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Contents

Opening Session. Advancing the Cause of Conservation: Recharging San Juan Hill?

Welcome and Opening Statement..1
Rollin D. Sparrowe

Lessons from History: The Conservation Legacy
of Theodore Roosevelt..9
John F. Reiger

Federally Owned Rangelands:
Are There New Grounds for Common Ground?.................................21
Mark Rey

Address Given by the Director of the United States Fish
and Wildlife Service...32
Steve Williams

Special Session One. Wildlife Diseases: Crying Wolf or Crying Shame?

Opening Remarks...37
Robert G. McLean

Type C Avian Botulism–Management Dilemma.................................40
Gary Wobeser and Trent Bollinger

Avian Vacuolar Myelinopathy:
A Newly Recognized Fatal Neurological Disease
of Eagles, Waterfowl and Other Birds...51
*John R. Fischer, Lynn A. Lewis, Tom Augspurger
and Tonie E. Rocke*

West Nile Virus: A Threat to North American Avian Species..............62
Robert G. McLean

Hemorrhagic Disease in White-tailed Deer:
Our Current Understanding of Risk..75
David E. Stallknecht, Elizabeth W. Howerth and Joseph K. Gaydos

Chronic Wasting Disease: Implications and Challenges for Wildlife Managers..87
Elizabeth S. Williams, Michael W. Miller and E. Tom Thorne

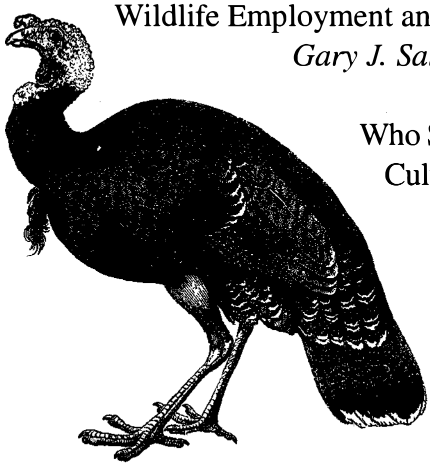
The Influence of Sylvatic Plague on North American Wildlife at the Landscape Level, with Special Emphasis on Black-footed Ferret and Prairie Dog Conservation.........................104
Michael F. Antolin, Pete Gober, Bob Luce, Dean E. Biggins, William E. Van Pelt, David B. Seery, Michael Lockhart and Mark Ball

Special Session Two. Our Changing Professional Culture: Throwing Out the Baby Boomers with the Bath Water?

Implications of Massive Agency Retirements on Future Fish and Wildlife Employment and Education..................................129
Gary J. San Julian and Amanda B. Yeager

Who Says Fish and Wildlife Ain't Got No Culture?..143
Sally Angus Guynn

Move Ahead with the Past for Wildlife and Nature Conservation...............................161
Delwin E. Benson



Passing the Torch of Wildlife and Fisheries Management: Comparing the Attitudes and Values of Younger and Older Conservation Professionals....178
Robert M. Muth, Rodney R. Zwick, Martha E. Mather and John F. Organ

The Fuel and Fire for Change....194
William H. Molini

Old and New Cultures in Wildlife Management: Welcoming Change and Diversity....199
Jerry Conley

Special Session Three. Amending the Endangered Species Act: Is ESA Threatened or Endangered?

Opening Remarks....209
Paul Hansen

Local Innovation and Shared Responsibilities Will Unlock the Act....211
Greg Schildwachter

Species Restoration: A Vision for the Endangered Species Act in its Fourth Decade....219
Jamie Rappaport Clark

The Administration's Approach to the ESA: Building a Stewardship Ethic for the 21st Century....229
Ann R. Klee

Heretical Thoughts: Ending the Stalemate over the Endangered Species Act....237
William Robert Irvin

Special Session Four. Game Ranching: Boon or Bane?

Opening Remarks..........249
Bruce Morrison

Farming Captive Cervids: A Review of Social, Economic and Ecological Opportunities and Risks in Michigan and North America..........251
Thomas G. Coon, Henry Campa, III, Alexandra B. Felix, R. Ben Peyton, Scot R. Winterstein, Frank Lupi, Mary Schulz and James Sikarskie

Why Game Ranching and the North American System of Wildlife Conservation Are Incompatible..........269
Valerius Geist

Impacts of Game Ranching on Wildlife Management in Texas..........276
John T. Baccus

The Federal Role in Regulating Alternative Livestock Operations..........289
Jose R. Diez, Mike Gilsdorf and Robert Werge

Status and Management Implications of Captive Cervid Farming in the Northeast..........297
John Buck

Closing Remarks..........308
Ronald J. Regan

Special Session Five. Energy and Conservation: Does Big Oil Mix with Big Game?

Opening Remarks..........311
Fred Lindzey

Overview of Hydrocarbon Production, Comsumption, Reserves and Potential, at World and Local Scales..313
Mitchell E. Henry and Debra Higley

Where Would You Like the Holes Drilled into Your Crucial Winter Range?..317
Thomas D. Lustig

Developing Oil and Gas while Protecting Wildlife on Public Lands...328
Dru Bower

Oil and Gas Development in Western North America: Effects on Sagebrush Steppe Avifauna with Particular Emphasis on Sage Grouse..337
Clait E. Braun, Olin O. Oedekoven and Cameron L. Aldridge

Potential Effects of Oil and Gas Development on Mule Deer and Pronghorn Populations in Western Wyoming.............................350
Hall Sawyer, Fred Lindzey, Doug McWhirter and Keith Andrews

Closing Remarks...366
Len H. Carpenter

Special Session Six. Conservation, Communication, Commitment: Moving Foward with Farm Bill 2002

Panel I. Modeling Conservation and Commodity Successes via the 1996 Farm Bill

Opening Remarks: Are We There Yet?..371
Ronald Helinski

Ranching Successes on the Texas Gulf Coast:
Achieving Mutual Economic and Conservation Objectives..............373
Bob McCan

Land and Wildlife Stewardship in the High Plains of Texas:
Combining Conservation Programs with Successful Agriculture......378
Randy M. Sublette and Gene T. Miller

Coming Together on the Farm Bill..383
James L. Byford

Panel II. How Do We Keep the Momentum Going and Continue to Foster the Development of Relationships to Meet Conservation and Landowner Goals?

Opening Comments...387
Rob Manes

Fostering Conservation with Economic Realities..............................390
Marc Curtis

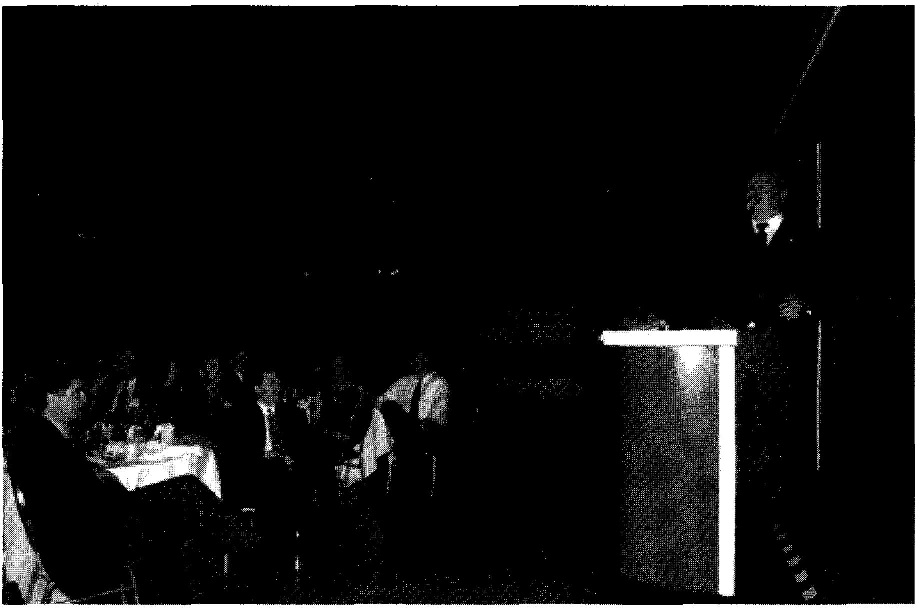
A Northeast Dairy Perspective of Farming and Conservation...........396
Carl W. Schwartz

Registered Attendance..401

2002 Presidents Award..410

2002 Touchstone Award...412

2002 Distinguished Service Award..416



In keeping with the centennial of his foresighted conservation agenda, President Theodore Roosevelt (aka Keith McCough) presents whistlestop comments and reflections for attendees of the banquet of the 67th North American Wildlife and Natural Resources Conference, in the Grand Hall of Union Station, Dallas, Texas. *Photo by Tami Heilemann.*

Opening Session.
Advancing the Cause of Conservation: Recharging San Juan Hill?

Chair
Rollin D. Sparrowe
Wildlife Management Institute
Washington, DC

Cochair
Robert L. McDowell
International Association of Fish and Wildlife Agencies
and New Jersey Division of Fish and Wildlife
Trenton

Welcome and Opening Statement

Rollin D. Sparrowe
Wildlife Management Institute
Washington, DC

Welcome to the 67th North American Wildlife and Natural Resources Conference. Our Opening Session theme, *Advancing The Cause of Conservation: Recharging San Juan Hill*?, has a historical ring by intent. This conference is the annual gathering of the professional management community responsible for the stewardship of wildlife, fish and other natural resources at the state, provincial and federal levels in North America. It is a forum to facilitate discussion and debate about important issues, ideas and developments affecting the future of fish and wildlife and their habitats. It is logical and prudent that such a dialogue consider what has gone before, regarding management of our natural resources and what we have or have not learned from past events.

Also this is the first conference in a new format–running during the week and ending on a weekend. As always, more than 150 meetings of committees, councils, working groups and management teams are going about the business of coordinating the conservation of America's habitats, fish and wildlife. This is your conference, for no other purpose than the exchange of information and ideas and, hopefully, as reflected in this plenary's theme, to advance the cause of conservation.

We last met in Dallas in 1960. In personal reflection, I was a year away from being handed my first copy of *Sand County Almanac* and from taking a course in which Aldo Leopold's text, *Game Management,* was a central focus. How simple life seemed in those days. There was no Endangered Species Act, no Land and Water Conservation Fund, no Wilderness Act, no National Environmental Policy Act, nor any of the wide range of laws and processes that since have been set up to steward our natural resources.

The Dallas venue was the year the name of this conference changed from the North American Wildlife Conference to the North American Wildlife and Natural Resources Conference, reflecting the broadening scope of the professional community's interests, problems and responsibilities. While, in 1960, there were technical sessions on depredations management, wetlands, field and farm game, and forest and range resources, there were also sessions focusing more broadly on whether the status of our natural resources met the needs of individuals, communities, fish and wildlife.

Major concerns then included strengthening the Federal Water Pollution Control Act, expanding the Soil Bank Conservation Reserve to 60 million acres and focusing on the threat to wildlife posed by pesticides. Congressional hearings had just been conducted on a proposed Wilderness Act.

A rancher from Oklahoma spoke passionately about his business of ranching and raising his family, and he noted painfully that his way of life seemed to be in conflict with the view of some about wildlife and recreation. A talk, entitled "America The Ugly," considered the effect of development, while others addressed how conservation helps business and industry and how important good conservation is to a sound economy.

These topics from the past bear striking resemblance to many current topics in all the countries of North America. The record from 40 years ago indicates that our professional horizon was expanding to try to encompass human as well as ecological dimensions of natural resource management. How well we have done in embracing both dimensions separately and jointly is a focus of this conference.

Much has been written about how our country, our world, has changed since that terrible day last September that none of us ever can forget. It had an immediate economic and psychological effect on our lives, and it has shifted dramatically priorities for the US government. In preparing his budget, President Bush has highlighted the war on terrorism, strengthening homeland protections, and revitalizing our economy and creating jobs. A renewed focus on government accountability is reflected in less money recommended for programs judged to be less effective or accountable, with more money recommended for those that seem to produce and for which accountability is apparent. Natural resource budgets have not appeared to be a high priority, but neither have they been dramatically reduced.

Many believe that we only have begun to see the effects on government budgets of the high cost of the war on terrorism, the changes in priorities and the shifting economy. This is true for Canada and Mexico, as well as the US. How should the professional fish and wildlife management community respond to this challenge? Clearly, we support meeting the needs of national defense and security. But, other values also are at stake. Long-term productivity of the soil, effective and efficient use of energy, and preserving functioning natural systems are more important to the future of all of North America at this time, not less so. At this difficult, maybe dangerous and certainly uncomfortable time in America, we must leave this conference having reaffirmed the reality that soil, water, air, forests, watersheds, wildlife and wild places are vital to the security and well-being of our continent. Those very arguments must continue to be voiced as the social, political and economic situation continues to reshuffle.

This year, we begin several celebrations of landmark conservation events. In September in Montana, the International Association of Fish and Wildlife Agencies and many of its partners will celebrate 100 years of coordinated, professional management of the fish and wildlife resources of North America. To open the celebration, the American Wildlife Conservation Partners– a new coalition of 35 organizations of hunter-conservationists–will host a reception on September 16, 2002. We will invite leading decision-makers to join us.

Since the first meeting of the International Association, in West Yellowstone 100 years ago, North America witnessed declines of many wildlife species during the first third of the century. In the 1930s, the conservation movement as we know it was in its infancy, and a progression of successful agency, nongovernmental and private landowner efforts restored and recovered many of those beleaguered wild species. Just as we have celebrated the success of programs to restore wildlife, the pace of human population growth–sprawl use of resources–has caught up with a whole array of other wildlife and led to the current onslaught of threatened and endangered species and their attendant problems. We must enter this celebration knowing there are new challenges that need new approaches to find solutions.

The Missouri Department of Conservation is celebrating 25 years of success in its landmark Design for Conservation Program that started in the 1970s. An evaluation of needs, a promise from that department to its citizens of what would be done and a resulting citizens' petition drive led to an eighth of 1 percent sales tax that has fueled broad fish, wildlife, habitat, education and recreation programs for the state. Missouri has sustained its public support and funding by regular reporting on progress toward its goals. The Design for Conservation has shown conclusively that a state fish and wildlife agency can deliver the programs needed to conserve all wildlife, enhance hunting and fishing traditions, and meet the diverse and dynamic needs of its constituents.

Missouri has shown what can be done with the right thinking, conviction, planning, accountability and application of science-based management fueled by more dollars to spend. A recent report by the International Association on state agency programs highlights the continuing need for a stable, long-term funding source to expand agency programs to deal with all fish and wildlife and their habitats. Nationally, the Conservation and Reinvestment Act (CARA) is still on the table, and conservationists recently met for a celebration on Capitol Hill to let decision makers know that CARA is alive and well, and we mean to see it through to completion.

Congress has provided new funds through appropriations for the second year in a row for grants to the states. Now, the challenge for the state wildlife agencies is to use that funding wisely to conduct projects that further demonstrate the need for a more comprehensive and stable approach to funding wildlife in America. While we appreciate the appropriation of significant new grant money, funding year-by-year cannot pay for fundamental staffing and infrastructure needed to develop programs of a long-term nature to conserve our natural resources, prevent the disruption of endangered species listings and meet the national priorities.

The first meeting of the National Wildlife Refuge Centennial Commission (Commission) occurred in March, launching an effort directed by the Congress (in the National Wildlife Refuge Centennial Act [Act] of 2000) to plan for the future of the Refuge System. While the celebration of the 100th anniversary of national wildlife refuges in the US is a vital step in providing the visibility they need, the centennial is a bigger opportunity than just an anniversary.

The Commission can utilize the resources of the Cooperative Alliance for Refuge Enhancement (CARE)–a diverse array of 20 organizations that has worked for more than seven years to evaluate, analyze and propose how to meet the needs for operations and maintenance of the refuge system. The work of this coalition with the US Fish and Wildlife Service (Service) and the Congress has led to greater accountability for the use of new funds provided in recent years. That accountability netted a strong proposal from the Bush Administration for $57 million in the fiscal year 2003 budget to meet operational and maintenance needs. This is a big help to CARE and a receptive Congress in making the case to put US national refuges on a sound footing for the future.

But, there is more to the story. The Act calls for an assessment by the Service of the needs for the Refuge System. With that assessment, and the foundation laid by CARE, the Commission has a unique opportunity to provide national focus on the needs of the Refuge System. Finding long-term solutions to these needs offers a bipartisan opportunity to the Administration and Congress for strong action that will bring them credit. We should demand nothing less.

Many at this conference have worked for a significant part of their career toward the current, strong conservation programs in the Farm Bill. Coming off the huge success in 1996 of elevating fish and wildlife to coequal status with soil and water conservation, thus involving fish and wildlife in the expenditure of billions of dollars on the land, the current revision of the Farm Bill offers promise for further strong steps for conservation. The current legislation awaiting agreement between the Senate and the House is the product of unusual efforts to bring differing interests together to work toward common goals. The fish and wildlife conservation community began almost three years ago, holding workshops, focus groups and private sessions with the agricultural community, looking for common ground. Coalitions with agriculture have formed in Washington, DC, and have been energized at the state level, while the dialogue has ebbed and flowed. The fish and wildlife community developed a consistent, reasonable platform of needs for habitats, based on documentation of the benefits of such popular programs as the Conservation Reserve, Wetland Reserve, Wildlife Habitat Incentives Program and a new Grassland Reserve. Positive funding is proposed in both House and Senate versions, and we are hopeful that the outcome will remain strongly positive for fish and wildlife.

A program approach, rather than a reactive approach, is the wave of the future for conservationists pursuing their goals, whether for the Farm Bill or other activities. In this case, working together enabled 29 fish and wildlife organizations to testify with one voice to the Congress last year in the early stages of formulating this new farm policy. The power of such unity is not lost on any of us. Now, we face the challenge of prompt and effective implementation of programs once Congress has done its work. We need close communication between state and federal agencies and nongovernment interests capable and willing to deliver programs on the ground. Wildlife and agriculture have a common stake in the outcome and must continue to work together. We need evaluation and monitoring of programs to assess how well they are working, and we require adaptive management processes to allow adjustment of programs as needed. The challenge is much larger than simply passing a bill with money and good provisions. Now, we really have to make it work.

Energy and wildlife are the focus of a session at this conference. We have all watched with interest and concern the current frenzy to accelerate energy production. Recent attention has been drawn to similar controversy in the Canadian Rockies and northern boreal forest. Last year, Congress conducted over 40 hearings during spring and summer on the topic of energy, with little or no attention to impacts on fish and wildlife and other renewable natural resources. There now is great public outcry over who was invited to the table to formulate the National Energy Plan proposed by the President. There has been virtually no dialogue with fish and wildlife professionals on this until recently, when the White House Energy Task Force, the Council on Environmental Quality and officials at the Department of Interior finally began to listen to our concerns about the impacts of ongoing and proposed energy development on fish and wildlife.

The basic position of fish and wildlife organizations has been clear–we want a seat at the table. While a major study is underway (and results are expected soon) to examine impediments to energy development on public lands, we propose equal time and resources for study of impediments to conservation and stewardship of our fish and wildlife resources. Further, we think it inappropriate and unfair that dollars from hunter and angler license and excise taxes are having to bear the cost of coping with energy development. Dealing fairly with fish and wildlife should be a cost of doing business to supply the country's energy. Funding should come from oil and gas revenues, not America's hunters and anglers, and we look for help from the current Administration to make this happen.

A modest proposal–let development of energy resources on public lands proceed with as much care and with the same kind of constraints on timing, levels of activity and pace of development that are required for energy extraction here in Texas on private lands. I suspect that we would be much happier with that kind of deal than what is presently occurring and being planned on the public lands in America.

The current rage in the politics of government is local decision-making. Whether for the 29 fast-track Bureau of Land Management (BLM) Resource Management Plan revisions designed to remove impediments to drilling, or the more than 30 forest management plans in progress, or hundreds of comprehensive conservation plans for national wildlife refuges–fish and wildlife interests and the public have been handed their own unfunded mandate. We are expected to be able to stop our lives and be present locally to protect our interests. That will not be easy–the total number of planning exercises combined for individual wildlife refuges, forests and resource management areas will be well in excess of 500 in the next decade.

We expect our fellow professionals in the agencies to be champions for fish and wildlife also. Our laws proscribe equal responsibility by our public land agencies to assure sound stewardship of renewable natural resources (fish, wildlife and their habitats) as well as maximum recovery of mineral resources. It is just plain hard to see how an agency can do that when they have been given orders to assess impediments, make plans to remove them, find all possible ways to speed up permitting and (by the way) obey all other laws. New money is coming to help agencies expedite resource planning to remove impediments, but there is no mention of restoring habitats or directly managing wildlife. Is this a train wreck in progress or a moving train that we can still board? We offer our hand to help our colleagues find the solution.

