, as are resource agency goals and status data for the species and processes involved. To demonstrate cooperative intent, costs of obtaining the needed information should be borne by wetland interest groups other than those currently paying to maintain existing benefits. Wetland conservation funds arising from freshwater fisheries programs are notable only by their absence.

Alliances between new partners and traditional wetland conservationists must strive to determine improvements in wetland functions feasible in the 21st rather than the 19th century. Expectations of ecosystem functions in the coastal Great Lakes region need to be considered within the context of landscape-level alterations (e.g., LAP) that govern the processes involved. Scenarios such as LAP are not likely to change, and policy-making that ignores such dominant paradigms is inappropriate and divisive. Clearly, there are case histories where structural marsh management is the best ecological compromise to a highly altered and permanently degraded wetland ecosystem. Recognition of the necessary role of structural marsh management is essential to unifying wetland interests, which is prerequisite to effective wetland protection in the Great Lakes region.

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Using Hierarchical Models to Index the Ecological Health of the Nation

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Understanding diverse ecological risks over large spatial extents is crucial for a national assessment of ecological health. As spatial extents increase, new phenomena may emerge as local effects blend into mosaics or into gradients that constitute higher order phenomena (Suter 1993, Travis and Futuyma 1993, O'Connor 1996). Ecological health assessment, therefore, has to accommodate contingent and hierarchical effects operating over scales that are undefinable *a priori*, problems that Berk (1994) cogently argues can be resolved only by recourse to hierarchical modeling. In this paper, we describe a recent breakthrough in hierarchical modeling with a particular data set that provides a paradigm for the national modeling of ecological health. Essentially, we describe a method of modeling the environmental correlates of bird species distribution and show how this leads naturally to a common "currency" in which to measure multiple risks to ecological health. These ideas originate in a pilot national biodiversity assessment developed under the auspices of the Biodiversity Research Consortium (BRC) (Kiester et al. 1993). Preliminary BRC-initiated studies (Stoms and Davis 1994, White et al. in press, O'Connor et al. 1996) suggest that there is considerable promise to this approach.

Basis for an Integrated Assessment of Ecological Health

Classification and regression tree (CART) analysis (Breiman et al. 1984) is at the heart of the methodology used here, though combined with ideas from hierarchy theory (Allen and Starr 1982). CART models previously, though infrequently, have been used in ecological modeling, e.g., in modeling species distributions (Caughley et al. 1987, Hollander et al. 1994) and biodiversity (O'Connor et al. 1996).

CART models recursively partition data sets on the basis of a set of independent variables. Figure 1 displays the results of a CART analysis of bird species richness (estimated from the Breeding Bird Survey [BBS]) in relation to climate and land cover class data over the 48 states (O'Connor et al. 1996, in preparation). The Environmental Monitoring and Assessment Program (EMAP) hexagonal grid (White et al. 1992) was used to provide an array of some 12,500 spatial units across the conterminous United States. Each EMAP hexagon (ca. 640 km^2 in size) was matched to (1) various local climate data (obtained from the Historical Climate Network or derived from such data); (2) land cover class data from a 14-class (Anderson Level 2) condensation of Loveland et al.'s (1991) prototype land cover classification of the United States derived from AVHRR satellite imagery; (3) land-use pattern metrics (contagion, fractal dimension, etc.), and 4) various ancillary data as to human pressure, e.g,. road density. The dependent variable used was the number of species recorded between 1981 and 1990 on each of 1,198 Breeding Bird Survey adequately surveyed routes (O'Connor et al. 1996). The CART procedure then tested each independent variable to find the best combination of variable and split threshold that separated the sample into two groups distinctive as to values of the dependent variable. In Figure 1 mean July temperature was that variable at the root, with the most discriminatory value being 21.557 degrees Celsius. Each subset was then further partitioned in turn, the process repeated recursively through descendent nodes so that a decision tree was grown, continuing until certain stopping rules were encountered. At this point, the resulting tree was pruned to an optimal fit by cross-validation. The result is a decision tree that specifies a hierarchically organized suite of chains of determinants of (here) species richness. In Figure 1, this gave 10 end nodes.

A decision tree of this type has a number of features of relevance. Within each end node all member sample points share common attributes, i.e., those that satisfy all of the decision criteria from root node to that end point. The dependent variable may vary or be similar between end nodes, but each node mean arises by virtue of a unique chain of decisions.

If we are to pursue an ecological health paradigm for the nation, we need to be able to map the location of both healthy and unhealthy regions of the country. With the decision trees, the location of the sample members in any particular node can be mapped to show where each combination of environmental determinants has its effect. Moreover, since we know all independent variables for every hexagon, the model's rules can classify every hexagon, even those without bird data (provided the sample is representative, a requirement met by the BBS data). Prediction of species richness for those hexagons without empirical bird data therefore is possible. Since nodes cluster in geographic space, node rules effectively define ecoregions.

Consider the two deepest end-nodes in Figure 1. These two sets of hexagons were split apart on the basis of the size of the largest "patches" of coniferous forest in the hexagon. (For technical reasons not directly relevant here, these patches have been rescaled and have odd units). The right-hand node contains hexagons with large patches of coniferous forest and the BBS routes in these hexagons averaged 80 species each. In contrast, the left-hand node containing hexagons with smaller patches of coniferous forest averaged only 72 species. We might conclude that conifer fragmentation was associated with the absence of, on average, eight species, presumably because of the area sensitivity of many bird species (Whitcomb et al. 1981, Robinson et al. 1995, Wilcove 1985). We can thus approximate the magnitude of the fragmentation-induced species loss and, additionally, map the locations of the sample hexagons thus suffering. As before, we can also map *all* locations satisfying the chain of antecedent constraints that lead to the conifer fragmentation split. Additionally, plotting the hexagons in the alternate branch from a fragmentation variable split identifies locations vulnerable to future fragmentation (because they share the antecedent conditions associated with the fragmentation losses in the other branch). Finally, had the fragmentation occurred higher in the regression tree, all nodes descendent from the internal node with small patches would have been plotted as affected by the fragmentation.