This conference, and modern fish, wildlife and natural resource management, is based on science. The credibility of science is the foundation on which difficult decisions are made in striking a balance between development and preservation of our national heritage. Recent publicity about scientists tampering with samples has raised a cacophony in the media and in Congress. Clearly, it appears that misguided, ill-advised and maybe even unethical actions were taken. Investigations still are underway to determine whether this tampering with a scientific process changed decisions about management of specific lands. Yet, members of Congress and the media are having a field day, being quoted in self-righteous, conclusive ways about what happened and how it has affected innocent people.

This comes at a time when unpopular decisions give rise to administrative, political and legislative responses that may diminish the role of science in management. Peer review seems to mean "if I don't like your conclusions, I want my scientists to review it." There are clear issues concerning the welfare of natural resources that could keep Congress and others so interested in science quite busy. Stop subsidizing marginal barge traffic on the lower Missouri River, restore normal flows, and gain huge economic and social benefits. Deny attempts to subsidize irrigation along the White River in Arkansas to produce more surplus crops at the expense of future water supplies, fish and wildlife. The science and the economics are clear in both cases and the Administration and Congress have a chance to perform on the careful use of facts. Cooler heads must prevail and wait for facts on which to form judgments and appropriate response. It is such wisdom and actions that will continue to advance the cause of conservation, which is our history and our future.

Lessons from History: The Conservation Legacy of Theodore Roosevelt

John F. Reiger
Ohio University
Chillicothe

In the process of researching the expanded edition of my *American Sportsmen and the Origins of Conservation*, published in 2001,[1] I was struck by how academic historians had oversimplified the motivations and philosophy of Theodore Roosevelt, who served as President between 1901 and 1909 and who brought more land under federal protection than any other conservationist in the history of the United States. If scholars at colleges and universities who had studied Roosevelt had trouble understanding him, one might assume that their students would have had even more difficulty comprehending the legacy of this central figure from our past. The depressing truth is that most college students today probably know little or nothing about Roosevelt, and they care even less.

With the decline in the last thirty years in what it means to be a college-educated person, none of the supposedly top schools of the United States require even one American history course. As reported by the *Wall Street Journal* on November 23, 2001, a recent study found that only 34 percent of graduating seniors from institutions like Yale and Duke knew that George Washington was the commanding general at Yorktown, the 1781 battle that ended the American Revolution and made the creation of the United States possible. Slightly more, 37 percent, thought that Ulysses S. Grant, a general from that other unpleasantness of the 1860s, was the officer in charge in 1781!

If Americans with supposedly the best educations available grasp very little about the key figures and events in our general history, imagine what little they, and the public at large, know about the more focused subject of "environmental history," the study of human interaction with the natural world over time. It is that area of American history that I believe has special significance for those working in the field of wildlife and natural resource management. This presentation will attempt to show why it is so important for contemporary conservationists to appreciate and understand the useful legacy of those kindred spirits who came before us. Of these early wildlife-advocates who have lessons to teach if we are ready to listen, none is more relevant today than Theodore Roosevelt. He shows us that a Republican President can lead his party successfully, while being a dedicated conservationist who would save large components of the natural world for generations yet unborn.

Actually, Roosevelt was not the first Republican President to play a key roll in preserving and managing–conserving–"natural resources," using that term in its broadest sense. Benjamin Harrison, who occupied the White House between 1889 and 1893, established what some scholars believe was the first national wildlife refuge and the first federal wilderness area, as well as the original national forest, part of a system today that totals about 192 million acres.[2]

As my book points out, Harrison and Roosevelt shared more than their membership in the Republican party. They were also self-styled "sportsmen," individuals of the upper classes who hunted and fished primarily for recreation, rather than commerce or necessity. These sportsmen-conservationists differentiated themselves from countless others who hunted and fished by their commitment to saving wildlife and habitat for the future, a dedication that often brought them into conflict with other Americans who seemed–at least to the sportsmen–to be only interested in the immediate, and complete, exploitation of all facets of the natural world.

This eagerness to perpetuate the traditions of sport hunting and fishing, and the context in which they took place, led sportspeople to found national newspapers emphasizing conservation issues, to establish organizations of like-minded individuals for protecting wildlife, including fishes, and to lobby state legislatures, and finally Congress, for the passage of laws to force all hunters and fishermen to accept the "code of the sportsman" as the only correct way to pursue game.

The development of this self-imposed, European-derived code meant that a sportsman should adopt a kind of contract with his quarry. Eventually, this one-sided agreement would mean that game should not be killed in the breeding season or sold for profit, that it should be taken only in reasonable numbers, without waste, and it should be pursued solely by sporting methods. The individual fish, bird or mammal was to have a "fair chance" of escape, even though its capture was made more doubtful as a result. Sportsmen came to condemn fishing for trout with worms instead of artificial flies, shooting at ducks on the water before they could take flight, or hunting white-tailed deer on snowshoes when the animals were mired down in deep drifts. In other words, a "true sportsman" of the upper classes came to see himself as superior to the great majority of hunters and fishermen at least partly because of the generous spirit he supposedly manifested toward the game.

To many today, the fact that so many of the early sportsmen-conservationists came from privileged backgrounds may offend our egalitarian sensibilities. Roosevelt, his good friend, George Bird Grinnell, editor of the outdoor weekly, *Forest and Stream*,[3] and Gifford Pinchot, Roosevelt's Chief Forester after he became President, all came from a group of Americans who have been called "patricians," the old upper class. Like their namesakes in ancient Rome, they had been socialized from early childhood to believe in themselves as leaders, and as stewards of the well-being of those beneath them on the socioeconomic ladder.

Instead of spending their lives in self-indulgence, as so many of equal wealth have done before and since, they chose to give up a large portion of their adult lives to public service. In so doing, they became models for their own time–and for ours.

It was at least partly because of his American version of *noblesse oblige*, or "noble obligation," to improve society for those who lacked the wealth, education, and social standing to improve it themselves, that Roosevelt decided to enter politics. As a young member of the New York legislature, he had taken an interest in the creation of the Adirondack Forest Preserve in 1885, but it was not until after he became involved in a crusade to give adequate protection to the neglected Yellowstone National Park, created merely on paper in 1872, that he initiated his career as an active conservationist. George Bird Grinnell was the man most responsible for bringing about this involvement, the genesis of which was a book review in *Forest and Stream* of Roosevelt's *Hunting Trips of a Ranchman*, published in 1885.

Although Grinnell had some favorable things to say about Roosevelt's volume on his early ranching experience in the West, the reviewer's overall tone was negative. Not surprisingly, the publication of the critique on July 2, 1885 brought an irate Roosevelt to Grinnell's office in New York. The editor must have made a strong case, for as he recalled later, Roosevelt "at once saw my point of view."[4] More importantly, this was the beginning of a life-long friendship between the two men and the first of many discussions during which Grinnell urged Roosevelt to join his campaign against the market hunters in the West, who were even inside Yellowstone National Park slaughtering big game like elk and deer for the commercial hide market.

For years, even before meeting Roosevelt, Grinnell had been demanding in his *Forest and Stream* editorials that a truly national sportsmen's association, one committed to passing and enforcing laws to preserve game and habitat, must be established. The founding of the Boone and Crockett Club in 1887 by Roosevelt, Grinnell, and other prominent sportsmen was the result of this thinking. After Grinnell became intimately associated with Roosevelt, he personally emphasized the need for an effective sportsmen's society, to do for the larger mammals what the Audubon Society–founded by Grinnell in 1886–was doing for birds. Roosevelt agreed.[5] The Boone and Crockett Club, named after two of America's most famous hunters, played an all-important role in the creation and administration of the first national parks, forest reserves, and wildlife refuges. In addition, "those Halcyon Days," as Roosevelt called the early Boone and Crockett period,[6] were the formative years of his development as the future leader of the conservation movement.

With its interest in the preservation of big game, the Club soon turned its attention to Yellowstone National Park. When that book review brought Grinnell and Roosevelt together, the editor of *Forest and Stream* had already spent several years in crusading for the reserve. There was still no real administrative structure for the park, however, and individuals continued to kill the wildlife, cut down trees, break out the geyserite mineral formations, and attempt to establish private concessions around the leading attractions like Yellowstone Falls and Old Faithful.

Describing his early relationship with Roosevelt, Grinnell later recalled that "the original attempt by a certain group of men to secure for their own profit control of all the important attractions of the park had been defeated before I knew him well, but as soon as he understood about the conditions in Yellowstone Park, he gave time and thought to considering its protection."[7] It would not be long before Roosevelt joined Grinnell and other members of the Boone and Crockett Club in actively working to establish a "government" for the park. By April, 1890, Grinnell was able to write Hart Lyman, an editor of the *New York Tribune*, that Roosevelt could now be counted among the reserve's most enthusiastic defenders. Like the handful of other guardians, Grinnell believed that Roosevelt had no other "motive in this matter, except the proper preservation of the Park."[8]

Despite the best efforts of Grinnell, Roosevelt and other members of the Boone and Crockett Club, the year 1892 still found them unable to pass adequate protective legislation for Yellowstone. Particularly powerful was a railroad lobby that at first wanted to build a railway across the park. But, because those who were pushing for the right of way had been effectively blocked on the grounds that a line through the park would be an infringement on its "integrity," they now reasoned that the perfect solution to the dilemma was to have the area in question cut off from the rest of the preserve and returned to the public domain. Legislation known as the "segregation bill" was introduced into Congress to accomplish that end. If passed, it would have removed 622 square miles from the northeastern portion of the park. When Grinnell published his *Forest and Stream* editorial, "A Standing Menace," on December 8, which attacked this new threat by the railway backers, that included mining interests and real-estate speculators, the paper followed it the next week with supporting letters from several park defenders, including Roosevelt.[9] Despite Grinnell's solicitation of the letters, they were presented to the public as a spontaneous response to his editorial.

Roosevelt's letter in *Forest and Stream*, dated December 5, 1892, is noteworthy because it shows that he was already thoroughly committed to the idea that natural treasures like the Yellowstone region should be preserved for all Americans and their descendants, and not handed over to a minority only interested in commercial exploitation and personal aggrandizement. He stated: "I have just read the article 'A Standing Menace,' printed in the *Forest and Stream*, in reference to the attempts made to destroy the National Park....I heartily agree with this article. It is of the utmost importance that the Park shall be kept in its present form as a great forestry preserve and a National pleasure ground, the like of which is not to be found on any other continent than ours; and all public-spirited Americans should join with *Forest and Stream* in the effort to prevent the greed of a little group of speculators, careless of everything save their own selfish interests, from doing the damage they threaten to the whole people of the United States, by wrecking the Yellowstone National Park. So far from having this Park cut down, it should be extended, and legislation adopted which would enable the military authorities who now have charge of it to administer it solely in the interests of the whole public, and to punish in the most vigorous way people who trespass upon it. The Yellowstone Park is a great park for the people, and the representatives of the people should see that it is molested in no way."[10]

After years of campaigning to protect America's first national park and, in fact, define what a national park should be, Yellowstone's defenders finally achieved victory after a bison poacher was caught inside the reserve killing some of the very last of this species on earth. A combination of a behind-the-scenes lobbying effort by the Boone and Crockett Club and a *Forest and Stream* editorial barrage that included photographs of slain buffalo in the snow resulted in the passage of the "Act to Protect the Birds and Animals in Yellowstone National Park," signed by President Grover Cleveland, on May 7, 1894.

From this discussion, it should be clear that many of the ideas that Roosevelt made national policy after he became President originated in the fertile mind of George Bird Grinnell, *Forest and Stream*'s editor and Roosevelt's fellow Boone and Crockett Club member, friend and adviser. In fact, a phrase that the Roosevelt administration would become famous for can be found in a *Forest and Stream* editorial of January 26, 1882, entitled, "We, the People." In calling the leaders of the state legislatures to push for "the conservation of our game and fish," Grinnell argued that, "laws prohibiting the destruction of game in its breeding season and of fish on their spawning grounds are not for the advantage of any narrow class or clique," but "are for the good of us, the people." Conservation, like all governmental policy, Grinnell exhorted, should be for "the greatest good to the greatest number."

To point out that Roosevelt took Grinnell's ideas and incorporated them into his evolving conservation creed in no way diminishes the central place Roosevelt holds in American environmental history. When it came to reform, Roosevelt prided himself on being a "doer," a man of action. Grinnell, on the other hand, was a creator and amalgamator of ideas, who, as James B. Trefethen of the Wildlife Management Institute once observed, "was a pusher rather than a leader, working behind the scenes and quietly steering the energies of more active public officials into constructive channels."[11]

As a political figure who needed to remain popular in order to stay in office, Roosevelt's job was, of course, much harder than Grinnell's. As a journalist, the latter's career was not dependent on making politically appealing public statements and developing politically acceptable agendas. In one sense, he could afford to make declarations based on pure principle and ignore the need for political expediency. American politicians, including Theodore Roosevelt, have never enjoyed this freedom.

After Roosevelt became President, his administration established five national parks, 18 national monumentss and 51 national wildlife refuges, but its focal point was the forest, as the most all-inclusive, practical issue in conservation. In a nation overwhelmingly utilitarian in its outlook, the only political approach he and Gifford Pinchot could take was to claim that the forests were being preserved and managed in order to protect watersheds and ensure a never-ending supply of building materials. To do anything else would have courted political defeat for the whole conservation program, particularly in the fiercely democratic West, where the administration's new forests were set aside.

In 1913, the former President related the frustrations he had experienced in office to his cousin Nicholas, who recalled that Roosevelt complained that "whenever as President he sought to withdraw lands on the public domain,...he was met by prompt and vigorous opposition from the lobbyists of...the lumber, mining and grazing interests,...[and] these lobbyists brought pressure to bear on state and local politicians, and saw to it that public opposition was loud and effective."[12] Yet, Roosevelt knew that, while vast tracts of timberland were being preserved–he set aside over 148 million acres–the big game he cherished so much would also find relief from uncontrolled hunting and habitat destruction, and he was right. Outside of Yellowstone and Glacier National Parks, the majority of Western woodland mammals south of Canada still live in the "national forests," as the forest reserves were called after 1907.

Following in the tradition of Samuel P. Hays, most historians stress the utilitarian objectives of Roosevelt and ignore the aesthetic side of his personality. For example, Roosevelt wrote to ornithologist, Frank M. Chapman, in 1899: "How immensely it would add to our forests if the great Logcock [the ivory-billed woodpecker] were still found among them! The destruction of the Wild Pigeon [Passenger Pigeon] and the Carolina Paroquet [Parakeet] has meant a loss as severe as if the Catskills [New York mountain range] or the Palisades [Hudson River cliffs] were taken away. When I hear of the destruction of a species, I feel just as if the works of some great writer had perished, as if we had lost all instead of only part of Polybius or Livy [ancient historians]."[13] To preserve the species, at least in museums, Chapman had collected one of the last ivory-bills in Florida in 1890, and he later worked with Roosevelt to establish the national wildlife refuge system to save egrets, ibises and other nongame species threatened with extinction.[14]

Another example of Roosevelt's concern for the total environment–for aesthetic as well as utilitarian conservation–is his statement, in 1903, regarding the need to protect the giant sequoias of California: "There is nothing more practical in the end than the preservation of beauty, than the preservation of anything that appeals to the higher emotions of mankind."[15] As in the case of the national forests, where he set aside many millions of acres and established the US Forest Service to administer these lands despite the howls of protest from Western Congressmen, Roosevelt translated his love of beauty into concrete action and achievement.

Welcoming the legislative leadership of another Republican, Iowa Congressman John F. Lacey, who was responsible for a number of the key laws of the early conservation movement and who publically stated that his conservation commitment was based on the code of the sportsman,[16] Roosevelt signed the Antiquities Act on June 8, 1906. Designed originally to protect spectacular archaeological sites, like Colorado's Mesa Verde and New Mexico's Chaco Canyon, from being damaged by looters seeking valuable artifacts to sell, the law quickly became an opportunity for Roosevelt to save other places that appealed to his aesthetic sensibilities. Applying the "object of scientific interest" clause of the Antiquities Act in the widest possible fashion, he proclaimed the Grand Canyon National Monument, in Arizona, in 1908 and the Mount Olympus National Monument, in Washington, in 1909.[17] Both would become the cores of great national parks.

The main reason Roosevelt established the Grand Canyon National Monument, aside from the fact that he "was awestruck by the sight of the gorge," was his desire, "to preserve the character of the Grand Canyon from the intrusion of the cable car," by putting "limits on all growth there."[18] As we have seen, he learned the importance of keeping natural areas natural in 1890, when he joined George Bird Grinnell's crusade to exclude railroads and other forms of destructive human activity from Yellowstone National Park.

During the same fight, Roosevelt worked to protect the bison and other big-game species from being killed by commercial hunters. This would again be a prime reason for him setting aside Mount Olympus National Monument, which, in addition to its beauty, contained a threatened herd of a subspecies of elk, named the Roosevelt elk, in 1897, by prominent mammologist and sportsman, C. Hart Merriam.[19] At the time, Merriam thought that the animal he discovered was a full species, and as an admirer of Roosevelt's books on natural history and hunting, he believed that "it is fitting that the noblest deer of America should perpetuate the name of one who, in the midst of a busy public career, has found time to study our larger animals in their native haunts and has written the best accounts we have ever had of their habits and chase."[20]

Using the well-known antagonism between philosopher John Muir and forester Gifford Pinchot as their model, some historians insist upon categorizing every environmental activist as either a "preservationist" (like Muir) or a "conservationist" (like Pinchot). While this dichotomy may apply in some cases, a true conservationist, like Roosevelt knew that natural resources–again using that term in its broadest sense–must be conserved under a variety of administrative schemes. He would fight just as hard for the scientific utilization of national forests as for the preservation of natural conditions in national parks.[21] And, like his friend and adviser, George Bird Grinnell, Roosevelt would continue to love to hunt, while at the same time campaigning for the establishment of wildlife sanctuaries. Neither man felt any inconsistency in his position because there was none. They knew that one had to be *both* an aesthetic conservationist and a utilitarian conservationist, depending on the issue involved. The "wise use of natural resources," a phrase the Roosevelt administration would come to popularize, meant that every unit in the conservation program–from national forests to national wildlife refuges–benefitted from continuous, scientific, apolitical management. And "management," of course, could mean no public use at all, if the area in question was one of special ecological concern.

As a result of this thinking, Roosevelt would almost certainly have opposed oil drilling on the coastal plain of the Arctic National Wildlife Refuge, a key component of an ecosystem that contains some of his favorite big-game species, like barren-ground caribou and polar bears. In a similar vein, I have no doubt that he would have supported keeping large portions of the national forests roadless and wild, in order that contemporary Americans could share the wilderness experience that had been such an important part of his life.

It is clear that the conservation legacy of Roosevelt contains at least two parts. First, there is the gift of the land itself, the tens of millions of acres that he brought under federal protection. Second, there is the administrative philosophy, and structure, his presidency created to preserve and manage that land.

But there is another dimension to Roosevelt's legacy, which, like the protected lands he left behind, continues to benefit us, and those who will follow us. For, Roosevelt is an excellent role model for those working in the field of wildlife and natural resource conservation.

The proof of that statement is the large number of Americans Roosevelt has inspired over the years. These include everyone from presidents like Roosevelt's cousin, Franklin, John Kennedy and Bill Clinton to ordinary citizens like myself[22] and the members of the Theodore Roosevelt Conservation Alliance (TRCA), a national advocacy organization that seeks to "motivate hunters and anglers to positively influence the future of our 192 million-acre National Forest system."[23] The TRCA website contains a likeness of Roosevelt and quotes his visionary statement that "We are not building this country of ours for a day. It is to last through the ages."[24]

Roosevelt even inspired Aldo Leopold, author of the classic *A Sand County Almanac*, who is considered the father of the American land ethic. In *Game Management*, published in 1933, Leopold applauded the coming of "the Rooseveltian era," which brought "the Crusader for conservation...who insisted that our conquest of nature carried with it a moral responsibility for the perpetuation of...threatened forms of wildlife," and, by implication, the habitats upon which they depend. This acceptance of responsibility, Leopold believed, "constitutes one of the milestones in moral evolution."[25]

Given the huge conservation legacy that he left to the nation, would Theodore Roosevelt–if he could give us his opinion–be content with how that bequest is being used by today's political leaders? I think we all know the answer to that question! The present emphasis given by some of these individuals to the "bottom line" and the immediate, economic exploitation of the public's natural heritage would have filled him with moral outrage. And, if we are willing to listen, we can even hear him calling to us to heed the lessons of history and restore the balance between the aesthetic and utilitarian conservation of lands held in trust for all Americans and their descendants.

Endnotes

1. The book, published by Oregon State University Press in Corvallis, contains a more detailed discussion of many of the points raised in this paper. Portions of this presentation have already appeared in the book and are used here with the permission of the publisher.
2. The actual figure is between 191 and 192 million acres and usually includes National Grasslands that have only a small number of trees.
3. This newspaper has no connection to the contemporary magazine, *Field & Stream*.

4. George Bird Grinnell, "Introduction," in *The Works of Theodore Roosevelt* (National Edition, New York, 1926), I, p. xv.
5. George Bird Grinnell to T. E. Hofer, January 15, 1919, Letter Book, p. 269, Grinnell Papers, Yale University.
6. John W. Noble to George Bird Grinnell, March 15, 1910, Grinnell Papers, Yale University.
7. Grinnell, "Introduction," in *The Works of Theodore Roosevelt* (National Edition), I, p. xxiii.
8. Grinnell to Lyman, April 23, 1890, Letter Book, p. 289, Grinnell Papers, Yale University.
9. "A Standing Menace," *Forest and Stream*, December 8, 1892, XXXIX, p. 485, and "A Standing Menace," ibid., December 15, 1892, XXXIX, p. 514.
10. Ibid.
11. Letter of James B. Trefethen to the author, October 23, 1967.
12. Nicholas Roosevelt, *Conservation: Now or Never* (New York, 1970), p. 9.
13. Quoted in Frank M. Chapman, *Autobiography of a Bird-Lover* (New York, 1935), p. 181.; first published in 1933.
14. Paul Russell Cutright, *Theodore Roosevelt: The Making of a Conservationist* (Urbana, Illinois, 1985), p. 223.
15. Quoted in John Ise, *Our National Park Policy: A Critical History* (Baltimore, 1961), p. 109.
16. John F. Lacey, "Let Us Save the Birds: Speech of Hon. John F. Lacey in the House of Representatives," *Recreation*, XIII (July, 1900), p. 33.
17. Hal Rothman, *Preserving Different Pasts: The American National Monuments* (Urbana, Illinois, 1989), pp. 69-70 and 234.
18. Ibid., p. 70.
19. Ibid., p. 68. Copyright, Theodore Roosevelt, p. 195.
20. Quoted in *ibid.*
21. Some might claim that Roosevelt's reluctance, as President, to take a stand against the damming of Hetch Hetchy Valley, in Yosemite National Park, was an example of backsliding on his commitment to aesthetic conservation. But, his ambivalence on this issue had much to do with a desire not to alienate the residents of nearby San Francisco, whose goodwill he deemed necessary to their future support of the park. The great majority of San Franciscans seemed to want the reservoir in Hetch Hetchy, as a more secure water supply than had existed before the recent (1906) earthquake. After all, it had been the bursting water and gas lines, with the resulting fires, that had caused most of the loss of life and property. For a balanced analysis of Roosevelt's ambivalence about the proposal to dam Hetch Hetchy, see Char Miller, *Gifford Pinchot and the Making of Modern Environmentalism* (Washington, DC, 2001), pp. 138-141 and 169-174.

22. Roosevelt was one of the primary inspirations for my leaving a tenured professorship for a five-year term as Executive Director of the Connecticut Audubon Society— in order to try to make a difference myself in the "real world" of environmental decision-making. See the second essay in John F. Reiger, *"Gifford Pinchot with Rod and Reel"/"Trading Places: From Historian to Environmental Activist:" Two Essays in Conservation History* (Milford, Pennsylvania, 1994).
23. Theodore Roosevelt Conservation Alliance, *Welcome to the TRCA!*, November 7, 2001, from http://www.trca.org/.
24. *Ibid.*
25. Aldo Leopold, *Game Management* (Madison, Wisconsin, 1986), p. 19.; first published in 1933.

Federally Owned Rangelands: Are There New Grounds for Common Ground?

Mark Rey
US Department of Agriculture
Washington, DC

I would like to thank the Wildlife Management Institute for providing me the opportunity to speak today about a subject that has become increasingly contentious over the past several years–the stewardship of America's federally owned-rangelands. I believe that you are an excellent test audience for what some will consider revisionist thinking.

While conflict is not a preferred state for humans, it is, nevertheless, not unusual on the range. Indeed, the range wars of the late 1800s and early 1900s are an important part of American folklore and the western identity.

Today, we have recreated the range wars, using less violent, twenty-first century means, but involving equally passionate views and similarly implacable foes. While some advocates vigorously defend a historic land use, others argue with increasing vehemence for sharp reductions–or even a complete cessation–of such uses, dismissing an entire lifestyle as nihilistic. In the face of such apparently intractable antagonism, some have predicted, with unseemly enthusiasm, the eventual sunset of federal land grazing. Others have advanced the seemingly enlightened idea of buying federal grazing leases as a better approach to improving publicly-owned range habitats.

In my short time as a political appointee responsible for federal range management, I have enjoyed some–and endured many–agency briefings. These briefings typically begin with exposition, followed by a series of findings with conclusions based upon those findings. The process ends with a recommendation with which any responsible person would have little choice but to agree. The inevitability of the process is often enhanced by two or three interruptive phone calls on unrelated subjects and a handy memorandum with an empty box in need of a check-mark.

Over the past few months, I have, with increasing frequency, come to rely upon the use of a single, simple question as a talisman to resist the hypnotically directed impulse to check the box for option 1. This simple question is: "OK, and then what?" What will happen after we set forth on the recommended–actually, the only logical, no, the surely inevitable–course of action?

As we visit today, many of us have either mentally, figuratively or literally checked the box, pointing toward sharp reductions in federal land grazing. The Forest Service may check the box in the Northern Great Plains National Grasslands. The Defense Department seems to check it here in Texas at Fort Hood.

OK, and then what? Well, the direct answer, as the memos clearly point out, is that we can expect improved federal rangeland conditions with concomitant wildlife benefits. It should be obvious. But, the intellectual elegance of asking "and then what" is that the obvious answer usually begs the next, most important questions: What are we giving up, what are we gaining in return and, if we are not satisfied, is there a better way? With your indulgence, I would like to explore these three questions.

What Are We Giving Up?

The new range wars have been fought with lawsuits rather than Winchesters. Hoofed animals still perish. But now-a-days, they are sacrificed to make the briefcases needed by the lawyers who file these lawsuits. Some of the lawsuits are from ranching interests, but they are mostly from those who argue for a cattle-free range.

This ongoing conflict has obscured the fact that grazing is, perhaps, the most fundamental and historic of the multiple uses mandated by law for the federal lands, including the national forests. Most people do not realize that range was far more important than timber for the early US Forest Service.

Ranch families and Forest Service families have shared the same communities for almost five generations. Many of the ranch families were there first. When the Forest Service came into the country in 1905, we depended upon the cooperation of local ranching communities. The works of a number of western writers vividly illustrate the early cooperation between ranchers and the Forest Service.

For example, the Montana writer, Ivan Doig, argues for the rightness of the national forests through the fictional words of an early homesteader. In his seminal work, *Dancing at the Rascal Fair* (1996), a sympathetic homesteader observes that, "the national forest was actually the pattern of homesteading, the weave of the land and utility, writ large: lives of logic laid upon the earth, toward the pattern of America. A quilt piece of mountains and grass and water to join our work-worn squares of homestead. The next necessary sum in trying to keep humankind's ledger orderly."

Today, the Forest Service manages about 75 million acres of rangeland. That is 40 percent of the National Forest System. In 2000, there were 7,494 permitees on the national forests and grasslands, which includes about 25 percent of the roughly 20,000 small ranchers in the West. In 2000, our permitees grazed almost 2.2 million animals, including cattle, horses, burros, sheep and goats.[1]

In recent years, however, we have lost some of the connection between ranch families and Forest Service families. We will continue to lose more of it as litigation becomes our principal means of dialogue. Unfortunately, the public grazing issue is fast becoming to the livestock industry what the spotted owl was to the timber industry. Can we learn from that and do better, or is this a desirable outcome? Worse yet, is it an inevitable process?

What Are We Getting in Return?

That brings me to my second question: What are we getting in return? Unfortunately, the smoke from the public grazing issue has blinded many people to, what I consider to be, the most important environmental issues facing the West. That issues are urban sprawl and new development.

The West is the fastest growing and most urbanized region of the country. According to the last census, the top five states in terms of percentage growth in population from 1990 to 2000 are Nevada at 66.3 percent, Arizona at 40.0 percent, Colorado at 30.6 percent, Utah at 29.6 percent and Idaho at 28.5 percent. Also, more people in the West live in urban areas than in any other region. The West is also the region of the country with the largest percentage of public lands. Consequently, development pressure is concentrated on a relatively small portion of the available land base. The heavily targeted lands are flat and well watered–in other words, private ranchlands.

Studies have shown that most family ranchers want to stay on the land, but gradually are forced to sell. From 1982 to 1997, more than 3.2 million acres of rangeland were developed for condos and ranchettes.[2] This fact has not garnered a lot of attention or concern. By contrast, entry into inventoried roadless areas, which have been released by state wilderness bills and which have certainly gathered attention, concern and controversy, has only totaled approximately 2.8 million acres during the same time frame. The pressure on ranchers to sell has been documented by Paul Rogers, a Pulitzer Prize winning reporter with the *San Jose Mercury News*. As Rogers states, "mounting debts, drought, and environmental lawsuits have taken a relentless toll on the roughly 20,000 small ranchers in the West.[3] From 1988 to 1999, the number of ranchers leasing lands managed by the Forest Service and the Bureau of Land Management dropped by 19 percent.

The exurban growth into the wildland or urban interface–translation: the conversion of ranches into subdivisions–is a critical concern, which is driving a number of environmental and land management problems, including wildland fire policy, water rights conflicts and water quality degradation. The issue that concerns the most people here, though, is wildlife. So, let us talk about that. The subdivided ranchland often contains critical habitat used by many species. For example, large animals, such as elk, use national forest lands in the summer and migrate to lower elevations in the fall. They need private rangeland at lower elevations to survive harsh winter conditions.

As ranchers are forced to sell, the winter range for wildlife is being fragmented and lost. The net effect is that we lose habitat needed to maintain viable populations of native wildlife. But, large ungulates are just one example. As ranches turn into ranchettes, as rural subdivisions erupt across the West, many native species are declining and being replaced by species adapted to human habitations. One scientist who has studied the problem is Richard Knight, a wildlife conservationist at Colorado State University. He states: "Rather than lark buntings and bobcats, we will have starlings and skunks. Rather than rattlesnakes and warblers, we will have garter snakes and robins. Is that the West we want?"[4]

I think the answer is no. I think most Americans want to conserve our heritage of the West. Americans want to conserve native species, but they also want to conserve the tradition of family ranching. They do not want to force people off the land, giving them nowhere to go and no hope for the future. We need to conserve our western wildlife and our western lifestyle. Both are part of what it means to be American.

Is There a Better Way?

That statement brings me to my third question: Is there a better way? I believe that the greatest environmental contribution I can make is to foster initiatives that keep private ranchlands in ranch family hands and out of developers' plans. Fortunately, I oversee two agencies that can contribute to that objective.

Natural Resources Conservation Service Initiatives

With the Farm Bill now before Congress, the Natural Resources Conservation Service will have increased opportunities and resources to do a couple of things, which are important to the objective of keeping private ranchlands in the ranchers' hands.

One of these opportunities is the new grassland option that is included in both House and Senate versions of the 2002 Farm Bill. This option is a counterpart to the existing Farmland Protection Program, which utilizes perpetual easements. The grassland versions call for options ranging from ten years to perpetual easements. We do not have the money to buy them in fee simple, nor to provide for perpetual easements on all acres. Nor do I think that it is necessarily a good idea. Circumstances can change a lot, and perpetuity is a very long time. Although the federal government will help fund the easements, they are usually held by local governments or nongovernmental entities such as the Nature Conservancy who provide funding for the local share. The Farmland Protection Program has proven to be both successful and popular in dealing with urban sprawl where the lands at risk are primarily cropland. When Congress passes the Farm Bill, we will have the capability of expanding the program to include grasslands–that is, ranchlands.

Another opportunity is the provision of technical and financial assistance to support rangeland improvements and to develop and implement manure management plans to address air and water quality concerns. Measures such as cross fencing, water development and distribution, and other rangeland improvement practices can help family ranch operations to remain financially and environmentally viable.

The manure management option will assist confined animal feeding operations to plan, install, and manage comprehensive nutrient management plans that will be helpful in improving air and water quality. This is largely new territory for the Natural Resources Conservation Service (NRCS), although after a few months in my present assignment, I am feeling increasingly expert in manure management.

Also, at the Administration's request, the bill offers a new program designed to encourage private capital to invest in farmland and ranchland protection. It will give NRCS the authority to work with agribusiness concerns. It will allow agribusinesses companies to use an agreed upon logo for marketing purposes, in exchange for their contribution to the farmland protection program and the purchase of conservation easements to reduce development pressures.

Forest Service Initiatives

With regard to the Forest Service, we must more actively engage ranchers as partners. For that to occur, we will need to be reacquainted as friends. But, we will also need to overcome some of the procedural roadblocks to collaborative management that we have experienced in recent decades. If you agree with my assessment that the most immediate and significant threat to the environment in the West is urban sprawl, then let me suggest a ranching philosophy that ought to guide this endeavor–that is, anything that makes ranching more difficult, rather than more productive, deserves some healthy scrutiny.

We are reviewing our procedures under the National Environmental Policy Act and, along with our counterparts at the Department of the Interior, consulting out procedures under the Endangered Species Act. Our objectives include streamlining the decision making process to: (1) get decisions made more quickly and (2) better respond to new information and developments.

We especially want to encourage local collaborative stewardship efforts to reduce the number of conflicts that drive too many national forest decisions. That encouragement is a priority for me. The Forest Service is already engaged in some promising partnerships and initiatives.

Quivira Coalition

The Quivira Coalition was started in Santa Fe, New Mexico about five years ago. When ranchers and environmentalists got tired of endless battles, they decided to see whether they could work together and found that they could. Today, the coalition has about 850 members, evenly divided among ranchers, environmentalists and government land agency staff.

The Quivira Coalition has developed a concept called the new ranch, based on the radical notion that good ecology, good ranching, and good business go together. New ranchers do things like graze herds for shorter periods of time to give the land more rest. But before they got to that point, they had to get rid of tired, old preconceptions ingrained in all three sides by decades of conflict. All sides decided to "get back to the ground," or see how the sun, rain, soils and other components of the land interact to make rangeland. All sides decided to forget about process and to focus on results.

The ranchers discovered that grazing is not always good for plants on every piece of ground. The environmentalists discovered that cattle-free range can be range headed for trouble, since grassland evolved with grazers and needs periodic disturbance to flourish. The ranchers learned that bare ground is the real enemy, not predators or environmentalists. And the environmentalists learned the need for respect to the ranching culture. Results, so far, are encouraging. Under new ranching, ranches are becoming stronger and more profitable; the range is becoming healthier and better able to support habitat for otter, elk and other wildlife.

Grassbank

The other idea I hope you will endorse is the grassbank. The Malpai Borderlands Group, in southwestem New Mexico, started the first grassbank in 1994 on the 321,000-acre Gray Ranch. Ranchers bring their cattle to the grassbank, placing a conservation easement on their own ranch. The rancher gets to use an amount of grass equal in value to the easement. So far, the Malpai grassbank has protected 25,000 acres on five ranches. Ranchers have taken advantage of the rest period to complete restoration projects on their properties.

Based on the Malpai model, but tailored to public lands, a second grassbank, or a forage reserve, was founded in 1997. It is called the Valle Grande Grass Bank, and it is located on the Santa Fe National Forest, in northern New Mexico. It was started by a partnership led by a nongovernmental organization, The Conservation Fund. The partnership bought a local ranch and managed an adjacent 36,000-acre grazing allotment. Permitees from other allotments can place their cattle on the Valle Grande allotment while their home allotments are rested and rehabilitated.

Twenty-one ranchers have participated so far, placing 1,065 cattle on the grassbank. It is an arrangement that fully integrates environmental and economic goals. It is also in line with the social and cultural traditions of the region. In fact, the grassbank idea is now spreading across the West. A Conservation Fund researcher has identified 22 different grassbank initiatives in 10 western states, reaching from New Mexico, to Califomia, to Montana.[5]

The Valle Grande Grass Bank is a partnership that brings together people who usually do not spend a lot of time talking to each other–ranchers, environmentalists and the Forest Service agents. Like the Quivira Coalition, grassbank initiatives can help people bridge their differences for stronger ranches and healthier ecosystems. And, open, healthy rangelands are what thriving populations of native wildlife need more than anything else.

Southwest Conflict Assessment

The Southwest has been the location of numerous contentious lawsuits on grazing issues. One of the major challenges facing the Forest Service, particularly in that region, involves the ability to continue to provide opportunities for livestock to graze while meeting legal obligations under the Endangered Species Act, the National Environmental Policy Act and other environmental laws. In an effort to try and find resolution to these issues outside the courtroom, the Forest Service last year asked the Institute for Environmental Conflict Resolution (Institute) to conduct a conflict assessment on issues in the Southwest. The goal is to develop an understanding of the core interests of the parties involved in this polarized debate to enable the Forest Service to more clearly focus on those issues where negotiation and/or mediation might be successful. After interviewing over 70 people, the Institute identified, not only areas of disagreement, but many areas of agreement and common ground as well. The final report on this conflict assessment will be the basis for a follow-up workshop to be hosted by the Institute this summer, which will bring parties together to discuss the next important steps. There are several areas where there is wide agreement regarding grazing and rangelands. People find that they can work together on monitoring rangelands and the effects of activities, like grazing.

Roundtable for Sustainable Rangelands

The Forest Service, along with the Bureau of Land Management (BLM), the Agriculture Research Service and Colorado State University, has sponsored a significant effort, with over 30 partners, to develop criteria and indicators for determining what constitutes sustainable rangelands. By the summer of 2002, the Roundtable for Sustainable Rangelands will be more than halfway through the collaborative process of identifying indicators of sustainability, based on social, economic, and ecological factors to provide a framework for a national assessment of rangelands and rangeland uses. This effort will result in a report on the nation's progress towards sustainable rangelands in 2003.

Rangeland Vegetation Classification

Congress has directed the Secretaries of Agriculture and the Interior to charter a group to develop a 10-year plan for completing rangeland vegetation classification and standardizing methods for rangeland inventory and monitoring. Having all the agencies within these departments conducting work in a similar manner across multiple rangeland jurisdictions will move our nation ahead in understanding the state of our Nation's rangeland resources.

Invasive Species

One of the issues which we are struggling to address with relatively limited support is the problem of noxious weeds on rangelands. The Forest Service has worked with many state organizations to stem this invasive tide and implement a combined strategy to combat this insidious problem on many fronts: prevention, education, detection, control, inventory, monitoring and research. The agency's noxious weed program funding has nearly doubled in the last year, from $8 million to $15 million due in large extent to organization and governments working together to bring remedies to this problem. At the same time, this issue–however critical on the ground–is suffering from lack of interest group attention.

Let me close by offering you my answers to the three questions I posed. First, what we are giving up is an irreplaceable part of both our natural and cultural heritage. Second, what we are gaining in return–largely by default–is not something that will shine proudly upon our children when we are gone. Third, if we can coalesce our thinking around the biggest problem, there are ways we can work together to help ranchers and wildlife both stay on the land.

I sometimes think that decision-makers fail to ask "and then what" due to a sense of foreboding. Yet, this is the key question that dedicated conservationists have always insisted must be asked. Aldo Leopold was clear about this when he observed in 1939 that: "Conservation, therefore, is a positive exercise of skill and insight, not merely a negative exercise of abstinence or caution....I have no hope for conservation born of fear.[6] For Leopold, the answer never was to banish livestock from the land. It was, instead, to exercise skill and insight in grazing management. Through initiatives such as the Quivira Coalition and the grassbank, we can help people exercise skill and insight when managing the land based on what they have in common.

Let me reiterate what is at stake–nothing less than the future of our western lands and our western heritage. Rangeland is a renewable resource. Through new ranch techniques, for example, ranchers are finding that they can repair damaged land and restore lost habitat for wildlife. But, we cannot repair rangeland after it is gone–after it has been subdivided, roaded and converted into condominiums.

Let us work together to keep our ranchers on the land. As strong a wilderness advocate as Wallace Stegner saw a place for ranching on the land. In 1960, he stated: "I have known enough range cattle to recognize them as wild animals; and the people who herd them have, in the wilderness context, the dignity of rareness; they belong on the frontier, moreover, and have a look of rightness.[7] No one since has said it better.

Endnotes

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Address Given by the Director of the United States Fish and Wildlife Service

Steve Williams
US Fish and Wildlife Service
Washington, DC

Thank you, Rollie. It is an incredible honor and opportunity to address old friends and to offer my views from a national fish and wildlife management perspective.

First, I want to thank the Wildlife Management Institute for having made the North American the venue for professionals to discuss the issues facing our profession. I also would like to express my gratitude to both President George W. Bush and Interior Secretary Gale Norton for selecting me to serve as the 14th Director of the Fish and Wildlife Service (Service).