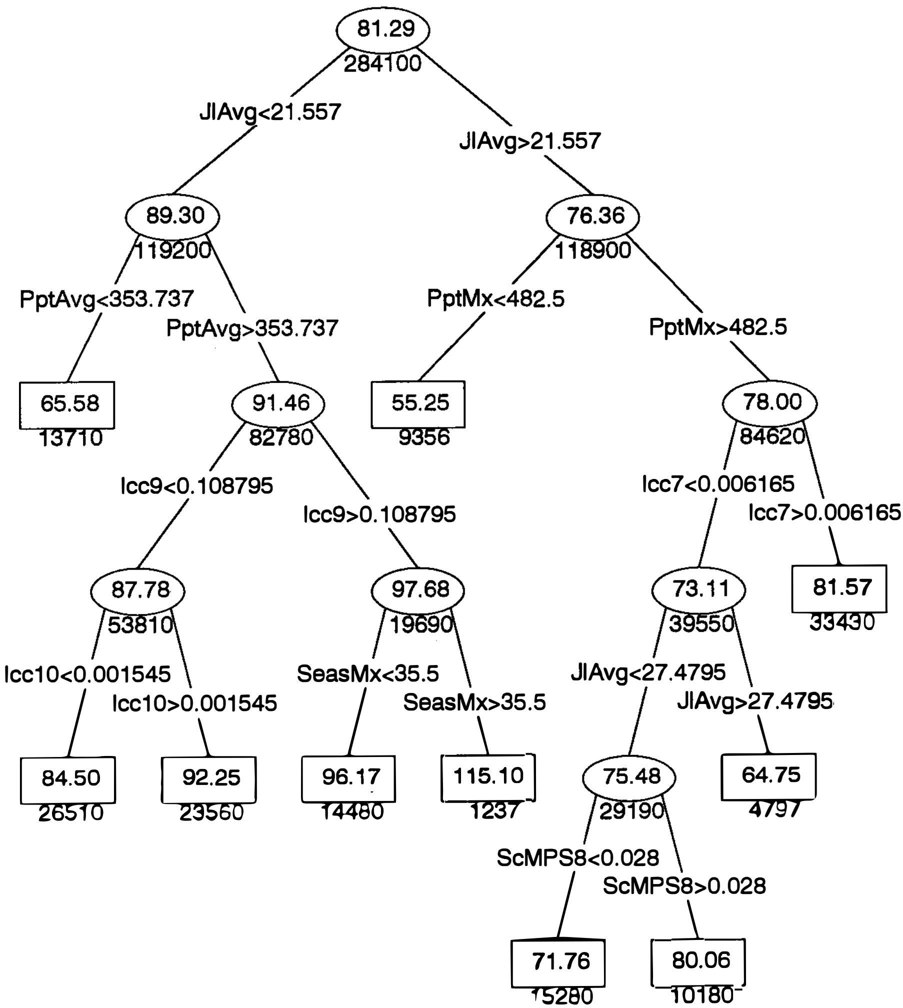

Figure 1. Regression tree structure for species richness across the conterminous United States in relation to significant environmental variables. Figures in boxes are the mean number of species across the Breeding Bird Survey routes satisfying the antecedents of that node. Ovals are internal nodes, squares are end-nodes, as determined by cross-validation fitting of the tree. Figures below each node are deviance measures. Values after each variable abbreviation are the thresholds at which the data were optimally partitioned at that split. Climate variables are long-term (30+ year) averages. JlAvg = mean July temperature (degrees Celsius); PptAvg = mean annual precipitation (mm); PptMx = maximum precipitation level within hexagon (mm); SeasMx = maximum seasonal temperature difference (January to July) (degrees Celsius); lcc7, 9, 10 = percent of hexagon in land class; land class 7 = deciduous forest; land class 9 = mixed coniferous-deciduous forest; land class 10 = water; ScMPS8 = size of largest patch of contiguous pixels of patch type 8 (coniferous forest) in the hexagon, after scaling with respect to national average.

This computation of species deficits (e.g., of eight species for the coniferous forest fragmentation in Figure 1) constitutes a risk assessment for an individual stressor. A logical extension is to compute a cumulated risk estimate, expressed in terms of species deficit, for all locations in the U.S. By tracing the antecedents of each end node to the root and tallying the effects of any stressor encountered, one can cumulate the number of species absent from the node through stressor action. Doing this for every end node yields an empirical estimate of species lost for every hexagon in the sample (i.e., a measure of the environmental stress at those locations). Since the loss specification rules for each node can be applied to all hexagons, not merely those with empirical bird data, we obtain a comprehensive 48-states inventory of landscape-level environmental risk effects.

With our BRC colleagues, we have conducted a preliminary risk assessment of this type. Since with more land cover classes a CART model can achieve greater discrimination, we used the original Loveland et al. (1991) 159-class classification, supplemented with an urban layer from the Digital Chart of the World. The complexity of this decision tree precludes presenting its details here, but its risk assessment scores across the conterminous states are summarized in Figure 2. The results suggest that about a quarter of the 12,500 hexagons in the conterminous states had no species deficit at all, and therefore no ecological damage. About 60 percent had deficits of 17 or fewer species, and the remaining 15 percent had large species deficits.

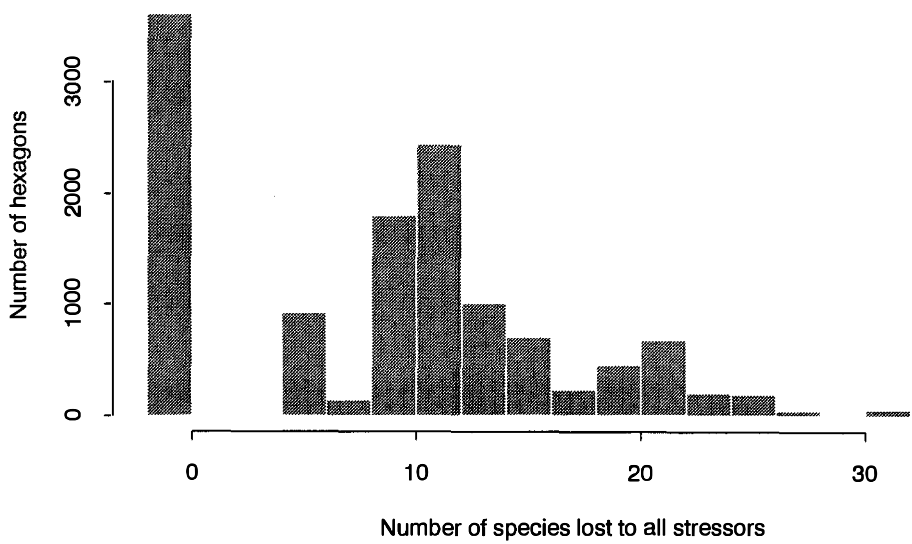

Figure 2. Frequency distribution of species losses from hexagons in association with anthropogenic stressors.