For the last 22 years, both as a graduate student and state wildlife director, I have looked forward to attending the North American Conference. Having the opportunity to address this session as the Service Director never really entered my mind. This is truly an honor.

I have been on the job now for just two months, and I realize I still have much to learn. What I have seen so far has reinforced my previous ideas about what the Service and the wildlife management profession must do to prepare for the future. We must restore balance to our fish and wildlife conservation mission.

As the theme of this conference implies, it often pays to look back, before moving forward. Theodore Roosevelt was a legendary, national, conservation leader. Throughout his life, he embodied the spirit of the original conservationist. An avid outdoorsman, he enjoyed hunting and fishing. He recognized the detrimental impact of market hunting and the reckless attitudes that led to the disappearance of the great buffalo herds and to the extinction of the passenger pigeon.

In fact, it was the market hunting of water birds for plumage that led Roosevelt to one of his greatest tasks. Having learned about the slaughter of birds on Pelican Island, Roosevelt asked if there was any law to prevent him from declaring the place a Federal Bird Reservation. Being told there was not, he said, "Very well, then I so declare it." Before Roosevelt left office, he had signed 51 executive orders establishing wildlife refuges in 17 states and territories. From his vision, the refuge system has grown to encompass 538 National Wildlife Refuges, more than 94 million acres of important wildlife habitats. These areas provide great opportunities for fishing, hunting, trapping, birdwatching and other outdoor recreation.

Roosevelt understood that there must be a balance between preservation and conservation. As a true conservationist, he realized that natural resources are a national asset that should be conserved–that is, used wisely. The resources that Roosevelt helped to conserve are the very resources that our society depends upon today to stimulate our national economy and to encourage future fish and wildlife conservation. Today, we celebrate Roosevelt's legacy of balance.

As we enter the 21st century, the wildlife management profession has its own balancing act to accomplish. Once, state and federal fish and wildlife agencies focused primarily on restoring and managing game species. Today, it must devote more time to nongame and endangered species. As our conservation mission has expanded, I fear we may have left some of our traditional constituencies behind. It is time to renew our partnership with America's sportsmen and women, those whose ethics and support have been the backbone of wildlife conservation for more than a century. Hunters and anglers deserve to be pivotal partners in fish and wildlife conservation.

As Director of the Service, it is my goal to restore the balance to fish and wildlife conservation. To achieve this goal, I am focusing on two important areas. The first is the need to repair the integrity and credibility of the wildlife profession's scientific reputation. The second is the need to strengthen partnerships, which includes improving the Service's relationship with the diverse wildlife conservation community, including states, industry, nongovernmental organizations, sportsmen and women, and private landowners.

Let us take the science issues first. When I accepted this job, I never imagined that it would be incumbent on me to defend the Service's scientific integrity. After all, the Service has a long and distinguished history of scientific accomplishment, from Rachel Carson and her research on the impacts of DDT to Olaus Murie and the establishment of the wilderness concept. The agency has an impressive record of scientific accomplishment. Yet, recent events have raised public concerns about the scientific credibility of the Service. These public perceptions threaten fish and wildlife conservation efforts on a national scale.

All of us in the wildlife management profession are vulnerable to questioning. When the arcane details of wildlife population survey techniques become the fodder for editorials and Congressional hearings, it is sobering to realize how closely our profession is scrutinized. If we lose the public's trust, our ability to direct resource conservation will be undermined severely , and we will find it nearly impossible to be effective fish and wildlife stewards.

If the wildlife management profession is to be taken seriously, we must demand solid and legally defensible science. Our science must be impeccable. It must be beyond reproach. We must also bring balance to our decisions.

That balance comes from common sense, open communication and an understanding of those who are ultimately affected by our decisions. We must be careful not to win every battle, yet lose the war. Our focus must be long-term, big-picture conservation benefits.

That brings me to the topic of partnerships. The Service values all of its partnerships, but it cannot deny that the relationship with the state agencies has been strained. As Director, I am committed to see the Service strengthen its ties with the states. Having spent 16 years working for state fish and wildlife agencies, I have a deep appreciation and respect for the scientific expertise and local perspective that state employees bring to the table. Those abilities must be called upon as the Service addresses its science issues. The states can help by adding their expertise, providing peer review, engaging the public when management alternatives are devised and being partners in the decision-making process.

There are many other areas where the Service and the states can work more closely as well. I know many of you have excellent, innovative programs to engage our constituents and improve conservation.

As Service Director, I want to learn from your programs and help promote them. The Bush Administration is committed to strengthening federal-state partnerships. I am happy to announce that, under the new State Wildlife Grants program, the Service is making 80 million dollars in federal grants available to state wildlife programs. Last week, you should have received the implementation guidelines for this new program. These cost-share grants should help to build on existing programs and develop plans for protecting and restoring species with the greatest need.

Additional sources of funding are on their way. Soon, expect to see proposals in the Federal Register for the implementation of the Landowner Incentive Program and the Private Stewardship Grants. These two competitive programs total 50 million dollars to encourage private landowners to undertake wildlife conservation activities on their own property.

An even bigger partnership initiative is included in the President's 2003 budget request. I refer to Secretary Norton's $100 million Cooperative Conservation Initiative. This initiative provides resources for landowners, land-user groups, environmental organizations, communities, federal, state, and local governments, and businesses to undertake innovative land conservation projects on local, state and federal lands.

These programs can strengthen the relationship between the states and the Service. With this new funding, we can work more closely to address several major wildlife management issues.

The first of these is the problem of overabundant wildlife, including snow geese, cormorants and resident Canada geese. In these instances, the Service provides states with greater flexibility to manage these issues.

On the other hand, we need to do more to address the decline of many bird populations. Soon, the Service will release an updated list of birds of conservation concern. My hope is that this list, and all bird conservation plans, will rally efforts across the country to save birds that have suffered habitat and population losses. Species included on the list will be given priority for funding research, monitoring and management. Through the combined efforts of agencies, organizations and individuals, we can return species to their natural abundance and keep them off the endangered species list.

Of course, when we talk about restoring balance, the Endangered Species Act invariably comes up. The Service has made progress by working with the some of the states and local groups to develop conservation agreements to prevent the need to list a species. I am determined to finalize the policy on evaluating conservation efforts. The policy will define criteria that the Service will use to measure the effectiveness of conservation agreements and measures. It is intended to strengthen state involvement in the process. Other efforts to improve the Endangered Species Act are being contemplated from a regulatory and administrative perspective.

We must restore balance in fisheries as well. As many of you know, the Service's Fisheries Program is seeking to define its priorities. Over the past two years, the Sport Fishing and Boating Partnership Council has helped the Service to address issues facing the Fisheries Program. The Council, a broad-based coalition that includes state agencies, industry, conservation organizations, academia and tourism interests, has formed a steering committee to look at the needs of our Fisheries Program.

In a report, entitled *A Partnership Agenda for Fisheries Conservation*, the committee recommends that the Fisheries Program be solidly funded, backed by sound science and grounded in dynamic partnerships with stakeholders. Further, it encourages the Fisheries Program to take a leadership role to stem the tide of habitat degradation that threatens fisheries and aquatic species across the country. The Service concurs with these recommendations and plans to work with the steering committee and the Council to develop implementation and communication plans. I look forward to meeting the challenges as the Service strengthens and revitalizes its Fisheries Program.

Lastly, I would like to close with an invitation. We hope you will join us in 2003 for the centennial celebration of the National Wildlife Refuge System. I already have described how Theodore Roosevelt established the first wildlife refuge on Pelican Island. True to Roosevelt's concept of balanced conservation, the wildlife refuge idea serves not to preserve wildlife sanctuaries, but rather to conserve wildlife habitat. Today, we have 538 national wildlife refuges, with at least one in every state. Yet, the National Wildlife Refuge System remains one of America's best kept secrets. With the Refuge Centennial, we plan to change that. I encourage you to join us to make the strongest possible impact on this grand occasion.

There are many opportunities for the Service, the states and other partners to work more closely together. In all we do, we should keep in mind trust, mutual respect and Roosevelt's legacy of balance. To move forward, we must stay true to our roots. Sound science and solid partnerships have been and continue to be the key to our nation's wildlife conservation success. I want to thank you for listening and for sharing in this success.

Special Session One.
Wildlife Diseases: Crying Wolf or Crying Shame?

Chair
Robert G. McLean
US Geological Survey, National Wildlife Health Center
Madison, Wisconsin

Co-chair
John R. Fischer
Southeastern Cooperative Wildlife Disease Study,
University of Georgia
Athens

Opening Remarks

Robert G. McLean
US Geological Survey, National Wildlife Health Center
Madison, Wisconsin

Diseases of North American wildlife are causing serious problems for wildlife, and some wildlife diseases pose health threats to humans and domestic animals. Information will be presented at this wildlife disease session to alert resource managers enough to consider disease as an important issue when managing wildlife populations. It will be a crying shame if appropriate actions are not taken to monitor diseases adequately and to prevent or control them to protect our wildlife resources.

Wildlife diseases are having a greater impact on wildlife populations than ever before because of invasive diseases, new and emerging diseases and re-emerging diseases. The quantity and quality of wildlife habitats are shrinking as human development encroaches on natural habitats and creates more habitat fragmentation. Because of this declining availability of quality habitats, combined with the rapid global movement of people, animals, products and disease pathogens, wildlife diseases have expanded and presented an increasing threat to our native wildlife populations, as well as to human and domestic animal populations that are associated with them.

We can no longer consider diseases of wildlife and the mortality they cause as insignificant, and we need to change the concept that the level of mortality caused by diseases is fully compensatory within wildlife populations. One mortality or one disease can kill a significant portion of already reduced and limited populations; diseases, such as avian botulism, killed thousands of white pelicans (*Pelecanus erythrorhynchos*) and brown pelicans (*P. occidentalis*) at the Salton Sea in southern California a few years ago. One wildlife disease, such as brucellosis in bison (*Bison bison*) of the Greater Yellowstone Area, can cause havoc and conflict between domestic livestock producers, the agencies that support and protect wildlife and the wild animal managers and agencies that also wish to protect the wildlife. A benign disease of birds in the eastern hemisphere, West Nile virus suddenly can invade the western hemisphere, causing extensive mortality in native North American bird species.

To combat these emerging wildlife diseases, we need to develop and expand our capabilities for:

- disease monitoring and surveillance programs to provide timely detection of new and emerging pathogens,
- diagnostic services to provide rapid identification of specific causative agents,
- timely and appropriate responses to contain and control disease outbreaks and to prevent disease emergence, and
- an infrastructure for the tracking, evaluation, and rapid dissemination of disease information during the course of outbreaks or invasive and emergent events.

These capabilities should be expanded before and not during a disease outbreak.

In this session, we selected some of the important wildlife diseases that currently affect a variety of wildlife species to discuss, and we assembled the disease experts to present the latest information on how these diseases impact native bird and mammal species of North America. Diseases to be presented are invasive diseases–represented by West Nile virus–newly emerging diseases–represented by chronic wasting disease of deer and American elk (*Cervus elaphus*)–and avian vacuolar myelinopathy–a neurological disease of bald eagles (*Haliaeetus leucocephalus*), American coots (*Fulica americana*) and waterfowl. Re-emerging wildlife diseases of birds, such as avian botulism, avian cholera, Newcastle disease and avian mycoplasma will be represented by a presentation on Type C avian botulism. Hemorrhagic diseases in white-tailed deer (*Odocoileus virginianus*) will be highlighted as part of the emerging and reemerging diseases of mammals that also include such diseases as bovine tuberculosis in deer, brucellosis in bison and rabies in raccoons (*Procyon lotor*). Finally, a presentation on sylvatic animal plague in the western states will represent those diseases affecting the recovery of the threatened and at risk wildlife species, black-footed ferrets (*Mustela nigripes*) and black-tailed prairie dogs (*Cynomys ludovicianus*), and other diseases in this category are impacting the recovery of additional at risk species, such as California sea otters (*Enhydra lutris*) and Hawaiian green turtles (*Chelonia mydas*).

Type C Avian Botulism–Management Dilemma

Gary Wobeser
University of Saskatchewan
Saskatoon

Trent Bollinger
University of Saskatchewan
Saskatoon

Botulism in wild waterfowl is a food poisoning caused by consumption of an extremely potent neuroparalytic toxin (C_1), produced by the bacterium, *Clostridium botulinum* type C. This bacterium is a saprophyte that grows vegetatively in protein-rich organic material under anaerobic conditions. The bacterium does not produce C_1 toxin unless it is infected with a bacteriophage (virus), which supplies the gene that encodes for toxin production (Eklund et al. 1971). The total mortality caused by botulism in any year is unknown, but Rocke et al. (1999) estimated that, during the latter half of the 1990s, millions of birds died of botulism in the United States and Canada.

The basic factors involved in botulism outbreaks include the presence of the bacterium and the bacteriophage, substrate or nutrient material to support bacterial growth and toxin production, environmental conditions–such as warm temperature and lack of oxygen suitable for bacterial growth and toxin production–packaging of toxin in a form that will be consumed by birds, and the presence of susceptible birds to consume the toxin.

The Bacterium

Clostridium botulinum type C is widespread and likely ubiquitous in wetland soils (Smith et al. 1982), although there may be differences in abundance among wetlands (Wobeser et al. 1987) or even seasonally within a wetland (Sandler et al. 1993). When environmental conditions are unsuitable for the bacterium, it forms very resistant spores that can persist in the environment for years.

The Bacteriophage

Little is known about the ecology of the bacteriophage in nature. Williamson et al. (1999) detected the type C_1 toxin gene in 16 of 18 wetland sites sampled, suggesting that it also is ubiquitous.

Substrates

The range of substrates in wetlands that can be used for growth by *C. botulinum* type C is unknown, however decaying plant material seems to be poor substrate for toxin production, while decaying animal tissue is very suitable (Coburn and Quortrup 1938, Bell et al. 1955, Hunter 1970). Spores of *C. botulinum* were detected in the tissues of many living wetland inhabitants (Jensen and Allen 1960, Reed and Rocke 1992), but these do not grow vegetatively or produce toxin. However, when an animal dies with spores in its tissues, there may be vegetative growth of *C. botulinum* and toxin production (Notermans et al. 1980, Smith and Turner 1987). Thus, all animals living in a wetland are potential substrate that may already carry spores. Bell et al. (1955) proposed the "micro-environment concept" in which proliferation of toxin occurs within small particulate objects, such as invertebrate carcasses, rather than in dissolved media. It showed that toxin could form within an invertebrate carcass in an aerobic environment. Dead invertebrates may be a potential substrate for toxin production and as a source of toxin for birds, however documentation of poisoning occurring from this source is limited. Jensen and Allen (1960) presented evidence of a relationship between declines in invertebrate numbers and the occurrence of botulism, and Rocke et al. (1999) associated the probability of botulism occurring in sentinel mallards (*Anas platyrhynchos*) with increasing invertebrate abundance. But, attempts to induce botulism in waterfowl by killing invertebrates in experimental ponds have been unsuccessful (Moulton et al. 1976). The micro-environment concept can be extended to vertebrate carcasses, which are particularly suitable for bacterial growth and toxin production because they provide a large amount of substrate, a self-contained anaerobic environment (Smith and Turner 1987) and the high temperature optimal for growth and toxin production (Wobeser and Galmut 1987). Carcasses support production of particularly high levels of toxin (Duncan and Jensen 1976). Hunter (1970) reported that, "botulism could be produced at will by adding a duck carcass," to experimental ponds containing sentinel birds.

Transfer of Toxin

For poisoning to occur, birds must consume toxin. There is no evidence that birds are poisoned through consumption of toxin diffused in water. Invertebrates are considered to be the primary source of toxin for birds (Jensen and Allen 1960, Rocke and Samuel 1999). This might occur through birds feeding on dead invertebrates that have served as a substrate for toxin production, or it may occur through living invertebrates that have acquired toxin from some other substrate. High levels of toxin occur in vertebrate carcasses, but, because most birds affected by botulism are not carrion feeders, direct consumption of flesh is unlikely. The role of carrion-feeding invertebrates, particularly the maggots of blow fly larvae, as carriers of toxin between carcasses and birds has been documented for many years (Jensen and Allen 1960). Duncan and Jensen (1976) reported that under experimental conditions dead invertebrates did not support toxin production at levels as high as those found in invertebrates associated with bird carcasses.

Other Environmental Factors

Because of the complex ecology of avian botulism and the unpredictable occurrence of the disease, it is difficult to identify specific environmental features that favour occurrence of the disease or to determine how factors relate to the bacterium, bacteriophage, substrates, transfer of toxin or bird usage. Traditionally, botulism outbreaks have been associated with shallow, stagnant, brackish or saline wetlands with low dissolved oxygen, fluctuating water levels and high summer temperatures. However, these features, "do not adequately characterize the timing and location of many botulism outbreaks in wetlands with deep, well-oxygenated water and stable water levels, or outbreaks that occur in late winter or spring" (Rocke et al. 1999). Three recent studies have attempted to identify factors that favour occurrence of botulism outbreaks. Rocke et al. (1999) found that higher water temperature, increased invertebrate abundance and lower oxidation-reduction (redox) potential were generally associated with botulism, but, with the exception of lower redox potential, these factors were not consistently different in outbreak and non-outbreak wetlands. Rocke and Samuel (1999) found that the relative risk of botulism was associated with water temperature, pH, redox potential, salinity just above the water-sediment interface and the amount of organic matter in sediment, but the relationships among various factors were "complex and involved nonlinear and multivariate associations." Dissolved oxygen concentration was not associated with the risk of botulism in either of these studies. High precipitation and increased water flow in the Bear River were associated with occurrence of large outbreaks in the Bear River Delta, Utah; Barras and Kadlec (2000) believed that these factors might act through fluctuating water levels and reflooding of mudflats. Summer temperatures were not different between outbreak and non-outbreak years.

Bird Populations

Most large outbreaks are reported from molting and staging areas but it is unclear if this is a function of bird density or simply that bird densities are high at a time when conditions are conducive to outbreaks. Barras and Kadlec (2000) found no correlative relationship between waterfowl use days and the magnitude of outbreaks of botulism over a 25-year period on marshes of Great Salt Lake, Utah.

Phases of Botulism

There are two distinct phases in the ecology of botulism (Ball et al. 1998). In the initiation phase, toxin formed in any suitable substrate is ingested by one or more birds that may subsequently die of botulism. The substrate is almost never known but could be any suitable decomposing organic material, including dead invertebrates or vertebrates. It is likely that this phase of botulism, in which toxin production occurs and a few birds die of botulism, occurs annually in many marshes. Because of the difficulty in detecting dead waterfowl (Stutzenbaker et al. 1986), limited mortality of this type is unlikely to be detected, except in situations where wetlands are searched intensively at regular intervals. Wobeser (1997) and Barras and Kadlec (2000) reported that, although botulism occurred to a limited degree annually on marshes in Saskatchewan and Utah, respectively, large outbreaks occurred only periodically. Rocke et al. (1999) monitored groups of sentinel ducks intensively on four wetlands on a California waterfowl refuge over a three-year period. On four occasions, one or a few birds died of botulism without any other mortality occurring during the preceding or following several weeks. Most of such small occurrences probably end spontaneously and in only a small proportion of instances does the disease progress to the propagation phase. Avian botulism is unique among poisonings, because the carcass of its victims forms optimal substrate for the production of additional toxin that can poison other individuals (Wobeser 1997). In the propagation phase, carcasses of birds that died of botulism are the substrate within which toxin production occurs. In this phase, the disease has many of the properties of an infectious disease, such as threshold densities and contact rates. The potential for amplification through the resulting carcass-maggot cycle is enormous. A Northern Shoveler (*Anas clypeata*) carcass may produce 9,000 to 10,000 maggots (G. Wobeser, personal files) and, depending on the amount of toxin per maggot, as few as one maggot may be lethal for a duck (Locke and Friend 1987, Hubalek and Halouzka 1991), so a single dead bird may produce sufficient toxin-laden maggots to poison hundreds of birds, each of which in turn may produce large amounts of toxin and many maggots.

Management

The goal in management of botulism is to prevent or reduce mortality of water birds. Two questions must be addressed to consider the potential management of this disease. The first relates to the need for management, which can only be answered in terms of the population effects of the disease. Botulism is likely an ancient disease of waterbirds and large outbreaks have been recognized in western North America for almost a century. Despite this long history and the occurrence of outbreaks in which an estimated 0.5 to 1 million birds have died (Ball et al. 1998), there is little understanding of the effect of botulism on waterfowl populations. One difficulty to the study of the disease is that the number of birds that actually die of botulism is unknown. Most small occurrences are not recognized or recorded and, in outbreaks that are investigated, there is usually only a crude estimate based on partial counts of carcasses. The second difficulty is that mortality has seldom been measured in terms of the population at risk. Botulism can have an impact on the local population using a wetland. In a study on the Canadian prairies, the 30-day-survival of molting mallards marked with radio-transmitters during botulism outbreaks varied from less than five to greater than 71 percent (Evelsizer, personal communication 2001). Direct recovery of mallards banded on wetlands on which botulism occurred in Canadian prairies was substantially lower than that of control birds banded in the same years on wetlands without recognized botulism outbreaks, indicating that exposure to outbreaks of botulism during the post-breeding season reduced late summer survival (Kevin Dufour, personal communication 2002). On the Bear River Migratory Bird Refuge, in Utah, the average mortality of waterfowl because of botulism has exceeded hunting mortality since 1950 (Barras and Kadlec 2000). Botulism also may have an impact at a regional level. Nerassen (1997) estimated that mortality from botulism in some years on one lake used for staging, in Alberta, exceeded the estimated production on all North American Waterfowl Management Plan wetlands in Alberta's prairie. We are not aware of published information documenting an effect of botulism on annual survival of any waterfowl species. Species such as the Northern Pintail (*Anas acuta*) may be of special concern because of disproportionately high mortality in relation to population size (Ball et al. 1998). The extent of mortality and the potential population effects on shorebirds are almost unknown. Clarification of the population effect of botulism should be a high priority of management.

The second question relates to the feasibility of management of avian botulism. Because botulism is food poisoning, the logical approach is to prevent birds from ingesting toxin. This might be done either by reducing the availability of toxin or by preventing birds' access to toxin. A major problem when identifying targets for management is that most factors that have been identified as required for outbreaks are constantly present or occur regularly in wetlands where botulism occurs, while large outbreaks occur unpredictably. The bacterium and the bacteriophage are always present in botulism-prone wetlands, waiting to multiply and produce toxin when suitable substrate becomes available. Because animals die continually in wetlands and other organic material is abundant, potential substrate is always available. Abiotic factors, such as warm ambient temperatures and anaerobic conditions that may be required for bacterial growth in some substrates, occur regularly in most marshes, while other substrates, such as vertebrate carcasses are largely independent of ambient conditions. Blow flies and other scavenging invertebrates that carry toxin to birds also are ubiquitous in wetlands during warm weather. No single factor that leads to an outbreak has been identified. The progression from the initiation phase through the propagation phase to a large outbreak appears to result from a series of steps involving many factors, each with a variable probability of occurring (Wobeser 1997). There likely are many alternate pathways that lead to an outbreak. A second problem for managers is that many of the features that have been identified as common on marshes where botulism occurs, such as shallow water, abundant invertebrates and extensive mudflats, are also desirable features to support waterfowl and shorebird populations.

Assuming that the initiation phase of botulism can not be prevented, because currently there are no proven methods for influencing bacteria and bacteriophage availability or toxin formation, emphasis should be on preventing the magnification of mortality that occurs through the carcass-maggot cycle. Many carcasses likely are removed from wetlands by scavengers before toxin forms. Factors that enhance natural scavenging may prevent the disease reaching the propagation phase in some situations. Rocke and Samuel (1999) indicated that removal of carcasses (i.e., enhanced artificial scavenging) is the only technique that has been effective in reducing botulism losses. This method has been used widely in response to botulism outbreaks, but its effectiveness has been assessed only recently. Under experimental conditions, Reed and Rocke (1992) found that captive ducks in pens with 12 carcasses per hectare were 4.5 times more likely to die of botulism than were birds in pens with no carcasses, indicating that removal of all carcasses is a useful management technique. However, because of the difficulty of finding dead birds and the cost of repeated intensive searches, it is unlikely that all dead birds can be removed from most wetlands during outbreaks. For example, 32 percent of marked carcasses were recovered during a carcass collection in an outbreak in Saskatchewan (Cliplef and Wobeser 1993). The effectiveness of carcass collection is being assessed in a study of lakes in the three prairie provinces of Canada. In this study, the proportion of marked carcasses recovered ranged from 7 percent on a large heavily vegetated lake to 51 percent on a small less densely vegetated wetland that was searched repeatedly and extensively. (T. Bollinger, personal files). On one lake, approximately 50 carcasses remained per hectare after an intensive search of a heavily vegetated area by an experienced crew using an airboat (Ball et al. 1998). There has been no apparent difference in survival of radio-marked molting mallards during botulism outbreaks on lakes with intense carcass collection compared to similar lakes on which carcasses were not removed (Evelsizer, personal communication 2001). Carcass collection is expensive and labour intensive. For example, the cost, excluding capital costs for equipment, to remove carcasses from two small Canadian lakes during July and August was approximately $52 (Canadian currency) and $101 (Canadian currency) per hectare (Stire 2001). The annual cost of botulism carcass removal on the Canadian prairies during the late 1990s was several hundreds of thousands of dollars (Canadian currency), peaking at approximately $1 million (Canadian currency) in 1998 (Kehoe, personal communication 2002). It is questionable whether sufficient carcasses can be removed under outbreak conditions on many wetlands to have an effect on mortality. Theoretically, early surveillance to detect the first evidence of mortality and to remove all carcasses should be successful in preventing outbreaks. However, the level of surveillance required to detect the first dead birds, the secretive nature of waterfowl and the inability to predict when or where botulism may occur, make this approach unfeasible on all but the most intensively managed wetlands.

An obvious method of preventing birds from ingesting toxin is by denying birds access to areas where toxin is present. Most large outbreaks occur on wetlands that are used heavily by many waterfowl. Dispersal of birds from attractive habitat is extremely difficult unless the habitat can be made unattractive to birds, e.g., by draining the wetland. This is possible in a limited number of wetlands with the ability to move large volumes of water rapidly. Dispersal of birds from the site of an outbreak may be impossible on northern wetlands where botulism coincides with molt. Some wetlands that suffer repeated heavy mortality may be black holes with a net negative effect on local or regional waterfowl populations. Because there currently are no effective methods to prevent mortality on these wetlands, managers may have to consider major modifications to make them less attractive to birds, including complete drainage during the time of year when botulism is expected to occur.

Avian botulism kills many waterfowl and shorebirds, and it influences the autumn flight of some species. The effects on continental populations and on annual survival of waterfowl are unknown. Effective management is hampered by an incomplete understanding of the environmental factors that precipitate outbreaks. Many forms of environmental manipulation have been suggested for the management of botulism, but collection and removal of carcasses during outbreaks is the only management technique that has been assessed to determine its effectiveness when reducing mortality. Results from on-going trials in Canadian prairie indicate that this technique is not effective, at least on large marshes, because of inability to find and remove sufficient carcasses to result in a reduction in mortality. Future research should define the population effects of botulism, identifying the factors that influence the propagation phase and objectively testing the effectiveness of management techniques in reducing mortality.

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Avian Vacuolar Myelinopathy: A Newly Recognized Fatal Neurological Disease of Eagles, Waterfowl and Other Birds

John R. Fischer
Southeastern Cooperative Wildlife Disease Study, University of Georgia Athens

Lynn A. Lewis
Southeastern Cooperative Wildlife Disease Study, University of Georgia Athens

Tom Augspurger
US Fish and Wildlife Service Raleigh, North Carolina

Tonie E. Rocke
US Geological Survey, National Wildlife Health Center Madison, Wisconsin

Introduction

Since 1994, wildlife biologists and wildlife health specialists have worked to determine the cause of avian vacuolar myelinopathy (AVM), a neurologic disease of bald eagles (*Haliaeetus leucocephalus*) and other birds. The causes of morbidity and mortality in wildlife typically are determined through both antemortem and postmortem examinations, combined with ancillary tests for microbiological organisms, toxicants and other etiologies. However, the etiology of AVM has not been determined yet, despite extensive diagnostic investigations, including examinations for common disease agents, as well as infrequent or unusual causes of mortality. With the failure of standard diagnostic testing to determine the cause of AVM, investigations have evolved to include an ecosystem-oriented approach, conducted through the collaborative efforts of numerous state and federal wildlife resource agencies, universities, private foundations and other institutions. Projects that have been conducted or are underway to determine the cause of AVM include behavioral studies of affected species, aquatic plant inventories, water quality and sediment analyses, epidemiological studies of AVM in wild birds, sentinel studies, and feeding trials. In addition to scientific research and extensive interagency cooperation, it is expected that persistence and serendipity will be key components of a successful search for the cause of AVM, its source and possible methods to reduce its impact on wildlife resources.

Recognition of AVM as a Cause of Eagle Mortality in Arkansas

During the winter of 1994 to 1995, unprecedented bald eagle mortality occurred at DeGray Lake, in southwestern Arkansas. A total of 29 dead or dying bald eagles were found at this location from November 23, 1994 through January 15, 1995 (Thomas et al. 1998). Most of the eagles were found dead, however those observed alive had difficulty with flight and crashed into trees, embankments or other objects. Birds captured alive died shortly thereafter, despite supportive care. All eagle carcasses were submitted to the National Wildlife Health Center (NWHC) of the US Geological Survey for diagnostic evaluation. Microscopic examinations revealed consistent lesions in the central nervous systems of the eagles, but further testing failed to identify other consistently abnormal findings or a causative agent.

The microscopic lesion observed in the brains of eagles consisted of widespread, bilateral and symmetrical vacuolization of the white matter of the brain, spinal cord and optic nerve (Thomas et al. 1998). The lesion was distinctly different from the transmissible spongiform encephalopathies, such as chronic wasting disease, scrapie and bovine spongiform encephalopathy, that predominantly affect the gray matter of the brain. The NWHC previously had not encountered vacuolar myelinopathy in wild birds during 20 years of mortality investigations.

Vacuoles were found in white matter at all levels of the brain, but they were particularly severe in the optic lobes. Affected tissues did not contain significant infiltrates of inflammatory cells, as occurs in many infectious disease processes. When viewed with a transmission electron microscope, it was apparent that the vacuoles were formed by separation of the myelin sheaths surrounding axons. Normal myelin sheaths have a laminar or onionskin appearance in cross section. Vacuole formation, due to splitting of these laminations, is characteristic of intramyelinic edema, which can be due to a variety of causes, including acute toxicosis. A point-source exposure to a toxicant was regarded as the most likely cause of the eagle mortality in view of the lesions, the absence of apparent infectious disease agents and inflammation, and the epizootiology of the mortality event. However, significant toxicants were not found in any of the carcasses, despite extensive testing for a variety of agents known to cause wild bird mortality as well as those known to cause intramyelinic edema.

Toxicants that previously have been associated with intramyelinic edema in domestic animals and human beings include a wide variety of natural and manmade compounds. For example, exposure to triethyltin is one cause of intramyelinic edema (Fleming et al. 1991) that was initially considered as a possible cause because it is used in marine paints to protect boat hulls, and there was a history of it in a paint factory in the DeGray Lake vicinity. However, significant amounts of triethyltin were not detected in the eagle carcasses (Thomas et al. 1998). Additional compounds associated with intramyelinic edema, such as the rodenticide bromethalin (Dorman et al. 1992) and the antituberculosis therapeutic isonicotinic acid hydrochloride (Blakemore et al. 1972) seemed implausible because they were unlikely to be available in quantities sufficient to produce such eagle mortality. Nonetheless, tests were run for these substances, and results were negative. In addition to the above manmade compounds, intramyelinic edema has been associated with two plants, *Stypandra imbricata* (Huxtable et al. 1980) and *Heliochrysum argyrosphaerum* (Van der Legt et al. 1996). However, these plants do not occur naturally in North America. Although the list of substances known to cause intramyelinic edema is relatively short, it represents a broad variety of types of compounds ranging from pharmaceuticals to organic metals to plant toxins.

Eagle mortality was not observed at DeGray Lake during the following winter of 1995 to 1996, although a single dead eagle with AVM was found at nearby Lake Ouchita. However, during the winter of 1996 to 1997, another 26 dead bald eagles were recovered: 14 at DeGray Lake, 11 at Lake Ouchita and one at Hamilton Lake, (Thomas et al. 1998). Eagle mortality began in mid-November and continued until late January. Of great significance during this period was the recognition that American coots (*Fulica americana*) at DeGray Lake were suffering from the identical neurological disease. Beginning on November 6, 1996 (approximately one week prior to the first eagle mortality), an estimated five percent of wintering coots at the lake were reluctant to fly, wobbled in flight, had difficulty swimming or had a drunken or staggering gait on land. Low numbers of coots were found dead. Captured coots ate readily, but showed no improvement in neurological signs in 72 hours (Thomas et al. 1998). Dead coots generally were not found at DeGray Lake, despite frequent surveillance. By early December, much of the coot population at DeGray Lake had migrated further south and by mid-December, observations of affected coots declined greatly.

Diagnostic evaluation of affected coots from DeGray Lake yielded microscopic lesions identical to those in affected eagles (Thomas et al. 1998). Furthermore, white matter vacuolization of varying severity also was found in coots not displaying signs of neurologic disease (J. R. Fischer, personal files). Again, extensive diagnostic testing of eagles, as well as numerous coots, failed to identify the cause of the neurologic lesions and mortality. At this point, it was hypothesized that eagles acquired AVM by ingesting affected coots, however it could not be ruled out that each species was independently exposed to the causative agent. Coots can be a major food item, especially of immature bald eagles (Sobkowiak et al. 1989), and eagles are considered opportunistic feeders (Johnsgard 1990) with a hunting strategy that may focus on sick or injured prey, potentially including neurologically impaired coots. Additionally, bald eagles feed on carrion (Griffin et al. 1982), and coot carcasses may be available during AVM outbreaks.

Recognition of AVM in Additional States and Additional Species

During the 1997 to 1998 migratory and wintering season, American coots with clinical signs and brain lesions of AVM were identified at Lake Juliette, Georgia and Woodlake, North Carolina. In one case, a wildlife biologist recognized affected coots after returning home from a bald eagle recovery meeting at which AVM was discussed, thus emphasizing the value of education of wildlife personnel regarding the newly recognized disease. Although low numbers of bald eagles were present near the Georgia and North Carolina sites, eagle mortality was not observed. However, two additional bald eagle deaths were attributed to AVM at Lake Ouchita, during the winter. With the discovery of affected coots in two additional states, AVM was recognized as a regional issue, rather than a situation unique to Arkansas. Furthermore, epidemiologic investigations at Woodlake indicated that neurologic disease and brain lesions similar to those of AVM were found in coots there as early as 1990 (Augspurger 1997).

During the winter of 1998 to 1999, severe AVM morbidity and mortality occurred in coots at Lake Juliette and Woodlake, and affected coots were identified at Lake Ouchita, as well as at Lake Murray, Lake J. Strom Thurmond (also known as Clarks Hill Lake) and a Savannah River Site reservoir in South Carolina. At the North Carolina site, AVM was diagnosed for the first time in low numbers of ducks, including mallards (*Anas platyrhynchous*), ring-necked ducks (*Aythya collaris*), and buffleheads (*Bucephala albeola*). Additionally, AVM was documented outside of Arkansas for the first time by bald eagle mortality; single dead bald eagles with AVM were found at Lake Juliette, Woodlake, the Savannah River Site and Lake J. Strom Thurmond (T. Augspurger er, personal files).

In subsequent years, AVM generally continued to occur in coots at the previously affected locations, and it has been documented in the deaths of low numbers of bald eagles in Arkansas, Georgia, North Carolina and South Carolina. However, AVM killed at least 16 bald eagles at Lake J. Strom Thurmond during the winter of 2000 to 2001 and was suspected or confirmed in seven more dead eagles at this site during the 2001 to 2002 migratory season. Two eagle deaths at Lake Ouchita were attributed to AVM in early 2002. During the severe eagle mortality events at Lake J. Strom Thurmond during the winters of 2000 to 2001 and 2001 to 2002, AVM also was documented in a large number of coots. Additionally, clinical disease and brain lesions were found in other species, including Canada goose (*Branta canadensis*), great horned owl (*Bubo virginianus*) and killdeer (*Charadrius vociferus*) (Fischer et al. 2002).

Through the spring of 2002, AVM has been confirmed or is suspected in deaths of at least 90 bald eagles at eight reservoirs in four southeastern states, with the majority of eagle deaths (55) occurring in southwestern Arkansas during the winters of 1994 to 1995 and 1996 to 1997. The impact of this newly recognized disease on the country's recovering bald eagle population is uncertain, but it is clear that the disease can devastate local populations. In southwestern Arkansas, where large numbers of eagles spend the winter, it was estimated that 30 to 65 percent of wintering eagles were killed by AVM from 1994 to 1997 (Thomas et al. 1998).

Avian vacuolar myelinopathy has been diagnosed in several other wild bird species in four other avian taxonomic orders, including ducks and geese.

One of the original questions regarding AVM concerned the apparent absence of this disease in birds other than bald eagles and coots at affected sites, despite the presence of numerous other species associated with water, predation and scavenging. The expanding list of affected species indicates that the species susceptibility range is much broader than originally suspected. Lesions of AVM have not been confirmed in mammalian species, and it remains unknown whether the cause of AVM will affect mammals, including human beings. However, the confirmation of AVM in ducks and geese, combined with the knowledge that ingestion is the apparent mode of transmission for eagles, has prompted public health and wildlife management agencies to advise hunters not to consume ducks, geese or other wildlife displaying signs of AVM or other disease.

Cooperative Efforts to Determine the Cause of AVM

There has been extensive collaboration to identify the cause of AVM by an ever-expanding group of wildlife resource, public land and water management agencies, universities, and other institutions, including private foundations such as the Ross Foundation and the Arcadia Wildlife Preserve, Inc. Each organization has contributed assistance, ranging from labor, materials, local expertise or financial support to aid in the investigations. It is impossible to identify every agency that has contributed to this effort, so the following list must be regarded as partial.

During the first mortality event involving only bald eagles, efforts were led by the Arkansas Game and Fish Commission, the US Army Corps of Engineers, and the NWHC, along with assistance from other agencies. The Southeastern Cooperative Wildlife Disease Study (SCWDS), which is contracted annually by 15 southeastern states and Puerto Rico to assist with the management of healthy wildlife populations, became involved as AVM was recognized in additional species and at additional sites. Furthermore, the Georgia Department of Natural Resources, the North Carolina Wildlife Resources Commission, the South Carolina Department of Natural Resources, the US Fish and Wildlife Service, universities and others assisted with investigations. Much of this work has been done with the existing finances of the organizations with a relatively low amount of supplemental support for AVM investigations. The following are selected examples of efforts of many of the collaborators to determine the cause of AVM and its source.

With the failure of standard diagnostic testing to identify the cause of AVM, investigations have been modified to include an ecosystem-oriented approach. Although the ultimate objective is to identify the cause of AVM, many of the projects have been conducted with the goal of better defining the problem. The first investigations centered on DeGray Lake and included thorough epidemiologic studies, including field investigations of the lake and region, determination of current and former land use in the area, and aquatic plant inventories. Subsequent projects at DeGray Lake included food habit studies of bald eagles and coots in the area, behavioral and movement pattern studies of these species, and analysis of water quality, sediment and algal communities.

Several additional investigations arose as AVM was found in more species and at more sites. Reservoirs at which AVM occurred were compared in order to identify commonalties between the sites that might suggest an etiology or its source. To date, wildlife morbidity and mortality due to AVM has been identified only at man-made reservoirs in Arkansas, Georgia, North Carolina and South Carolina. The reservoirs range from just over 1,000 to more than 70,000 acres in surface area. Most of the reservoirs are on publicly owned land; some are used for production of hydroelectric power and one has a coal-fired power plant on its banks. In many cases the land is managed by an agency, such as the US Army Corp of Engineers, and is accessible to the public. Woodlake is a private residential community with gated access. Two affected reservoirs at the Savannah River Site are within a high security area with no public access. The primary common feature among all of the sites is that the water is relatively clear with abundant submergent vegetation that serves as a food source for migrating and wintering coots. The predominant vegetation varies from site to site with *Hydrilla* or *Egeria* spp. being the most common. These plants are not known to be poisonous.

Recognition of AVM lesions in coots that appeared clinically normal, combined with information suggesting AVM occurred as early as 1990, indicated that the problem may be more widespread than originally suspected and that active surveillance would be necessary to document affected sites. Detection of affected reservoirs would identify sites that should be studied to determine the cause of AVM. With Section 6 funds provided through the Arkansas Game and Fish Commission, SCWDS conducted a multi-state epidemiological study of AVM in coots from autumn 1998 through spring

2001. Sampling of wintering coots at more than 40 lakes in 15 states throughout the Southeast, Northeast, Midwest and Southwest detected AVM at nine sites, including Sam Rayburn Reservoir, in Texas, where birds clinically affected with AVM never have been observed (Fischer et al. 2001). Additionally, it was determined that coots developed lesions after arriving at wintering sites free of lesions, the peak of clinical disease occurred from late November through mid-December, and there was poor correlation between brain lesions and clinical signs of AVM.