The histogram of Figure 2 assumes completely additive risks. In practice, the nesting of multiple risks requires weighting for the effects of lower splits on the means of higher splits. This can be allowed for by starting at the lowest level and working upward, recursively correcting for the effects of the lower nodes. The peaks of Figure 2 will shift leftward when this is done. It is also arguable that the species deficits in Figure 2 should more properly be displayed as a fraction of the number of species at risk in the hexagon, rather than as absolute numbers. Figure 2 therefore is to be taken only as a "proof of concept" for such an assessment of national ecological health.

A final point is that one can partition the deviance among the explanatory variables, just as in multiple regression, to compute an R^2 value and its contributions from the independent variables. Therefore, one can describe the relative importance of individual stressors as sources of ecological ill-health.

Discussion

An emergent view of biodiversity conservation argues that a "coarse filter" approach to resource conservation—the management of aggregates of communities, ecosystems or landscapes—is likely to be more cost-effective than traditional "fine filter" efforts focused on individual species and their specific stressors (Bourgeron and Jensen 1994). Application of the coarse filter approach regionally or nationally requires a landscape context (a scale of 10-100 km). Hierarchy theory (Allen and Starr 1992) treats landscapes as organized patterns within a hierarchy of spatial and temporal scales. A wide variety of ecological and anthropogenic disturbances may maintain these patterns or trigger processes which generate new patterns. Landscapes show pattern at multiple scales (Turner et al. 1991, O'Neill et al. 1992), and disruption of these patterns can reduce the sustainability of these landscapes (Turner 1989, O'Neill et al. 1992a). The hierarchical modeling adopted here captures this susceptibility to obtain better assessment of ecological health than otherwise possible.

Since spatial pattern affects the way animals and plants are distributed over the landscape in their movements and resource use (Johnson et al.1992, Holling 1992), the landscape metrics used here are a critical component of the model. Although many of the landscape metrics designed to capture aspects of landscape modification (EPA 1994) are cross-correlated (Riitters et al. 1995), it is not known if this is true nationally; it is possible that within-patch correlations may vary regionally, e.g., with shifts as to the types of environmental determinants prevailing.

Human population distribution and change are the major class of stressor not considered here. Witham and Hunter (1992) show that changes in bird populations in New England were related to changes in human populations indexed by Census data, probably because these data served as an effective surrogate of changes in land use not directly assessed. Mageean and Bartlett (in preparation) have shown that the population growth of the United States between 1980 and 1990 has fallen selectively onto some of the most fragile ecosystems in the country, suggesting that inclusion of population data will enhance the ability of the CART models to detect and characterize adverse impacts on biodiversity.

Measurements of spatial autocorrelation in bird distributions within New England show that many populations, or perhaps technically metapopulations, are distributed on very large scale (ca 300 km or larger) (O'Connor 1996). Such distances would be resolved reasonably by the 27-kilometer scale of EMAP hexagons. What is less researched is whether there are multiple scales in these distributions, as demonstrated by Holling (1992), and if scale effects are present, which is the right one to use for ecological health assessment (Wiens 1989). This is an issue both in principle and operationally (because patches may extend across hexagon boundaries, so that metrics may incorrectly assess patch size and, thus, fragmentation and related effects). Turner et al. (1991) used moving windows of various sizes along a finely divided transect across their study area and found distinct peaks in the autocorrelation function for their data, corresponding to particular scales of analysis (and therefore distribution) within the transect. The two-dimensional analog of their study is Pielou blocking (Pielou 1977), and application of this to our data potentially could help resolve spatial structure within our end nodes. In the meanwhile, the hierarchical analysis described here appears to offer a practical solution to obtaining a national assessment of landscape-level risks to ecological health.

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Shortleaf Pine/Bluestem Grass Ecosystem Renewal in the Ouachita Mountains

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Presettlement and Current Ecological Conditions

The 8 million-acre (3,237,600 ha) Ouachita mountain physiographic region is located in westcentral Arkansas and southeastern Oklahoma. The mountains are east to west trending and range in elevation from 500 to 2,700 feet (150-820 m). Travelers in this region prior to European settlement described the landscape as dominated by pine (*Pinus echinata*), pine-hardwood and mixed-oak (*Quercus* spp.) forest communities with fire-dependent and floristically rich grass and forb understories (Du Pratz 1774, Nuttal 1821, Featherstonhaugh 1844). Large grazing herbivores including elk (*Cervus elaphus*), bison (*Bison bison*) and white-tailed deer (*Odocoileus virginianus*) found suitable habitat there (Smith and Neal 1991). Fire return intervals averaged less than 10 years for most sites (Masters et al. 1995). Tree densities averaged 170 trees per acre (420/ha), and the mean diameter was 11.4 inches (29 cm) (Kreiter 1995).

Today the Ouachita mountain landscape is still dominated by forests, but the structure and composition of these forests have changed dramatically. The density of trees has increased to 200 to 250 trees per acre (494-618/ha) and the mean diameter is now 9 inches (23 cm) (Kreiter 1995). Understories are now dominated by woody vegetation and certain once-dominant grasses and forbs are uncommon (Fenwood et al. 1984, Masters 1991, Sparks 1996). Elk and bison have been extirpated. Other species, such as Bachman's sparrow (*Aimophila aestivalis*) and the brown-headed nuthatch (*Sitta pusilla*), have been affected negatively by habitat loss (Jackson 1988) and the red-cockaded woodpecker (RCW) (*Picoides borealis*) is endangered (Neal and Montague 1991). Average fire return intervals now range from 40 to more than 1,200 years (Masters et al. 1995).

Historical and present-day ecological communities of the 1.7 million-acre (690,000 ha) Ouachita National Forest (ONF) are illustrative of the above descriptions. Present-day forests developed largely in response to two factors: commercial exploitation of the original forests and suppression of fires. Large-scale harvest of trees commenced in the 1910s, and by 1940 most of the virgin forests had been cut (Smith 1986). With USDA Forest Service (FS) stewardship, the period of forest regeneration that followed was marked by a strict policy of wildfire suppression. That policy has largely remained in effect to the present. The recent use of prescribed fire by managers, averaging 25,000 acres (10,100 ha) annually over the last decade (R. Miller personal communication: 1995), has been insufficient to maintain a woodland (i.e., tree/grass) ecosystem. The result is that such ecosystems have all but disappeared from the Ouachita mountain landscape (Foti and Glenn 1991).

Desired Ecological Condition in the Context of a Contemporary Landscape

National forest lands are now subject to the philosophy of ecosystem management. Ecosystem management has been variously defined, but most definitions have two attributes in common: an overriding goal to protect ecosystem integrity, sometimes called ecosystem health, and an allowance for human uses that do not compromise ecosystem integrity. The following are key elements of a large-scale ecosystem management project on the ONF to restore the shortleaf pine-bluestem grass ecosystem on 155,010 acres (62,730 ha), and in the process provide sufficient habitat for a recovered population of the endangered RCW and a sustainable supply of wood products (FS 1996).

Elements of Ecosystem Management

Increasing the use of prescribed fire and using tree cutting to simulate natural disturbance patterns. Reduction of basal area is accomplished by commercial thinning. Stand regeneration is accomplished by commercial timber sales using irregular seed tree and irregular shelterwood methods. With either regeneration method, some of the seed trees are retained indefinitely. The size of prescribed burning units encompasses landscapes rather than smaller stand-sized blocks. The average size of prescribed burning units has increased from 200 to 600 acres (81-243 ha), with some units as large as 8,000 acres (3,230 ha) (R. Miller personal communication: 1997). In the past, most prescribed burning occurred during the dormant season from October to March. We now include some burning during the growing season to emulate fire patterns described in Foti and Glenn (1991) and Masters et al. (1995).

Using a modified control strategy for wildfires. Traditional FS policy has been to suppress all wildfires and minimize the area burned regardless of whether the fire was beneficial to resources. We found that a modified control strategy for wildfires, which recognizes that some wildfires are beneficial and should be allowed to burn, helps increase the area affected by fire each year. In those instances where wildfires are burning within prescription, occurring in areas determined to be desirable and not threatening human safety or property, willdfires can be allowed to burn to the nearest man-made or natural barrier. This change is an example of "FIRE 21," a new effort initiated by FS leadership to embrace the changing responsibilities in wildland fire management in the 21st century (Apicello 1996). Goals for FIRE 21 include contributing to restoring, maintaining and sustaining ecosystem function for healthier forests and rangelands, and integrating wildland fire management concerns and the role of fire into all agency management programs, where appropriate.

Increasing rotation age. The minimum time between regeneration cutting, or rotation age, has been increased from 70 to 120 years for shortleaf pine forest types. This allows for a greater number of acres of older trees and results in increased mast production from hardwoods retained in these pine stands. The older trees are also required for RCW and other cavity-dependent species. Cavity development is associated with a fungal heart rot (*Phellinus pinii*) infection that usually does not occur in stands less than 70 years of age.

Maintaining mixtures of native pines and hardwoods. An important part of the restoration process is to replace non-native trees when possible and retain mixtures of pines and hardwoods on the landscape both among and within stands. Retention of mast-producing trees has been a significant issue for the ONF.

Developing and maintaining forested linkages among mature forest habitats. Minimizing ecotonal differences between contiguous stands and reducing habitat fragmentation is important to many bird species. Each timber harvest proposal is examined for ways to keep forest regeneration localized, which maximizes the size of areas that support mature stands. We have increased the size of regeneration areas from 40 to 80 acres (16-32 ha). Because the total amount of regeneration per year or decade is fixed by the rotation age, achieving it on fewer, larger areas rather than many smaller areas reduces the total edge between dissimilar conditions. This also maximizes the area of contiguous mature habitat.

Recognizing that people are an important part of this ecosystem. Traditional uses of forest, such as timber harvesting, hunting, firewood gathering, bird watching and fishing, continue while we work to restore ecological (historical) conditions. No special limitations are placed on the public while using the area. Project planning incorporates local values through an extensive public involvement program. Information from monitoring the effects of restoration has been gathered through close collaboration with university researchers. Detailed information is used to monitor the effectiveness of our projects and guide the restoration effort.

Assessing Ecological Health

There are three areas by which the ONF can measure success at attaining ecosystem health. Biodiversity, recreation opportunities and timber supplies are used as "yardsticks" because all were significant issues in recent planning efforts.

Biodiversity

Wilson et al. (1995) examined the breeding bird response to this restoration effort. They found that 10 species of ground/shrub-foraging species (yellow-breasted chat [*Icteria virens*], brown-headed cowbird [*Molothrus ater*], Carolina wren [*Thryothorus ludovicianus*], northern cardinal [*Cardinal cardinalis*], wild turkey [*Meleagris gallipavo*], indigo bunting [*Passerina cyanea*], northern bobwhite [*Colinus virginianus*], chipping sparrow [*Spizella passerina*]) and shrub-nesting species (American goldfinch [*Caruelis tristis*], prairie warbler [*Dendroica discolor*]) were favored by thinning and prescribed burning, as compared with controls. Two ground-nesting species, the ovenbird (*Seiuris aurocapillus*) and black-and-white warbler (*Mniotilta varia*), declined in the same restoration areas. Small mammals were found to have increased in numbers and species on the same restored sites (Lochmiller et al. 1993). Sparks (1996) found that prescribed burning produced higher herbaceous species richness and diversity, and forb and legume abundance in the project area.

Recreation Opportunities

Outdoor recreationists, including hunters and bird watching enthusiasts, are attracted to these restored lands. In *A Birder's Guide to Arkansas*, White (1995) featured the project area as a unique opportunity to view RCW, brown-headed nuthatch and Bachman's sparrow. Discussing the decline of the northern bobwhite, Brennan (1991) provided some evidence that the forest-management techniques used here (reduction of tree basal area, reduction of midstory and prescribed burning every one to three years) resulted in higher bobwhite numbers. Masters et al. (1996) examined white-tailed deer forage production on the project area. They found that restoration efforts increased preferred deer forage sixfold.

Timber Supply

Timber harvesting is an essential part of these restoration efforts. The environmental impact statement for the FS long-term strategy for RCW recovery (USDA 1995) in the Southern Region concluded that this region-wide restoration effort would result in a gradual long-term increase of timber supplies after an initial decline. The ONF implementation of this strategy, because of favorable age class distribution, projected that timber harvest volumes would remain constant in the next two decades, and decline slightly from 29.2 to 27.5 million cubic feet of wood by the fifth decade (Bukenhofer et al. 1994). The decline in long-term sustained yield is largely a function of increasing the rotation age from 70 to 120 years.

Other Considerations

Another measure of ecosystem health is the potential for reintroduction of extirpated species. The elk has been successfully reintroduced to three nearby locales, the Buffalo National River in northern Arkansas, and the Pushmataha and Cookson Hills wildlife management areas in eastern Oklahoma. Earlier attempts at reintroduction failed due to brain worm (*Parelaphostrongylus tenuis*) infestation (Carpenter 1973). Recent studies (Raskevitz 1991) determined that the intermediate hosts for the brain worm were snails (Gastropidae) that were dependent on moist forest conditions where tree densities were high, including a well-developed mid-story. They found that elk preferred habitat that included open, drier forest conditions unfavorable to the snails, and this preference yielded elk with no clinical signs of brain worm infestation. In the future, we expect that the drier forest conditions provided by shortleaf pine/bluestem grass ecosystem renewal will supply a sufficient quantity of suitable habitat capable of supporting a reintroduction of elk in the ONF.