Information from this study strongly suggested that exposure to the cause of AVM occurred at sites where the affected birds were found. This was confirmed through a sentinel bird study conducted by the NWHC and the US Fish and Wildlife Service. Healthy domestic mallards and wild-trapped coots from a remote site developed brain lesions shortly after release at a site during an AVM outbreak (Rocke et al. 2000). Additional studies at this site, conducted in cooperation with North Carolina State University, suggested that exposure to the site is necessary because healthy mallards did not become affected when co-housed with sick coots removed from a lake during an AVM outbreak (Larsen, personal communication 2002). Furthermore, information obtained in these trials indicated that clinical signs of AVM resolved in some affected coots (Larsen et al. 2002). This is consistent with resolution of intramyelinic edema due to hexachlorophene toxicosis (Towfighi 1980).

Feeding trials also have been used in attempts to identify the source of the AVM agent and its mode of transmission, as well as to develop animal models for AVM investigations. In 2001, SCWDS experimentally reproduced AVM for the first time by feeding tissues from affected coots to rehabilitated but unreleasable red-railed hawks (*Buteo jamaicensis*) (Fischer et al., unpublished data: 2001). Feeding trials are continuing at SCWDS to determine potential mammalian susceptibility to the cause of AVM and to develop animal models for future AVM trials. Feeding trials also have been conducted by other organizations, including NWHC and North Carolina State University. Materials, including water, sediment and vegetation collected from lakes during AVM outbreaks, have been fed to laboratory mice, mallards and bobwhites; results have been negative to date (Rocke et al. 2002).

Investigations of AVM continue to be conducted by a number of organizations. In addition to those listed above, the South Carolina Department of Natural Resources, Clemson University and the Savannah River Ecology

Laboratory have collaborated to investigate potentially toxic algae that are one possible cause of AVM. The NWHC and SCWDS continue to conduct diagnostic examinations of eagles and other birds with AVM, as well as field investigations during AVM outbreaks, to identify additional species, particularly mammals, that may be susceptible to this recently recognized disease.

The wildlife biologists and health specialists that have been investigating AVM since 1994 frequently have called upon scientists in other disciplines for consultation. University of Arkansas Medical Center neurologists have conducted examinations and radiologists have performed diagnostic imaging of affected bald eagles found alive. Researchers of myelin disorders at the Mayo Clinic in Rochester, Minnesota have reviewed diagnostic materials and provided consultation regarding birds with AVM. Human neurologists, state and federal public health authorities, and toxicologists have met with AVM investigators to assess the efforts and to offer suggestions for future diagnostic and research projects.

Summary

Wildlife biologists and health specialists have been frustrated by a long list of negative findings in their AVM investigations, however studies continue to provide pieces of information to aid the determination of the cause and its source. Available data indicate that AVM may have been present at least since 1990, occurs in at least five states, has been documented during October through April at sites of wintering populations of birds where the exposure apparently occurs, and has killed at least 90 bald eagles. Birds with AVM have difficulty or inability to fly, swim, walk or perch, but there has been resolution of clinical signs in some affected coots. The list of affected species continues to grow, but remains confined to wild avians, including bald eagle, American coot, great horned owl, killdeer, Canada goose, mallard, ring-necked duck and bufflehead. The effects of the AVM agent on mammals, including human beings, are unknown. A neurotoxicant of manmade or natural origin is the suspected cause of AVM because no infectious disease agents, such as viruses, bacteria, parasites and prions, have been found, and the lesion and epizootiology of AVM resemble those of toxicoses. Additionally it is documented, experimentally, that exposure to raptors can occur through ingestion of affected coots.

Collaborative studies will continue in the effort to identify the cause of AVM, its geographic distribution and the range of species susceptibility. Hopefully, this information can be used to identify measures that might be taken to reduce the impact of AVM on the wildlife resource. Multiple agencies, institutions and individuals must rely on each other's expertise in the multidisciplinary approach to this problem, persevere in their efforts and take advantage of serendipity that presents itself during investigations of this newly recognized cause of wild bird mortality.

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West Nile Virus: A Threat to North American Avian Species

Robert G. McLean
US Geological Survey, National Wildlife Health Center
Madison, Wisconsin

Introduction

West Nile virus (WNV) was introduced into the United States (US), specifically in New York City (NYC), in 1999; this translocation represented a major shift out of its normal geographical distribution of Africa, the Middle East, Europe and the western parts of Asia (Center for Disease Control 1999a). The route or method of entry into the US is still unknown. WNV is in the genus *Flavivirus*, the family Flaviviridae and is closely related to some other viruses in this family, such as Japanese encephalitis virus in Southeast Asia, Murray Valley encephalitis virus in Australia and St. Louis encephalitis (SLE) virus in North and South America. The principal vertebrate hosts for these viruses are wild birds, but few cases of clinical disease or mortality of wild birds were reported previously from natural infection with these viruses, although significant morbidity and mortality occurred in humans and domestic animals (Monath 1988). Natural maintenance of these arboviruses (arthropod-borne viruses) involves their transmission from infected mosquitoes to susceptible birds. A variety of wild birds may become infected, however some species are incompetent hosts for the viruses and do not regularly infect mosquitoes. On the other hand, infections in reservoir competent wild bird species produce high amounts of the virus in their blood (viremia) for the duration of several days and subsequently infect the mosquitoes that feed upon them, completing the transmission cycle. These competent bird species frequently maintain and amplify the particular virus.

Bird populations within the US are frequently infected with the closely related SLE virus, and birds are the source of the virus when humans are infected through mosquitos that feed on both (McLean and Bowen 1980). WNV infects similar wild bird species within its geographic range (Work et al. 1955, Komar et al. 2001b) and fill the same role as a source to infect mosquitoes that transmit

WNV to humans (Marfin et al. 2001). Domestic birds infected with WNV do not develop viremias sufficient to infect vector mosquitoes and are considered incidental hosts for the virus (Langevin et al. 2001), with the exception of domestic geese (Swayne et al. 2001). Domestic livestock, especially equines, and humans are incidental or dead-end hosts as well, since they do not generally contribute to further WNV transmission.

West Nile Virus Introduction and Establishment in United States

The strain of WNV introduced into the US was nearly identical to a new more virulent strain (Isr98) from the Middle East (Lanciotti et al. 1999, Giladi et al. 2001). This invasive virus caused a human epidemic of 62 cases, 7 deaths and extensive mortality in birds in the NYC region before the transmission season ended in November 1999 (Center for Disease Control 1999b). West Nile virus activity expanded from the original epidemic zone in Queens in NYC and from the central cluster of WNV positive birds in the NYC area to more than a 100-mile-wide (over 161 km) epicenter, in 22 counties in three states surrounding NYC (Eidson et al. 2001a). Sightings of dead crows in the region from August to October matched the outward geographic expansion of the laboratory-confirmed, WNV-positive American crows (*Corvus brachyrhynchos*), suggesting that crows were likely responsible for the expansion of WNV out of NYC and that thousands of crows may have died from WNV infection (Eidson et al. 2001b). Analysis of December bird count data from the area showed a decline in the number of crows in the affected zone after the epizootic in 1999, compared to 1998 data (Eidson et al. 2001a). The American crow emerged as the primary indicator of WNV activity because of its high susceptibility to infection. Local and state public health departments began using WNV positive crows to make decisions about human risk. This unique surveillance system integrated state and federal agencies of wildlife health with public health into a coordinated effort to monitor the detection, intensity and geographic expansion of WNV activity. In the US, a total of 295 free-ranging birds of 20 avian species (89% were American crows) were laboratory-confirmed WNV-positive in New York, New Jersey and Connecticut in 1999 (Figure 1), including some captive native and exotic bird species in zoological collections in the area (Steele et al. 2000, Eidson et al. 2001a). Positive birds were collected from August 2 to November 15, 1999.

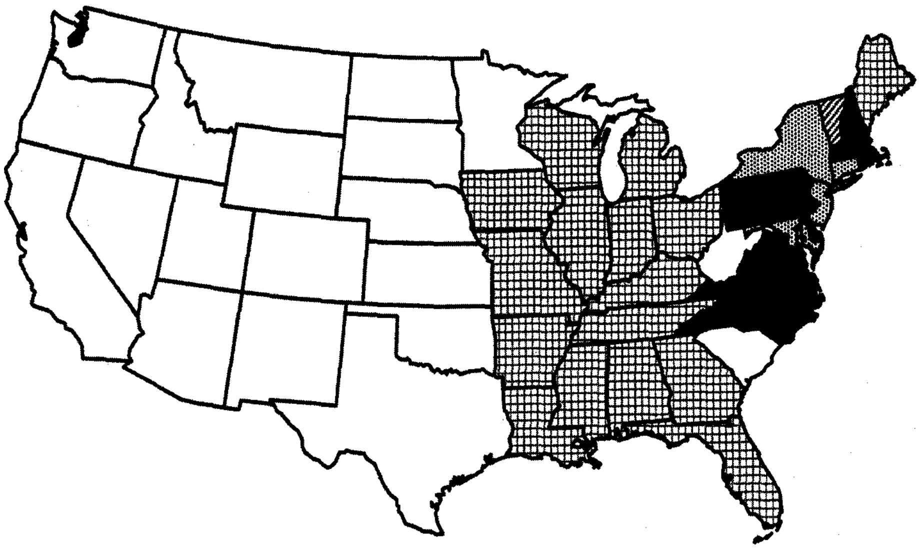

Figure 1. The distribution of WNV activity between 1999 and 2001, in the United States (Eidson et al 2001, Marfin et al. 2001, USGS 2001). Stippling represents WNV presence during 1999 and 2001, diagonal lines represent 2000 only, solid black represents 2000 and 2001, and cross hatching represents 2001 only.

West Nile Virus Expansion in North America

2000 National Surveillance Information

West Nile virus survived the temperate winter of the northeastern US, where there is no continuous mosquito activity to sustain transmission. But, it re-emerged in 2000 within the same 1999 epicenter in the NYC area, first in American crows in May. Enhanced surveillance of wild birds, sentinel chicken flocks, mosquito vectors and domestic animal and human infections was established initially in 20 states along the Atlantic and Gulf Coast to monitor the geographical dissemination and temporal spread of WNV in the US (Center for Disease Control 2000). Local government officials and the public were enlisted through communication and education campaigns to observe, report and collect dead birds for testing by state and federal laboratories for WNV infection. Data from all of the surveillance components were accumulated, verified and submitted by state health departments to a cooperative WNV national surveillance network, ArboNET, developed and maintained by the Centers for Disease Control and Prevention (Marfin et al. 2001). This surveillance system provided weekly data summaries and maps of WNV activity throughout the country to monitor its spread, to identify areas of high risk and to assist in the development of prevention and control strategies.

The reporting of WNV activity in 2000 rapidly expanded northward from the 1999 epicenter to the Canadian border during the spring and early summer, then westward to Lake Erie during late summer, and finally southward to North Carolina in the autumn, ultimately including 12 states and the District of Columbia (Figure 1). Additional human cases (21) and two deaths occurred in the NYC metropolitan area (Marfin et al. 2001). Of the total of 104,816 dead birds, reported in 321 counties in 16 states from the state surveillance networks, 12,961 (12%) were submitted for WNV testing, and 4,305 (33%) were virus positive (Table 1). Crows comprised 7,580 (58%) of the birds, and 50 percent of the tested crows were WNV-positive, whereas only 481 (9%) of birds from other species tested (5,381) were positive (Marfin et al. 2001). A significant portion was from New York State (Bernard et al. 2001). The positive percentage of all birds tested in New York was similar to the national positive percentage (Table 1). In upstate New York, north of the epicenter of WNV activity in the NYC area, 23 percent of all birds tested were WNV-positive, versus the 51 percent within the epicenter region. Other bird species and American crows had similar infection rates in the non-epicenter region, whereas 67 percent of dead crows tested from the epicenter were WNV positive (Bernard et al. 2001). Two other states within the epicenter region, Connecticut and New Jersey, reported even higher numbers of WNV positive crows (greater than 1,000) than New York in 2000, but these states concentrated on collecting and testing primarily crows. The percentage of crows testing positive (70%) for WNV infection in the epicenter region of Connecticut (Hadler et al. 2001) was similar to the 67-percent infection rate found in the New York part of the epicenter (Table 2). Five wild mammals (striped skunk, *Mephitis mephitis*; eastern gray squirrel, *Sciurus carolinensis*; eastern chipmunk, *Tamias striatus*; big brown bat, *Eptesicus* fuscus; and little brown bat, *Myotis ucifuus*) were found WNV-positive in 2000 in New York and Connecticut (Marfin et al. 2001).

Dead birds confirmed with WNV infection were reported, the first on February 6, 2000, from a red-tailed hawk (*Buteo jamaicensis*) (Garmendia et al. 2000), and the last on November 17, 2002, from an American crow. However, 85 percent of positive birds were found between July 1 to September 30 (Marfin et al. 2001). This late summer peak of positives represents the amplification of

Table 1. Birds tested for and laboratory-confirmed positive with West Nile virus in 2000 in New York State and for the United States (Bernard et al. 2001, Marfin et al. 2001)

Location/ category	Number positive species	Number tested	Number positive	Percent positive
New York State	61	3,403	1,201	35
Crows only	2	1,732	814	47
Other species	59	1,671	387	23
United States	63	12,961	4,305	33
Crows only	2	7,579	3,823	50
Other species	61	5,382	482	9

WNV transmission in the form of an epizootic in the bird populations. Serologic testing of sentinel bird species for WNV antibody within the epicenter, in 2000 on Staten Island, New York, identified captive pigeons (*Columba livia*) and several wild passerine bird species as possible candidates for use in active WNV surveillance programs (Komar 2001a).

Tens of thousands of birds died in 2000, affecting many new species, from hummingbirds to wild turkeys for a total species list, for the first two years, of 54 native and five non-native, free-ranging species and of six native and five exotic captive species (US Geological Survey 2001a). It is estimated that about 40,000 crows died in New York State alone and of the 12,961 birds tested in the 12 affected states, 4,305 (33%) were WNV-positive (Tables 1 and 3). American crows comprised 3,824 (89%) of all virus positive birds and bluejays (*Cyanocitta cristata*) were 196 (5%). One common raven (*Corvus corvax*) also tested positive in Massachusetts for a total of 93 percent of all

Table 2. *Corvus* spp. tested for and laboratory-confirmed positive with West Nile virus in 2000 in two epizootic states and for the United States (Bernard et al. 2001, Hadler et al. 2001, Marfin et al. 2001)

Location	Number species	Number tested	Number postive	Percent positive
United States	3	7,580	3,824	50
New York State 7	2	1,732	814	47
Non-epicenter				23
Epicenter				67
Connecticut (epicenter)	2	1,574	1,095	70

Table 3. Laboratory-confirmed positive birds with West Nile virus reported in 2000 in the United States (Marfin et al. 2001)

Common name	Scientific name	Number positive	Percent of all infected birds
Crows	*Corvus* spp	3,824	88.8
Blue Jay	*Cyanocitta cristata*	196	4.6
Hawks and Falcons	*Accipiter, Buteo, Falco* spp.	44	1.0
Ruffed Grouse	*Bonasa umbellus*	27	0.6
Gulls	*Larus* spp.	26	0.6
House Sparrow	*Passer domesticus*	20	0.5
American Robin	*Turdus migratorius*	20	0.5
Mourning Dove	*Zenaida macroura*	17	0.4
Other Birds	46 other species	131	3.0
Total	63 species	4,305	

positive dead birds as Corvidae. Predatory birds may also be at risk since six hawk and two owl species were positive. Despite the large numbers of birds reported dead and the relatively large number tested for virus, little is known about the effect this virus may have on local or regional populations of birds. The broad expansion of WNV activity in 2000 was probably accomplished by other bird species, most likely some migratory species that do not suffer much mortality (Rappole et al. 2000). The virus was detected as far south as North Carolina by the end of September and even may have reached farther south before the end of the autumn migration of birds.

2001 National Surveillance Information

Following the 10-fold expansion of the distribution of WNV in the northeastern US in 2000, the virus again survived through the dormant winter season and reappeared in American crows in five separate states in late April and early May 2001. These sites were within the 2000 expanded WNV region in the Northeast. Four of the five locations now represent persistent geographical foci of WNV activity (Connecticut, Maryland, New Jersey and New York) because positive birds were reported there from 1999 to 2001 (Eidson et al. 2001a, Marfin et al. 2001, Center for Disease Control 2001a). A new focus of WNV was detected in northern Florida in June and began to quickly expand in all directions. This virus focus probably started during autumn of 2000 by migratory birds becoming infected in the northeast and carrying WNV south during their fall migration to and through Florida. The seeding of the virus and the establishment of WNV at this Florida site was certainly influenced by the extended period of mosquito activity that occurs in the warmer Gulf Coast areas of the southeastern states. Transmission of WNV in the bird-mosquito cycle in northern Florida remained below surveillance detection until amplification of transmission was sufficient in June for dead crows to be observed and submitted for WNV testing from this rural area (Center for Disease Control 2001a). Equine clinical cases quickly followed in June and the first human case of the year for the US was reported in an adjacent Florida county with onset of the illness around July 15. Since mosquito transmission within this WNV focus likely occurred weeks before the detection of the virus in June, migrating birds could have become infected while traveling through the area in April and May on their way northward carrying WNV to northern locations, including to some Midwestern states.

Regardless of how the virus was disseminated in the US in 2001, WNV began to be detected in an expanding area from the northeast and southeast to eventually encompass 27 states and Ontario, Canada, by the end of the northern transmission season in November (Figure 1). The original focus in northern Florida gradually expanded throughout that state south to the Florida Keys (Florida Department of Health 2001) and into the neighboring states of Georgia and Alabama. The virus was detected in the Midwestern states of Ohio, Michigan, Wisconsin, Illinois and Indiana, starting in July and August, and it expanded in those states throughout the remainder of the transmission season (Center for Disease Control 2001b). After the initiation of autumn bird migration to the south, states along the Mississippi flyway began detecting WNV-positive dead birds until all of the states on both sides of the Mississippi River, except Minnesota, reported positive birds. Some of the reporting sites were in cities on the river, like Saint Louis, Missouri and Memphis, Tennessee (Center for Disease Control 2001c, US Geological Survey 2001b). Memphis reported 44 positive birds during the months of September and October.

Preliminary surveillance results for 2001 indicate that 58 human cases–with eight deaths–occurred in 10 states, 564 equine cases–in 18 states (US Department of Agriculture 2001, Florida Department of Health 2001)–and 911 pools of mosquitoes (a pool consists of 1-100 mosquitoes, generally of a single species, collected from one site during one night of trapping) tested positive from 24 mosquito species–in 17 states. From a total of 7,058 birds in 27 states, 5,036 crows (71%) were reported WNV-positive (US Geological Survey 2001b). If the current rate of expansion of WNV continues, doubling the geographical distribution (Figure 1) and the number of dead birds each year (Figure 2), all of the contiguous continental states could be affected and more than 15,000 birds could die from WNV in 2002.

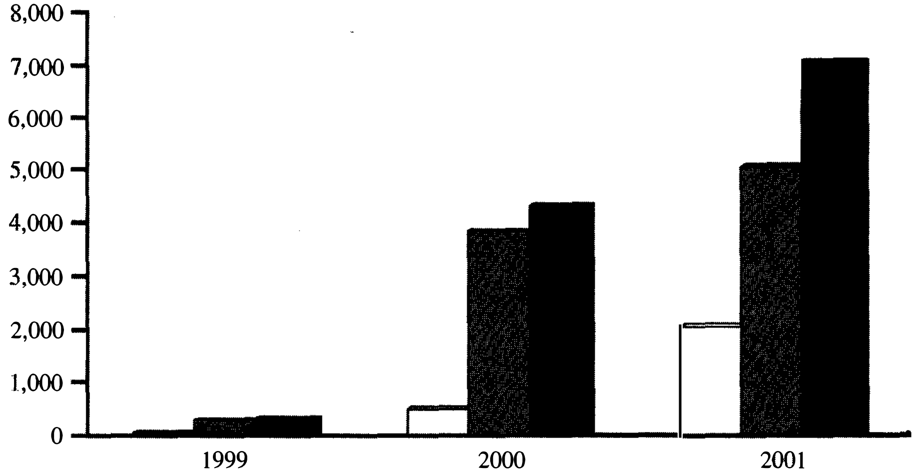

Figure 2. The number of dead birds reported positive with West Nile virus between 1999 and 2001 in the United States (Eidson et al. 2001, Marfin et al. 2001, US Geological Survey 2001). White represents other birds, gray represents American crows and black represents total birds.

Experimental Studies

Since the information from the dead bird surveillance indicated that crows were particularly susceptible to infection with WNV, experimental studies were initiated in the biosafety level 3 animal facility at the US Geological Service National Wildlife Health Center to determine the extent of their susceptibility. American crows captured in Wisconsin in late winter 2000 were used in two separate experimental infection studies (McLean et al. 2001). Experimental crows were inoculated subcutaneously with a New York 1999 strain of WNV and control birds were inoculated with saline. In the first experiment, the crows were held individually in separate cages and all of the WNV inoculated crows died within four to seven days; the control birds did not become infected.