Summary

The most influential laws relating to and governing FS land management activities include the Multiple Use-Sustained Yield Act, Endangered Species Act, National Forest Management Act, Clean Water Act and, to a lesser extent, the Clean Air Act. For many, these laws present conflicting direction and create an insurmountable operational, regulatory and judicial tangle.

All of these laws predate direction issued by FS Chief Dale Robertson to Regional Foresters in June 1992 in which he admonished them to follow a philosophy of ecosystem management in their stewardship of national forest lands. All of these legal mandates remain in full force. Collectively, these laws can be summarized as requiring that national forests be managed to allow for sustainable human uses, both economic and non-economic, without compromising land health. The role of the ecosystem management policy adopted by the FS is to provide a single, all-inclusive philosophical context for management that integrates the spirit and letter of these laws. It puts sustaining land health first. We think this is appropriate, for over the long term, it will be impossible to sustain human uses without first sustaining the health of the land.

Our project is one example of ecosystem management. It embodies elements of landscape ecology, restoration ecology and endangered species recovery. It seeks to restore an entire ecosystem on portions of today's Ouachita mountain landscape. This is not so much because the landscape was prominent in pre-European settlement times, but rather because it had almost disappeared along with its unique flora and fauna. The project is mindful of Aldo Leopold's (1949) famous dictum that saving all parts and pieces of the ecosystem is the first precaution of intelligent tinkering. At least in this case, we have demonstrated that managing for ecosystem integrity (health) need not result in significant reductions in timber resources for traditional human uses. This, coupled with the increased recreation opportunities enumerated above, is a "win-win" situation.

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Closing Remarks

James D. Fenwood
USDA Forest Service
Washington, D.C.

We have spent the afternoon searching for the measures, methodologies and paradigms needed to bring focus to the somewhat fuzzy concept of ecosystem health. In doing so, we have ranged far-afield, from national parks to western riparian areas, the Columbia Basin, a midwestern marsh, and the Ouachita Mountains. We have looked into the past, discussed ways to assess the present and speculated about the future.

Chris Jauhola opened the session with some historical perspectives and a comparison of views on the meaning of ecosystem health. We were cautioned about drawing analogies between ecosystem health and organism health. Chris outlined some of the dilemmas facing managers as they attempt to choose among management themes which range from utilitarian conservation to normative health based on ecosystem stability, to the sustainability of ecosystem resilience and integrity. Chris left us with one important thought—that there is no one right way to assess or manage for ecosystem health.

Don Huff followed with the observation that few, if any, contemporary ecosystems, and possibly no prehistoric systems, exist without some significant influence from humans. Don challenged the way we have traditionally used certain terms; exposed some of the pitfalls associated with terminology such as "natural," "unnatural" and "native"; and posited that as the concept of a pristine pre-European paradise is debunked, these terms become increasingly arbitrary in meaning. While warning us that the traditional meanings attached to the term "forest health" should not necessarily be applied to the term "ecosystem health," Don admonished us that defining social objectives for ecosystems will likely be required before we can assess and manage the health of those systems.

Our history lesson began in earnest with Marci Todd's and Wayne Elmore's examination of the close ties between inhabitants of the West and the riparian areas they have occupied, used and altered for thousands of years. They described the conservation ethics of the region's native people and discussed the ways they related to and influenced riparian areas. We learned how European settlement ended this era of sustainable use and began one of degradation. With our recent attempts to apply ecosystem management principles to riparian areas, the authors see us coming full circle. Wayne and Marci suggested that a standardized vocabulary to describe watershed conditions will be essential to the task of restoring healthy riparian conditions, and they described how restoring ecosystem processes is the key to healthy riparian systems.

Dan Dessecker warned us of some of the biases inherent in techniques for estimating historical vegetation conditions. These included varying rates of pollen deposition and degradation, shifts in disturbance patterns in response to climate variation, and the nonrandom nature of land survey data. Of particular concern to Dan was the likelihood that aboriginal populations had declined significantly several centuries before Europeans first began documenting conditions. Dan left us with the conviction that although historical data on vegetation composition provide useful insights, they may be inappropriate as benchmarks for future desired conditions.

Fred Samson and a cast of thousands turned our attention to the theory and practice of ecosystem management. Focusing on the Columbia River Basin, Fred discussed recent ecosystem-scale efforts to evaluate historical conditions, determine habitat requirements, supplement this information with finer scale analyses, and mesh with legal requirements and organizational processes. Fred described a process for evaluating all vertebrate species in an area based on trend and habitat data, and concluded with some lessons learned about integrating wildlife management with strategies for ecosystem health by linking wildlife assessment at the ecosystem scale with ecosystem planning at the ecosystem scale, closing the gap between theory and management, and developing strategies for long-term persistence of wildlife.

With a presentation by Roy Kroll, we sharpened our focus to a 2,000-hectare marsh in Ohio. Roy and his coauthors studied historical conditions and influences on the marsh. A combination of factors, ranging from diking and introduction of exotic fish, appeared to be responsible for dramatic declines in emergent vegetation compared with historical conditions. If emergent vegetation is a principle indicator of ecosystem health in freshwater wetlands, then this marsh must be deemed "unhealthy." Roy advised that policy decisions concerning wetland conservation need to consider the landscape-level alterations that have taken place.

Moving back up to a broader scale (the United States), Ray O'Connor presented a tool for assessing ecosystem health. Such an assessment requires a comparison of observed states of a resource with expected conditions. Ray proposed linking widely available breeding bird census data with the Environmental Mapping and Assessment Program (EMAP) grid. With such a system, bird species richness might portray the ecological health of the nation by displaying where losses have occurred as the result of human activity.

In the final presentation, George Bukenhofer and Larry Hedrick shared their vision of applying an ecosystem management philosophy to restoring healthy conditions to 64,000 hectares of longleaf pine/bluestem ecosystem in Arkansas. George discussed the dramatic changes that have occurred in this system including reduction in fire occurrence, cutting of original forests, and extirpation of some plant and animal species. Restoring this system will require increased use of fire and tree cutting to simulate natural disturbance, deferring harvest of overstory pines, maintaining linkages among habitats, and recognizing that people and their activities are an important part of ecosystems.

This afternoon we have ventured onto some slippery terrain. While the territory of ecosystem health still remains largely unexplored, we have accomplished at least two things today. First, we have shared a variety of perspectives and filled in a few more blank places on the chart that will guide us in our exploration of ecosystem health, ecosystem management and wildlife management in contemporary landscapes. Future explorers and cartographers of this territory will find much to chart in applying what we learn about the past to getting where we want to be in the future, to developing criteria and indicators for what constitutes a healthy ecosystem, and for reconciling human value judgements about what is healthy with an ecological perspective on ecological integrity. Second, we have persevered in this task right through to the last paper of the last session of this year's North American. I congratulate you.

Registered Attendance

Alabama

Jim Armstrong, David C. Hayden, Nicholas R. Holler, Lee Kennamer, Dennis C. Tates

Alaska

David Allen, Jay R. Bellinger, Robert Bosworth, John D. Buffington, Ellen Campbell, James A. Caplan, Jack Capp, Tina Cunning, Phil Janik, Robert Leedy, John Payne, Wayne Regelin, Ken Taylor

Arizona

Brian Czech, David D. Daughtry, Pat Daughtry, Bruce D. Eilerts, Michael M. Golightly, Susan Golightly, Bill Grossi, Donald K. Hack, Jeanette Hack, Junior D. Kerns, Paul R. Krausman, David Krueper, James P. Nelson, Charles Pregler, Rudolph A. Rosen, Duane L. Shroufe, Linda K. Shroufe, Philip M. Smith, Anne Taubert, Bruce D. Taubert, Jay Thompson, Therese Thompson, Dave Walker

Arkansas

Nicholas E. Finzer, Sarah Magee, Tony Melchiors, Tim Moser, James T. Popham, Bill Robinson, Benny F. Swafford, Wyonne N. Swafford, Steve N. Wilson, Scott Yaich

California

Norma C. Brossa, Timothy A. Burr, Roy Clark, Katherine Clement, Wanda Deal, Julie J. Eliason, Andrew Engilis, Jr., Jean Fisher, William Fisher, Bill Gaines, Richard E. Griffiths, Mark Hagan, Jon K. Hooper, Joseph R. Jehl, Jr., Sharon L. Jones, Diane C. Macfarlane, John P. McAndrews, Thomas V. Mull, John R. Phillips, Nancy Read, Frederic A. Reid, Bruce S. Reinhardt, Keith Rubin, John Schmidt, Christine Schonewald, Tamara Ann Shepherd, Kent A. Smith, G. Lynn Sprague, Ron Stromstad, Susan Williams, Thomas Wright

Colorado

Arthur W. Allen, William Allen, Spencer Amend, Kimberly Anderson, Robert Anderson, Sally Angus, Maryanne Bach, Chris Bandy, Clait E. Braun, Robert Brozka, Casey R. Buechler, Joe Capodice, Len A. Carpenter, Alan P. Covich, Richard Curnow, Wayne O. Deason, Eugene Decker, David Dolton, Eric Dornfeld, Nancy Dornfeld, Charlene Dougherty, Elizabeth Estill, Rebecca Frank, Joan Friedlander, Paul E. Gertler, Dana R. Green, Dwight Guynn, Lynn Haines, Bob Hays, Dan Edward Huff, Patrice Janiga, David M. Knotts, Skip Ladd, Carol Lively, Michael Lucero, Ralph O. Morgenweck, John W. Mumma, John L. Oldemeyer, Bill Reeves, Dick Roth, Will Shafroth, David E. Sharp, Gary T. Skiba, Gene Stout, Richard Wadleigh, Thomas L. Warren, Melanie Woolever, Mike Worthen

Connecticut

Chris Chaffin, Susan Chaffin, Rick Patterson

District of Columbia
Fred Abraham, Bobby Acord, Catherine Allen, Dan Ashe, Terry Austin, J. Lamar Beasley, Ken Berg, Mel Berg, Gail Bingham, Michael Blymyer, L. Peter Boice, Judith Bowers, William F. Bragg, Linda Cantrell, Richard Christian, Jamie Rappaport Clark, Glen Contreras, Chris Darnell, Tom Darden, Robert Dewey, Desiree DiMauro, Mike Dombeck, Naomi Edelson, Nina Fascione, Erika Feller, James Fenwood, Laurie A. Fenwood, Bob Ferris, Dwight Fielder, John Grandy, Frankie Green, Nancy Green, John Hadidian, Susan Hagood, Jerry Hagstrom, David Hall, Don Hawthorne, Matthew Hess, Joel Holtrop, Margaret E. Hopkins, Jacquelyn M. Howard, Bill Imbergamo, Chris Jauhola, Jim Joy, Gary S. Kania, Bob Lange, George Lapointe, Kristen P. LaVine, Eric Lawton, Michael R. Lennartz, Paige Lewis, Martin MacDonald, Donald E. MacLauchlan, Jim Mallman, Gwen Mason, Bruce McCloskey, Doris J. Miller, James E. Miller, Phil Million, Mary Munson, Patrick K. Murphy, Angela R. Nelson, Deborah Ann New, Janice Peterson, R. Max Peterson, Debbie Pressman, Mark J. Reeff, Kathryn B. Reis, Gregg D. Renkes, J. Douglas Ripley, Chris Risbrudt, archy roach, John G. Rogers, Jon Scheid, Eric Schenck, Rodger Schlickeisen, Max Schnepf, Sally Schuff, Liz Skipper, Kenneth L. Smith, Fred Stabler, Robert Streeter, Scott Sutherland, James M. Sweeney, Jim Tate, Carol Taylor, Gary J. Taylor, Elliott Teel, Whitney Tilt, Chris Topik, William D. Torgersen, Len Ugarenko, Jim Waltman, Molly Williams, Bill Woolf, Daniel Wrinn, James Wyerman, Carol Wynne

Delaware
Lloyd Alexander, Lynn Allen Herman, Andrew T. Manus, Bill Whitman

Florida
David Brakhage, Ken E. Conley, Jodi DiCamillo, Allan L. Egbert, Ronald F. Labisky, Dick Lattimer, Rick McWhite, Frank Montalbano, Arnim Schuetz, Stephen M. Seiber, Steve Shea, Rob Southwick, Aileen Walsh, Patrick B. Walsh