Viremias in infected crows were sufficient, before they died, to infect vector mosquitoes, indicating that crows are reservoir competent hosts (McLean, personal communication 2001).

In the second experiment, nine WNV inoculated crows, receiving the same dose as in the first experiment, and seven non-inoculated control birds were housed together in the same animal room in a free-flying arrangement that allowed regular contact with each other. Again, all nine inoculated crows died within five to eight days, however control birds began to die 10 days after the start of the experiment, two days after the last inoculated crow died (McLean, personal communication 2001). Five of the seven control crows died by day 21. The method of transmission between the infected and control crows was likely through oral ingestion and not by aerosol, since no control birds died during the first experiment where their only contact was by air. Direct transmission between birds through pecking and cannibalism of infected and clinically ill birds, as has occurred with eastern equine encephalitis virus in commercially raised ring-necked pheasants (*Phasianus colchicus*) (McLean et al. 1985) and in other exotic game birds, was not the method of transmission among crows in this experiment. Virus-laden discharge in feces from birds infected with the 1999 New York strain of WNV occurred in experimental studies with chickens (Langevin et al. 2001) and was the likely source of WNV for control crows in this experiment. The significance of direct transmission of WNV between crows and whether it occurs under natural conditions is unknown at this time. Even though crows die from infection with WNV, they circulate enough virus in their blood for a few days prior to death to infect large numbers of vector mosquitoes and locally perpetuate WNV transmission.

Summary and Conclusion

The introduction and extensive expansion of WNV in the US in the last three years is having a dramatic impact on native wildlife. The disease continues to cause significant mortality in a variety of bird species throughout the eastern US, particularly in American crow and blue jay populations. As the virus expands to new habitats in the southern, midwestern and western states, new bird species will be at risk and different patterns of transmission will develop. In the western states, many additional species of Corvidae (crows, jays, ravens, magpies and nutcrackers) may be affected. Once it becomes well established in states with warm climates, like Florida where mosquitoes are active year round to sustain almost continuous transmission; these states could serve as annual sources of WNV for migratory birds to re-introduce the virus to northern states in the spring. The rapid increase in geographical distribution of WNV activity that has occurred throughout the eastern US and the rapid increase in the infection and mortality rates in birds during the last three years indicate the emergence of an epizootic disease of major importance to North American birds.

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Hemorragic Disease in White-tailed Deer: Our Current Understanding of Risk

David E. Stallknecht
The University of Georgia
Athens

Elizabeth W. Howerth
The University of Georgia
Athens

Joseph K. Gaydos
University of California
Davis

Introduction

Although hemorrhagic disease (HD) in white-tailed deer (*Odocoileus viriginianus*) was first described from an outbreak in New Jersey during 1955 (Shope et al. 1960), suspected HD-related mortality was reported as early as 1901 (Nettles and Stallknecht 1992). The disease is caused by viruses in the Epizootic Hemorrhagic Disease (EHD) and Bluetongue (BT) serogroups of the genus *Orbivirus,* family *Reoviridae.* In North America, there are two serotypes of EHD virus (EHDV-1 and EHDV-2) and five serotypes of BT virus (BTV-2, BTV-10, BTV-11, BTV-13 and BTV-17). With the exception of BTV-2, all of these viruses have been associated with HD in white-tailed deer (Shope et al. 1960, Thomas et al. 1974, Barber and Jochim 1975, Howerth et al. 1988). Hemorrhagic disease represents the most important viral disease affecting white-tailed deer throughout their range in the United States, but, due to extreme variation in clinical response, ranging from death to subclinical infection, spatial and temporal risks associated with these infections are not constant. The objective of this review is to evaluate our understanding of risk associated with HD, specifically addressing the following questions:

- Can we predict where HD mortality and morbidity will occur?
- Can we predict when such mortality and morbidity will occur?
- Can we predict the impacts of such outbreaks on white-tailed deer populations?

Where does HD occur?

The distribution of HD within the United States has been mapped based on 10 years (1980-1989) of clinical data compiled from state wildlife agencies (Nettles et al. 1992a). In general, HD has been reported throughout the southeastern United States, extending as far north as New Jersey and as far west as Texas. From this area the range of reported HD extends in a northwesterly direction through the Midwest to eastern Montana. Reports of HD also have been recorded from Washington, Oregon and California, primarily from mule and black-tailed deer (*O. hemionus*). There are few reports from states in the Northeast and Southwest and from those states bordering the Great Lakes. As of 2002, this distribution has not changed (Nettles, personal files).

Clinical disease associated with HD is extremely variable, ranging from subclinical infection to death, but clinical patterns can be predicted, based on the occurrence of endemic or epidemic disease patterns (Nettles et al. 1992b, Davidson and Doster 1997). In endemic areas that occur throughout the coastal plains of the Southeast, some mortality may occur, but most reported cases of HD represent the chronic form of the disease. These cases are characterized by hoof and rumen lesions, and, in general, the disease may affect condition, but most infected animals survive. In contrast, in areas of the Midwest and in the Piedmont and Appalachian Mountain areas of the Southeast, where epidemic HD occurs, high levels of mortality are common. In addition to these two patterns, a third pattern exists in Texas and possibly other areas of the Southwest and Midwest. In these areas, infections do not result in clinical disease. In Texas, for example, there are very few reported cases of HD, though infection rates, as determined by the presence of antibodies to these viruses, approach 100 percent (Stallknecht et al. 1996). Based on few clinical reports of HD (Nettles et al. 1992a) and very high antibody prevalences for both the EHD and BT viruses (Stallknecht et al. 1991), a similar situation may occur in southern Florida.

It is believed that this clinical variation associated with infection with the EHD and BT viruses reflects varying degrees of enzootic stability (Stallknecht et al. 1996). In this case, the severity of disease is inversely related to the antibody prevalence, which reflects the extent of previous infection in the population. Such a relationship can exist as a result of herd immunity, through maternal antibody transfer, from acquired immunity resulting from previous infection or through the long-term evolutionary development of innate resistance.

Maternal antibody transfer could serve to protect fawns during the first transmission season. In areas such as Texas, where a very high prevalence (approaching 100%) of antibodies to these viruses exists, virtually all fawns demonstrate antibodies to multiple EHD and BT viruses (Gaydos et al. 2002). Maternal antibodies to both the EHD and BT viruses, as detected by agar-gel immunodiffusion and serum neutralization tests, can persist for at least 23 and 18 weeks, respectively. This indicates that fawns would have some antibody-based protection throughout most of the normal transmission period for these viruses. It is unknown, however, if such antibodies would be totally or partially protective. Acquired resistance, through previous exposure to these viruses, has been shown to provide protection, but is dependent on the serotype and the serogroup of the subsequent challenge virus. Previous infection will provide protection if the animal is challenged with a homologous EHD virus (Shope et al. 1960, Pirtle and Layton 1961, Quist et al. 1997). This also has been demonstrated with the BT virus (BTV-10) in pronghorn (*Antilocapra americana*) (Hoff and Trainer 1972). Previous infection will provide partial protection against subsequent challenge with a virus in the same serogroup. In white-tailed deer, this has been shown with EHD (Gaydos 2001), but not BT. No protection is provided if the challenge virus belongs to a different serogroup. This has been demonstrated in white-tailed deer that had recovered from EHDV-2 infection that were subsequently infected with BTV-10. (Quist et al. 1997) and vice versa (Hoff and Trainer 1974). These results demonstrate that herd immunity can be dependent on which specific EHD or BT virus subsequently infects the population. From a field standpoint, however, this may not present a limitation to protection via this route. Serologic testing of white-tailed deer herds, especially in the southeastern United States, suggests that in endemic areas, such as Georgia (Stallknecht et al. 1995) and Texas (Stallknecht et al. 1996), herds are commonly exposed to multiple serotypes of both EHD and BT viruses. In addition, subsequent infections occur annually or in a relatively short two- to three-year cycle within the normal life expectancy for a white-tailed deer. This does not appear to be the case in epidemic areas, where only one serotype (EHDV-2) appears to dominate. This has been demonstrated through long-term serologic testing of white-tailed deer in Georgia (Stallknecht et al. 1995) and through virus isolation results from HD cases submitted to the

Southeastern Cooperative Wildlife Disease Study (SCWDS) from the entire United States. Since 1990, over 90 percent of more than 120 virus isolations from white-tailed deer have been identified as EHDV-2 (D. E. Stallknecht, personal files). However, while this lack of viral diversity would favor individual animal protection through challenge with an homologous virus, the occurrence of outbreaks on a long-term eight- to ten-year cycle exceeding the longevity of most white-tailed deer limits the importance of this potential protective mechanism at epidemic sites.

Innate resistance to these viruses was originally suspected based on observations that HD was rarely reported from deer in areas where high antibody rates to both EHD and BT viruses were observed (Stallknecht et al. 1996). To date, this has been studied only with the EHD viruses and only with two subspecies of white-tailed deer (Gaydos 2001). A marked difference in clinical response was observed between two subspecies of white-tailed deer, one from Texas (*O. v. texanus*), which occupies an EHD/BT virus endemic area, and one from Pennsylvania (*O. v. borealis*), which occupies an epidemic area. This difference was observed in experimental infections with both EHDV-1 and EHDV-2, and, in the case of EHDV-1, clinical variation was extreme with 100-percent mortality observed in Pennsylvania deer versus 0-percent mortality for the Texas deer. Results from similar studies with deer from Missouri and North Carolina suggest that similar variations in innate resistance may occur within other white-tailed deer populations (Gaydos 2001). Although innate resistance has only been demonstrated in deer with the EHD viruses, a similar situation probably exists with the BT viruses as mortality is seldom reported from BT virus endemic areas.

The distribution of broad clinical patterns associated with HD can be predicted based on the range of the vector species *Culicoides sonorensis* (Holbrook 1996) and the extent of viral challenge in the populations. Due to the absence of *C. sonorensis* in the Northeast, HD is not present. Significant mortality occurs only in epidemic areas where the disease is seen infrequently. A low prevalence of antibodies in white-tailed deer, usually represented by a single EHD or BT virus serotype, is characteristic of such areas. Mortality is seldom seen in endemic areas, and this probably relates to the combined effects of acquired and innate immunity. In endemic areas, such as the Coastal Plain of the Southeast where infection probably occurs on a two- to three-year cycle, mortality is rare, and the chronic form of HD is most often reported. These areas are characterized by a moderate prevalence of antibodies, usually exceeding 30 percent, and serologic evidence of multiple EHD and BT serotypes. These areas, where chronic HD is most often reported, probably represent a gradient in susceptibility between complete susceptibility, as seen in epidemic areas, and the compete resistance, observed in deer from areas of enzootic stability. Areas where enzootic stability occur are characterized by extremely high antibody prevalence rates (approaching 100%) and high serotype diversity.

When does HD occur?

The seasonal distribution of HD is well documented. Disease is seen from mid-summer through late-autumn and usually peaks in September (Couvillion et al. 1981). From 1990 to 2001, we have made over 120 isolations of EHD and BT viruses from deer throughout the Southeast and Midwest and all have come from clinical submissions within this same seasonal period (D. E. Stallknecht, personal files). Seasonal distribution is most likely related to seasonal patterns in vector abundance. In addition to *C. sonorensis*, seasonal abundance patterns of several other *Culicoides* species coincide with the late summer and early autumn peaks observed with HD (Smith and Stallknecht 1996, Smith et al. 1996). The vector status of these additional species currently is unclear.

Annual variation is much more difficult to understand. In endemic areas, viral transmission appears to occur on a short two to three-year cycle (Couvillion et al. 1981). In epidemic areas, transmission appears to occur on an eight- to ten-year cycle (Couvillion et al. 1981, Nettles et al. 1992b). These cycles are not explained at this time, but probably relate to combined effects of herd immunity and natural or weather-induced fluctuations in vector populations. This is further complicated by the possibility that these short- and long-term cycles may occur concurrently in some areas where epidemic and endemic areas interface. Such a situation may exist in Georgia, where long-term analysis (20 years of data) of antibody prevalence in white-tailed deer suggests that HD outbreaks can be predicted based on the combined effects of concurrent three- and eight-year cycles (D. E. Stallknecht, personal files).

Although it is reasonable to assume that long- and short-term weather patterns affect the distribution and abundance of *Culicoides* vector populations, predictive models, relating to climate and its influence on HD, currently are lacking. In Australia, climatic factors have been tested in relation to the prevalence of antibodies to BT viruses in cattle (Ward 1994). Although a relationship was detected between prevalence, average daily minimum temperature and average annual rainfall, these variables accounted for only 40 percent of variation, suggesting that other nonclimatic factors need to be included. Indirect climatic indicators also have been evaluated, in relation to BT virus vectors around the Mediterranean (Baylis et al. 2001). In this study, the annual distribution of the vector *C. imicola* was predicted based on remotely sensed data. Distribution could be predicted based on indices reflecting the phase of the annual vegetational cycle. Such approaches have not been applied to the occurrence of HD in white-tailed deer populations.

These generalized cycles have regional application only. At present, there is no way to predict risks associated with specific populations or locations within specific regions.

What are the impacts?

Although HD has been recognized as a potential mortality factor in white-tailed deer, the actual impacts of this mortality on populations are very poorly understood. It has been suggested, based on previous observations and estimates of high mortality sometimes exceeding 90 percent (Fay et al. 1956, Shope et al. 1960, Karstad et al. 1961), that these outbreaks can result in significant impact on the population. Potential indirect impacts, primarily associated with reproduction, also have been suggested (Thomas and Trainer 1970). As BT represents an internationally important, domestic animal disease, indirect impacts also can take the form of management conflicts with domestic animal producers

Direct impacts of HD on an infected white-tailed deer population are difficult to evaluate because of two recurring problems. The first relates to available pre- and post-population estimates for white-tailed deer populations affected by HD. The second relates to obtaining accurate and complete data on mortality during an outbreak. With regard to population estimates of white-tailed deer, scale often is problematic. Outbreaks do not follow the geographical or management boundaries that humans set, and, often, HD outbreaks are localized. It often is extremely difficult to obtain population data on specific areas. In addition, most population estimates are based on indices or models driven by harvest data. Such data are often biased by variables that affect hunter success, and, for this reason, short-term population fluctuations are difficult to detect. This is especially true on small management areas with shorter hunting seasons, where weather or habitat conditions can greatly affect hunter success. With regard to estimating mortality, data are even more difficult to obtain. Direct counts of dead deer are impractical in most areas, and indices relating detected mortality to actual mortality are lacking. Because of these problems, there are few estimates of HD impacts in the literature, and all are associated with epidemic areas.

Results from an HD outbreak, in Missouri during 1988, were analyzed on a deer-management unit basis, using models (Fischer et al. 1995). Results suggested that mortality ranged from 6 to 16 percent, representing the death of over 14,000 animals. These loses were additive to hunting mortality and appeared to result in population declines extending for two years after the outbreak. In West Virginia, data relating to a localized outbreak, affecting deer in two contiguous counties during 1993, was evaluated (Gaydos 2001). In this study, it was estimated that 35 percent of the herd was infected with EHDV-2 (the only virus present during this outbreak) and that 23 percent of the herd died. In this case, total mortality was estimated at 2,000 animals. Data from another localized HD outbreak, occurring in Missouri during 1996, suggested an infection rate of 24 percent with 8-percent mortality (Beringer et al. 2000). It is interesting to note that this outbreak was detected because white-tailed deer were being radio-monitored as part of another study; beyond this there was not a single report of mortality received from the public.

Perhaps the most important observation relating to HD impacts is the fact that white-tailed deer populations have expanded dramatically in the presence of continued infection with both the EHD and BT viruses. This observation does not negate the possibility of large-scale die-offs or short-term population impacts, but it certainly suggests that HD does not represent a long-term population limiting factor.

In addition to direct mortality impacts, potential indirect impacts also need to be considered. As previously stated, effects on reproduction have been suggested. However, with HD, the normal reproductive season for white-tailed deer and the observed transmission cycle for HD do not correspond and it is unlikely that *in utero* problems, as can occur in livestock, present a significant risk to deer populations (Nettles and Stallknecht 1992). Fertility problems also have been suggested as testicular hemorrhage in affected animals has been reported (Karstad 1961, Thorn et al. 1988).

Bluetongue represents an important livestock disease primarily affecting sheep and cattle. In sheep, significant mortality can occur, while in cattle infection, it may produce a mild, clinical disease. The EHD viruses can infect both sheep and cattle but are suspected of causing clinical disease, similar to bluetongue, only in cattle (Metcalf et al. 1992, Abdy et al. 1999). Bluetongue is a List A disease, as classified by the Office International des Epizooties (OIE), and infection in domestic animals can result in export restrictions that cause significant economic losses to livestock producers. As HD outbreaks often are detected in wildlife species before or during confirmed or suspected BT or EHD cases in livestock, white-tailed deer often are suggested as the source for these problems. At present, such claims are not supported by scientific literature. Both wild and domestic species can act as amplifying hosts for these viruses, and, during outbreaks, it is likely that the combined effects of the total susceptible ungulate population (both wild and domestic) are important.

A final area of potential impact relates to captive white-tailed deer. Mortality in such herds can be excessive, and SCWDS has received numerous reliable reports of mortality, exceeding 90 percent under confinement conditions (D. E. Stallknecht, personal files). This problem seems to be exacerbated when white-tailed deer from areas where HD is absent or rarely occurs are translocated to endemic areas.

Conclusions

- The distribution of HD in the United States is well defined.
- Spatial patterns of clinical severity within this distribution also can be defined, based on presence of the vector and prevalence of antibodies to BT and EHD viruses.
- The mechanisms behind these patterns are not completely understood, but there is evidence that both acquired and innate resistance are involved.
- Seasonal outbreaks are predictable and probably relate to vector abundance patterns.
- Annual outbreaks, while somewhat predictable on a regional scale, are not understood and probably are driven by a combination of weather, vector, herd immunity and random events.

- Direct impacts associated with HD outbreaks are not well-defined, but overall growth of the white-tailed deer populations suggests that long-term effects are not significant.
- Potential, indirect impacts associated with reproduction are not well-defined or supported at this time.
- Conflicts with livestock or alternative livestock (white-tailed deer) producers can occur, but at present are unfounded.

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Chronic Wasting Disease: Implications and Challenges for Wildlife Managers

Elizabeth S. Williams
University of Wyoming
Laramie

Michael W. Miller
Colorado Division of Wildlife
Fort Collins

E. Tom Thorne
Wyoming Game and Fish Department
Cheyenne

Introduction

Chronic wasting disease (CWD) is a transmissible spongiform encephalopathy (TSE) of cervids. The TSEs are grouped together because of similarity in clinical features, pathology and presumed etiology; the infectious agents are hypothesized to be prions (infectious proteins without associated nucleic acids) (Prusiner 1999). Scrapie of domestic sheep and goats, bovine spongiform encephalopathy (BSE) of cattle and transmissible mink encephalopathy of farmed mink (*Mustela vison*) are TSEs of domestic animals. Several rare fatal diseases of humans are also TSEs; Creutzfeldt-Jakob disease (CJD) occurs worldwide and variant CJD is associated with the agent of BSE, which occurs in cattle in areas, including the United Kingdom and parts of continental Europe. Since the appearance of BSE in the mid-1980s and, especially since the 1996 announcement of an apparent relationship between BSE and variant CJD (Will et al. 1996), there has been considerable media, public, animal agency and human health agency interest in TSEs. Consequently, CWD is a disease of increasing concern for wildlife managers, both in CWD-endemic areas and across North America. Many biological features of CWD pose significant challenges for wildlife managers attempting to control or eradicate the disease. Perhaps even greater challenges are those associated with balancing complex and often competing and conflicting interests of the general public, sportspeople, the game farming industry, traditional livestock industries, and many state and federal animal health and public health agencies. This is a short review of the biological features of CWD and strategies being used for its control and management.

History of Chronic Wasting Disease

CWD has been known as a clinical syndrome of mule deer (*Odocoileus hemionus*) for more than 30 years (Williams and Young 1980); modeling suggests the disease may have been present in free-ranging populations of mule deer for more than 35 years (Miller et al. 2000). Key events in the chronology of CWD are shown in table 1. Only three species of the family *Cervidae* are known to be naturally susceptible to CWD: mule deer, white-tailed deer (*Odocoileus virginianus*) and Rocky Mountain elk (*Cervus elaphus nelsoni*). Though, it is very likely that other subspecies of *C. elaphus* are susceptible to CWD. Susceptibility of other cervids to CWD is not known. Cattle and other domestic livestock appear to be resistant to natural infection. To date, only three of 13 cattle have become infected with the CWD agent following experimental intracerebral inoculation (Hamir et al. 2001), although this and other experimental studies, begun in 1997, are not yet completed (Williams et al., unpublished data).