Georgia
Jim Anderson, Bert Bivings, Jimmy Bullock, Noreen K. Clough, Sheila Colwell, John C. Cruz, Glen Gaines, Steve Greene, Dottie Head, William C. Hunter, Robert C. Joslin, Lawrence E. McSwain, Susan Mead, Douglas A. Moore, Victor Nettles, Charles E. Parramore, Jr., Stephen R. Rickerson, Tom Sinclair, Kathryn Sukkestad, Peter K. Swiderek, Linton Swindell, Mike Van Den Avyle, Jeff Veck, David Waller, Jim Wentz, John J. Wojcik

Guam
Heidi C. Hirsh, Leslie Morton

Hawaii
David R. Anderson, Lance Bookless, Cathleen Hodges, Rick Potts

Idaho
Jon Bart, S. Kent Carnie, Gary J. Foloff, Nancy H. Halliwell-Carnie, Jonathan Haufler,

Mark A. Hilliard, Robert House, William 'Buz' Kennedy, Mike Kochert, George W. LaBar, Daniel C. McCluskey, Marjorie L. McHenry, Stephen P. Mealey, Carolyn Mehl, Terrell D. Rich, Gary J. Roloff, Michael Scott, Jill Silvey, Jerald D. Tower, Mark Vinson, William A. Wall, Jack Williams

Illinois
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Indiana
David J. Case, Gary D. Doxtater, Rebecca Fitzmaurice, Kenneth Nettles, Olin E. Rhodes, Jr., Phil T. Seng, Ed Theroff

Iowa
Judy Bishop, Richard A. Bishop, Richard A. Clewell, Nancy Derey, Allen L. Farris, Kathie Farris, Joe Haffner, Bruce Menzel, Terry Z. Riley, Dee Ann Wilson, Larry J. Wilson

Kansas
Ken Brunson, Joe Kramer, David P. Jones, Rob Manes, Carin Richardson, Steve Williams

Kentucky
Roy Grimes, Rick Lowe, Rocky Pritchert, Kim Ragland-Gray, Thomas A. Young

Louisiana
John M. "Frosty" Anderson, Nancy J. Anderson, Wylie C. Barrow, Jr., Virginia Burkett, Carroll L. Cordes, Robert Helm, Bill Hohman, John J. Jackson III, Eric Keith, Greg Linscombe, Mary E. May, David B. Smith, Bob Stewart, Johnnie Tarver, Barry Wilson

Maine
Raymond J. O'Connor, Kari K. Schank

Maryland
Robert A. Bachman, Paul J. Baicich, Jeff Bossart, Dixie Bounds, Betty Boyland, Paul Brouha, John Bruggink, Carol Byerly-Conner, David Caithamer, Bill Clay, Mark C. Conner, Brenda Sue Cruz, Jim Dubovsky, Thomas M. Franklin, Aelred D. Geis, W. Reid Goforth, Bill Green, Bette S. Gutierrez, Paul W. Hansen, Earl W. Hower, Fred Johnson, Bryan D. King, James A. Kushlan, Daniel L. Leedy, Virginia Leedy, Douglas P. Lister, Duncan MacDonald, Laury Marshall, Richard E. McCabe, Joseph Miller, Mary Moore, Rodney Moore, Jim Mosher, Paul Padding, Thomas D. Patrick, Norm Phelps, Daniel A. Poole, Dorothy Poole, Jim Pottie, Kyle Rambo, Tim

Richardson, Patricia A. Richerson, Jim Sabrack, Joshua L. Sandt, Jerry Serie, Graham W. Smith, Jacqueline Smith, William Spicer, Kenneth P. Stachiw, Ed Temple, Robert Wardwell, Leslie A.C. Weldon, Michael K. Weldon, Molly Whitworth, Lonnie L. Williamson, Thomas Wray II, Alice Wywialowski

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Mississippi

Ken Babcock, Charles Baxter, James L. Cummins, Jr., Richard A. Fischer, Stephen C. Grado, John E. Gunter, L. Pete Heard, Rick Kaminski, Eric Kurzejeski, Ron Lukens, Chester O. Martin, Ross Melinchuk, Donna L. Minnis, Richard B. Minnis, Jean O'Neil, Michael Passmore, Randy Robinette, Donald W. Thompson

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Nebraska
William Baxter, James Douglas, Gloria J. Erickson, Keith W. Harmon, Robyn Mowery, Wes Sheets

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Amy Cantor, Vickie Davis, John W. Lanier, Ray Whittemore, Scot J. Williamson

New Jersey
Jim Applegate, George P. Howard, Jean Howard, Robert A. Itchmoney, John Joyce, Robert McDowell

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Leon Fisher, Susan George, Nancy Kaufman, Joanna P. Lackey, Eugene LeBoeuf, Jim Lloyd, Jerry Marracchini, Patrick C. Morrow, Melody Munson-McGee, Dan Sutcliffe, Peter Windler

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North Carolina
Eric G. Bolen, Jennifer L. Caylor, John Cecil, Stephanie Donaton, Mark Gates, Bryan R. Henderson, Albert Henry, W. Michael Hunnicutt, Brian Hyder, Lynn A. Maguire, Robert Montgomery, Rich Noble, William H. Rogers, Scott B. Smith, John D. Stanton, Wendy D. Stanton, Evelyn C. Watkins, Anna Yellin

North Dakota
Dennis E. Breitzman, Douglas H. Johnson, Michael A. Johnson, Dona Jean Kirby, Ronald E. Kirby, Randy Kreil, Dan Limmer, Michael McKenna, Jeff Nelson, Richard D. Nelson, Roger L. Pederson, Jim Ringelman, Ken Sambor, Keith A. Trego

Ohio
Susan Adkinson, Theodore A. Bookhout, Michael Budzik, Ken Fritz, Steve Gray, Richard W. Keefe, Roy W. Kroll, Tony J. Peterle, Richard B. Pierce, Patrick Ruble, Robert T. Sexton

Oklahoma
George A. Bukenhofer, Greg D. Duffy, Lisa Duffy, David Leslie, Jeff Trousil, Glen Wampler

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Puerto Rico
José Montduo

Rhode Island
Thomas Greene

South Carolina
Robert Abernethy, Ron Brenneman, Larry D. Cartee, W. Brock Conrad, Jr., John Edwards, Drenia Frampton, John E. Frampton, Kathleen E. Franzreb, Rob Keck, James Earl Kennamer, F. W. Kinard, Jr., Nancy B. Kinlaw, Ronald E. Kinlaw, David Ledford, Bobby Maddrey, Mike McShane, John R. Sweeney, Gary Tanner, James A. Timmerman, Debbie Yarrow

South Dakota
Chuck Berry, John Cooper, Joy Gober, Pete Gober, Doug Hansen, Steve Riley, George Vandel

Tennessee
Bruce D.J. Batt, Ed Carter, Tom Duncan, Loy M. Fulford, Bob Harmon, Mickey E. Heitmeyer, Robert D. Hoffman, James R. Jordan, Jr., Gary Larson, Gregory W. Lee, Kimberly A. Lee, Larry C. Marcum, Chester A. McConnell, Gary Myers, Cynthia P. Neal, Jack Payne, Annette Power, Cynthia Ragland, Jan Wentz, W. Alan Wentz

Texas
Gilbert T. Adams, Terry L. Bashore, Vernon Bevill, Kirby Brown, Robert Brown, George R. Carlson, Patricia A. Chamberlain, Robert L. Cook, Jerry Cooke, Rafael D. Corral, Steve Demarais, Lynn Drawe, Corrie Fendrick, Ron George, Gary Graham, Randall L. Gray, Robert H. Gray, Clifton Griffin, Dennis M. Herbert, John Herron, Billy Higginbotham, Joyce Johnson, Robert C. Kull, Jr., Tessa E. Martin-Bashore, Nick C. Parker, Nova Silvy, Janiece Smith, Loren M. Smith, Robert W. Spain, Don Steinbach, James G. Teer, Ray C. Telfair, II, Warren Thetford, Michael J. Warnock, Doris L. Weller, Milton W. Weller, Linda Woestendiek

Utah

John A. Bissonette, Jack A. Blackwell, Dale E. Bosworth, Barbara Burbridge, William R. Burbridge, Jim Cole, Mike Conover, Raymond D. Dueser, Brian Ferebee, Charles W. Gay, Christine Gordon, Keith Highley, John A. Kadlec, Tina Crump Lanier, John W. Martin, Terry A. Messmer, David A. Newhouse, Mary Lu Roskelley, Mike Roskelley, Bob Swinford

Vermont

Allen A. Elser, Joe Minadeo, Thomas A. More, Mark J. Twery

Virgin Islands

David Nellis

Virginia

Mike W. Anderson, Robert L. Anderson, Robert Barber-Delach, John L. Bardwell, Bob Blohm, Roxanne Bogart, Craig Bonds, Christine Bunck, Dee Butler, Robert L. Byrne, Ron Circé, Matthew D. Chan, John A. Chrisafis, Keith W. Cline, Pamela Couch, Robert L. Davis, Jr., Aimee Delach, Jessica Dewey, Gary Edwards, Dennis B. Fenn, Jim Fleming, Mary Beth Geil, Kevin R. Goodwin, Steve Gottshall, Deborah Green, Lawrence E. Greene, Skip Griep, Valerie C. Guardia, Susan Haseltine, Mike Hayden, Valerie W. Hilliard, Matt Hogan, Brian K. Hoppy, Rebecca Mills Horman, E. Brian Hostetter, Stephanie Hussey, Douglas B. Inkley, Helen F. Jahn, Laurence R. Jahn, Fred Jarman, Kerrie Kirkpatrick, Hannah Kirchner, Brad Knudsen, Ron Kokel, Mark Koneff, Joseph Kuti, Susan R. Lamson, Jennifer Lawson, Kelley Lipphard, Heather Mansfield, Stuart Marks, Teresa Martinez, Donald F. McKenzie, Steve L. McMullin, Steve Miller, Keith A. Morehouse, Bill Morrill, Robert D. Nelson, Jennifer Norman, Ralph Otto, Frank M. Panek, Rick Parsons, Pat Peacock, Carol J. Peddicord, Randy Phillips, Norville Prosser, Danny C. Reinke, William J. Romberg, Sharon Rushton, Paul Schmidt, Elizabeth Scholl, Robert Shallenberger, Maitland Sharpe, Ronald J. Small, Jr., Ryan Smith, Timothy W. Southard, Bettina Sparrowe, Rollin D. Sparrowe, Tim Stamps, Kelly D. Starinchak, Michelle Birgit Steg, Mendel Stewart, Dan Stiles, Thomas L. Striegler, David M. Sutherland, Lloyd W. Swift, Rose Swift, Melinda Tajbakhsh, Dottie Taylor, Billy Templeton, David L. Trauger, John F. Turner, Kelly Wadsworth, Jeff Waldon, David Waterman, Ben West, David K. Whitehurst, Ken Williams, James R. Woehr, Paula Woehr, Catherine M. Zielske

Washington

Shauna Hanisch, Becky Herbig, Lorin L. Hicks, William R. Ladd, Joe LaTourrette, Maureen E. Liang, Kent Livezey, Wayne R. Marion, John H. Munn, James A. Rochelle, Bern Shanks, Dean Smith, Michael S. Spranger, Todd Thompson

West Virginia

Jennifer Bell, Donald C. Gasper, Glee H. Gasper, Kurt W. Gottschalk, Ian Gregg, Scott Hartman, Paul Johansen, Diane Krishon, Mark McFall, Charles L. Myers, Gordon Robertson, Cindy Schiffer, Lynette Serlin, Mike Tome

Wisconsin
Harold W. Benson, Al Boss, Darrel Covell, Dan Dessecker, Tom Harelson, Thomas Hauge, Daniel Gonnering, Diane Lueck, Butch Marita, Kim Mello, Donald L. Meyer, Stephen R. Mighton, Rick Mooney, Susan Niebauer, Tom Niebauer, Todd Peterson, Robert L. Ruff, Donald H. Rusch, Christine Thomas

Wyoming
John Baughman, Scott Fitzwilliams, Mark W. Gorges, Sandra H. Key, Larry Kruckenberg, Jay Lawson, Robert Model, Rick Pallister, Thomas Puchlerz, Art Reese, Tom Thorne, Karen Werbelow, Bill Wichers

Barbados
Antenor Nestor A. Guzman

Canada
Joey Amos, Michael G. Anderson, Dave Anknev, Grant Baker, Rick Bates, Richard K. Baydack, Dave Brewster, Dale Caswell, Brigitte Collins, Lorne Colpitts, Joan Cox, Kenneth W. Cox, Patricia Dwyer, Rod Fowler, Brian Gray, Trish Hayes, Darryl Kroeker, Simon Llewellyn, Robert J. MacFarlane, Lynda Maltby, Gerald McKeating, Robert S. McLean, Terry G. Neraasen, Frank Pokiak, Tomasz Sankowski, Gary Stewart, Andy Van Busse, John Wilson, Jim Young

Cuba
Patricia Martinez

Panama
James M. Chavers

Zimbabwe
Graham Child