The origin of CWD is not known and it may never be possible to determine how or when CWD arose. Though of academic interest, determining the origin is probably not very important from a management perspective. Nonetheless, speculation continues. Scrapie, a TSE of domestic sheep, has been recognized in the United States since 1947, and it is possible that CWD was derived from scrapie. Arguments can be made both for and against this hypothesis. It is possible, though never proven, that deer came into contact with scrapie agent either on shared pastures or in captivity along the front range of the Rocky Mountains, where high levels of sheep grazing occurred in the early 1900s. In addition, *in vitro* models suggest there is less of a species barrier to interspecies TSE transmission between deer, elk and sheep than between these cervids and either cattle or humans (Raymond et al. 2000). However, CWD has never been identified in other areas of North America or other parts of the world where cervids and domestic sheep with scrapie must have co-mingled. Strain-typing experiments determined that CWD is not like

Table 1. Chronology of significant events in the history of chronic wasting disease (CWD).

Year	Event
Late 1960s	first recognition of a clinical syndrome termed chronic wasting disease in captive mule deer in Colorado
1977/1978[a]	diagnosis of CWD in mule deer as a spongiform encephalopathy
1978/1979[a]	diagnosis of CWD in captive mule deer and black-tailed deer in Wyoming
1979	diagnosis of CWD in captive Rocky Mountain elk
late 1970s	diagnosis of spongiform encephalopathy in captive mule deer in a zoo in Ontario (CWD did not persist in this location.)
1980	first published report of CWD in captive mule deer
1981	diagnosis of CWD in free-ranging Rocky Mountain elk in Colorado
1982	first published report of CWD in Rocky Mountain elk
1983	start of hunter-harvest surveillance for CWD
1985	diagnosis of CWD in free-ranging mule deer
1990	diagnosis of CWD in free-ranging white-tailed deer
1992	first published report of CWD in free-ranging cervids
1996	diagnosis of CWD in game farm elk in Saskatchewan
1997	diagnosis of CWD in game farm elk in South Dakota
2000/2001[a]	diagnosis of CWD in free-ranging mule deer in Saskatchewan, possibly associated with CWD affected elk farm
2000/2001[a]	diagnosis of CWD in free-ranging mule deer in Nebraska, contiguous with the CWD endemic area of Colorado and Wyoming
2001	extensive depopulation of game farm elk in Saskatchewan due to CWD
2001	diagnosis of CWD in an elk imported from Canada to Korea in 1997
2001	declaration of a USDA animal emergency because of CWD in game farm elk
2002	diagnosis of CWD in free-ranging deer associated with an affected game farm in Nebraska

[a]Year samples collected/year diagnosis made.

known scrapie strains (Bruce et al. 2000), though direct comparisons with North American scrapie strains has not been conducted. Experimental transmission of CWD to a domestic goat by intracerebral inoculation had a prolonged incubation (Williams and Young 1992); shorter incubation would be expected with scrapie strains in goats. Experimental scrapie in cattle (Cutlip et al. 1994, Cutlip et al. 1997) and lesions of CWD in cattle are quite different (Hamir et al. 2001).

It may be possible that CWD is a spontaneous TSE that arose in deer in the wild or in captivity and has biological features promoting transmission to other deer and elk. The majority of human CJD cases are thought to be spontaneous (Gajdusek 1996) and associated with conformational change in a normal cellular protein (PrP^{C}) to the abnormal disease associated protease resistant protein (PrP^{res}), considered by many to be infectious agents of the TSEs. Occurrence of spontaneous CJD is approximately one per 1 million population per year. Spontaneous CWD may have happened in deer, though it is difficult to see how this could be proven.

Clinical Signs

Chronic wasting disease-affected deer and elk show loss of body condition and changes in behavior. The clinical disease is often more subtle and prolonged in elk than in deer. Affected animals may walk repetitive courses; they may show subtle ataxia and wide based stance; subtle head tremors occur in some animals; they may be found near water sources or in riparian areas; they may have periods of somnolence, and they may carry their head and ears lowered. Chronic wasting disease affected animals continue to eat, but amounts of feed consumed are reduced, leading to gradual loss of body condition. Excessive drinking and urination are common in the terminal stages because of specific lesions in the brain. Many animals in terminal stages of CWD have excessive salivation and drooling; this may result in wetting of the hairs of the chin and neck. Death is inevitable once clinical disease occurs.

The clinical course of CWD varies from a few days to a year, with most animals surviving from a few weeks to several months. While a protracted clinical course is typical, occasionally acute death may occur. Shorter clinical disease may be more common in the wild than in the relative security of captivity. Aspiration pneumonia is a common finding at postmortem examination of terminal CWD cases and may confuse the diagnosis if the brain is not examined. Aspiration pneumonia, presumably, is due to difficulty swallowing, hypersalivation and inhalation of foreign material into the lungs. Thus the brain should be examined for evidence of CWD on every prime age cervid that dies with pneumonia.

Diagnosis

Clinical signs of CWD alone are not diagnostic and definitive diagnosis is based on examination of the brain for spongiform lesions and accumulation of the CWD associated protease resistant protein (PrP^{CWD}) in brain and lymphoid tissues by immunohistochemistry. This test is based on use of monoclonal antibodies and chromogens to detect accumulation of PrP^{CWD} in various tissues. The parasympathetic vagal nucleus in the dorsal portion of the medulla oblongata at the obex (Figure 1) is the most important site to examine for diagnosis of CWD (Williams and Young 1993, Peters et al. 2000) because of its early involvement following infection. It is critically important that the correct portion of the brain be sampled for a meaningful test. The segment of the medulla oblongata required for testing can be removed from the brain through the foramen magnum and the specimen appropriately preserved (the obex in 10% buffered formalin and remaining brain frozen). Recent studies indicate that testing the retropharyngeal lymph node is more sensitive in deer than testing the brain and maybe the tissue choice for diagnosis of CWD in the future.

Demonstration of PrP^{CWD} in lymph nodes and tonsil of mule deer early in incubation (Sigurdson et al. 1999) provides a reliable means of antemortem and preclinical diagnosis of CWD (Miller and Williams 2002, Wolfe et al. 2002). However, due to differences in pathogenesis of CWD in elk, sampling lymphoid tissue in elk does not appear to be sensitive enough to use as a reliable antemortem diagnostic test.

Several laboratory tests developed for BSE are being evaluated for use in CWD diagnostics. If these tests are determined to be adequately sensitive and specific in subclinically affected cervids, they may provide for more rapid testing than is currently possible using immunohistochemistry.

Epidemiology

Chronic wasting disease is both transmissible and infectious, but most details of its transmission remain to be determined. In contrast to BSE

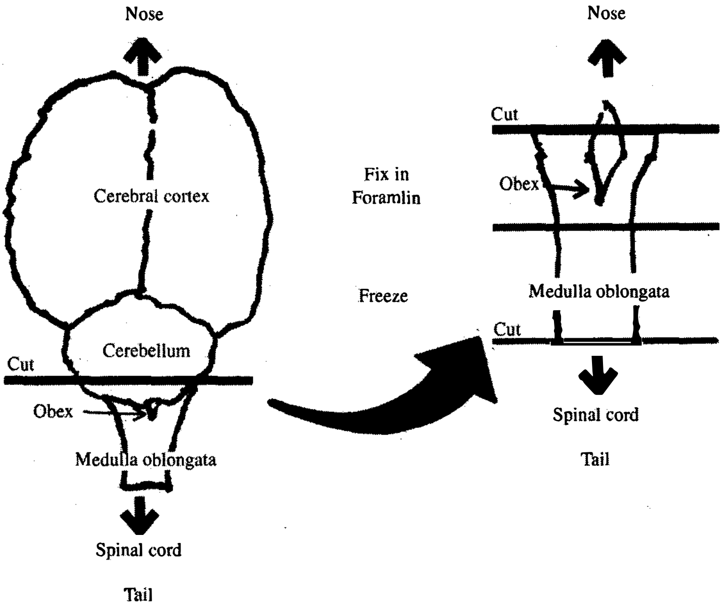

Figure 1. Diagram showing the correct portion of the brain needed for CWD testing by immunohistochemistry. The obex region should be fixed in 10% buffered formalin and the other portion of brain frozen.

(Wilesmith et al. 1988), CWD is not a foodborne disease associated with rendered ruminant meat and bonemeal. Instead, observations of CWD among captive deer and elk provide strong evidence of lateral transmission (Williams and Young 1992, Miller et al. 1998, Miller et al. 2000), which is similar to scrapie (Hoinville 1996); experimental and epidemic modeling data support these anecdotal observations (Miller et al. 2000, Gross and Miller 2001, Miller 2002). Maternal transmission may occur, but appears to be relatively rare and cannot explain most cases where complete epidemiologic data are available (Miller et al. 1998, Miller et al. 2000). Some interspecies transmission probably occurs among the three natural host species; suspected transmission from mule deer to elk, mule deer to white-tailed deer and elk to mule deer and white-tailed deer has been observed.

The presumed CWD agent (PrP^{CWD}) has been demonstrated by immunohistochemistry in various lymphoid tissues, including those of the digestive tract (e.g., tonsil, Peyer's patches and mesenteric lymph nodes) (Sigurdson et al. 1999, Miller and Williams 2002, Spraker et al. 2002). These distribution patterns suggest that PrP^{CWD} may be shed through the alimentary tract. Because TSE agents are resistant to the environment (Brown and Gajdusek 1991), transmission may be both direct and indirect. Concentrating deer and elk in captivity or by artificial feeding probably increases the likelihood of direct and indirect transmission between individuals. Contaminated pastures appear to have served as sources of infection in some CWD epidemics (Miller et al. 1998, Williams et al. 2002, Miller 2002); similar phenomena have been suspected in some outbreaks of sheep scrapie (Greig 1940, Palsson 1979, Andreoletti et al. 2000). The apparent persistence of PrP^{CWD} in contaminated environments represents a significant obstacle to eradication of CWD from either farmed or free-ranging cervid populations.

The overall duration of CWD infection (time from exposure to end-stage clinical disease) has been difficult to determine in natural cases–without clear knowledge of when animals become infected, it is impossible to accurately determine the overall course of disease. Experimental CWD challenge studies based on single-dose oral exposure to infectious brain tissue have yielded some insights into disease course. However, because the course of infection appears to be inversely related to exposure dose (i.e., greater exposure results in shorter duration), experimental data probably underestimate time frames for natural infections. Experimentally, minimum incubation (time from exposure to onset of clinical disease) was about 15 months and mean time from oral infection to death was about 23 months (range 20-25 months) in mule deer (Williams and Miller 2002); the range of incubation observed in orally infected elk was approximately 12 to 34 months (Williams et al. 2002). The maximum disease course is not known, but can exceed 25 months in experimentally-infected deer and 34 months in elk. Duration is less certain in naturally-occurring cases. The youngest animal diagnosed with clinical CWD was 17 months old, suggesting 16 to 17 months may be the minimum natural incubation period. Among deer and elk residing in facilities with a long history of CWD, most natural cases occur in two- to seven-year-old animals, however deer have lived greater than seven years in heavily infected facilities without succumbing to CWD and elk greater than 15 years of age have succumbed to CWD. It is not known when during the course of infection an animal may become infectious, but it appears likely that PrP^{CWD} shedding is progressive through the disease's course; epidemic models suggest shedding probably precedes onset of clinical disease in both deer and elk (Miller 2002).

CWD can reach remarkably high prevalence in captive cervid populations. In one infected research facility, more than 90 percent of mule deer resident for more than two years died or were euthanized while suffering from CWD (Williams and Young 1980). Recently, high CWD prevalence (about 50%) has been demonstrated via immunohistochemistry in white-tailed deer confined with an infected Nebraska elk farm (Morrison, personal communication: 2002). Among captive elk, CWD was the primary cause of adult mortality (5 of 7, 71%; 4 of 23, 23%) in two research herds (Miller et al. 1998) and high prevalence (59%) was detected by immunohistochemistry in a group of 17 elk slaughtered from an infected farm herd (Peters et al. 2000).

To estimate prevalence in infected free-ranging populations, tissues from deer and elk harvested by hunters in CWD-endemic areas have been collected and examined at random (Miller et al. 2000). Within endemic areas, prevalence of preclinical CWD, based on immunohistochemistry for PrP^{CWD}, has been estimated at less than 15 percent in mule deer and less than 1 percent in elk (Miller et al. 2000). Modeled CWD epidemics failed to achieve a steady-state equilibrium in infected deer populations, suggesting that CWD may lead to local extinctions of infected deer populations if left unmanaged (Gross and Miller 2001).

Distribution

Among captive cervid herds, CWD distribution has been determined through a combination of surveillance and epidemiologic investigations (Figure 2), and it is probably underestimated at present. Chronic wasting disease in free-ranging cervids occurs in contiguous areas of Wyoming, Colorado (Miller et al. 2000) and Nebraska; this is considered the core endemic area for CWD (Figure 2). Distribution of CWD in free-ranging deer and elk has been determined primarily through necropsy and examination of tissues from animals showing clinical signs suggestive of CWD (clinically targeted surveillance); this is an efficient approach for detecting new foci of infection (Miller et al. 2000). CWD-infected free-ranging cervids have been detected outside the contiguous Wyoming-Colorado-Nebraska endemic area in Saskatchewan, Nebraska, South Dakota, Wisconsin and New Mexico.

Control Strategies

No treatment is available for animals affected with CWD. Once clinical signs develop, CWD is invariably fatal. Affected animals that develop pneumonia may respond temporarily to treatment with antibiotics, but ultimately

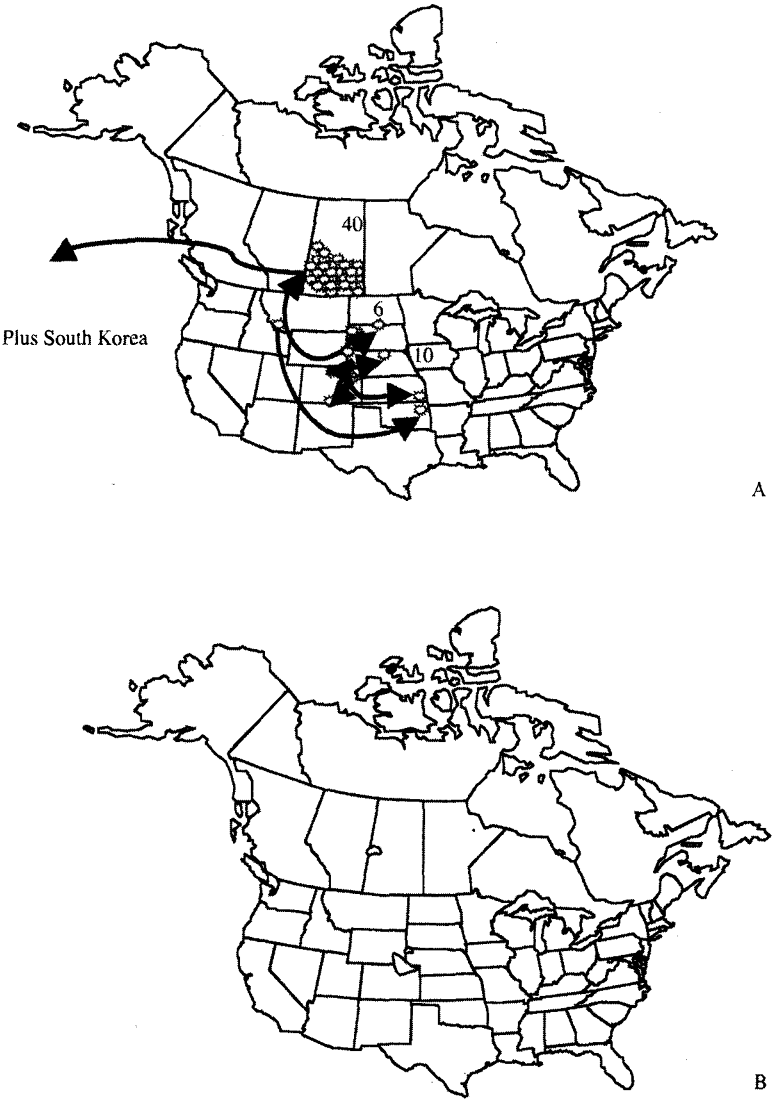

Figure 2. Known geographic distribution of chronic wasting disease (CWD), as of February 2002. A. Captive, commercially owned deer and elk. Circles indicate affected herds depopulated, quarantined or released from quarantine without depopulation, as of January 2002. The numbers refer to numbers of affected herds in Saskatchewan (40), South Dakota (6), and northeastern Colorado/western Nebraska (10), and the black lines and arrows indicate known movement of elk among affected farms. B. Free-ranging deer and elk. The outlines show the core CWD endemic area (Colorado, Wyoming and Nebraska) and foci of CWD in Saskatchewan and Nebraska.

the outcome is fatal. Similarly, no vaccine is available to prevent CWD infection in deer or elk. It follows that controlling CWD is problematic. Long incubation periods, subtle early clinical signs, absence of a reliable antemortem diagnostic tests, extremely resistant infectious agent, possible environmental contamination and incomplete understanding of transmission all constrain options for controlling or eradicating CWD.

In captive facilities, management options currently are limited to quarantine or depopulation of CWD-affected herds. Two attempts to eradicate CWD from cervid research facilities failed; the causes of these failures were not determined, but residual environmental contamination following depopulation and facility clean-up was likely in both cases (Williams and Young 1992, Miller et al. 1998). Attempts to eliminate CWD from farmed elk populations are more recent. Consequently, the efficacy of these attempts remains uncertain. Whether contaminated environments can ever be completely disinfected remains questionable. Until effective cleaning and disinfection procedures are identified, captive cervids should not be reintroduced into commercial facilities where CWD has occurred. Moreover, free-ranging cervids also should be excluded from previously-infected premises. Establishment of free-ranging reservoirs of infection in the vicinity of infected game farms, as exemplified by probable cases in Saskatchewan and Nebraska, could severely impair attempts at eradication from captive facilities. Inherent difficulties in managing infected herds and premises underscore the need for aggressive surveillance to prevent movements of infected animals in commerce.

Managing CWD in free-ranging animals presents even greater challenges. Long-term, active surveillance programs to monitor CWD distribution and prevalence have been instituted in the endemic area to determine the extent of the endemic area and to assist evaluation of both temporal changes and effects of management intervention. Management programs established to date focus on containing CWD and reducing its prevalence in localized areas (Miller and Kahn 1999, Colorado Division of Wildlife 2001) Ultimate management goals vary among affected states and provinces. In areas where CWD may not yet be endemic, eradication appears to be the ultimate goal for CWD management. In contrast, wildlife managers in Colorado and Wyoming have refrained from committing to eradication because it appears unattainable in their situations (Colorado Division of Wildlife 2001).

A variety of specific strategies for managing CWD in free-ranging wildlife have been adopted in affected jurisdictions. Translocating and artificially feeding cervids in endemic areas have been banned in attempts to limit range expansion and decrease transmission. Selective culling of clinical suspects has been practiced throughout the endemic area of Colorado and Wyoming for a number of years, but this approach alone has proven insufficient to reduce prevalence in affected populations. Localized population reduction in an area of high CWD prevalence has been undertaken in Colorado as a management experiment, but efficacy remains to be determined. Although it seems intuitive that lowered deer and elk densities should reduce both transmission and likelihood of emigration by affected animals to adjacent areas, historic migration patterns and social behaviors characteristic of some deer and elk populations may diminish the effectiveness of wholesale density reduction in controlling CWD. Models of CWD epidemic dynamics suggest early, aggressive intervention via selective culling or more generalized population reduction show the greatest promise of preventing new endemic foci from being established (Gross and Miller 2001). Unfortunately, surveillance limitations (cost and sensitivity) may delay detection of newly infected free-ranging populations for a decade or more after CWD has been introduced (Miller et al. 2000). In both Nebraska and Saskatchewan, aggressive reductions of deer numbers in newly-identified endemic foci have been undertaken in attempts to eliminate CWD from these areas. The recent development of tonsil biopsy as an antemortem test for CWD in deer might aid control efforts under some conditions, but large-scale applications to free-ranging populations seem impractical (Wolfe et al. 2002).

Public Health Concerns

No cases of human prion disease have been associated with CWD (World Health Organization 2000, Belay et al. 2001, Food and Drug Administration Transmissible Spongiform Encephalopathy Advisory Committee 2001). Contrary to a widely distributed story that recently circulated, none of three young hunters diagnosed with CJD were connected epidemiologically to CWD exposure (Belay et al. 2001). The tendency toward a natural species barrier reducing human susceptibility to CWD and other prion diseases has been demonstrated by in vitro studies. In those studies, PrP^{CWD} inefficiently converted human PrP^{C} to the abnormal isoform, as compared to homologous

PrP^{CWD} to cervid PrP^{C} conversions. Cervid PrP^{CWD} to human PrP^{C} conversions were essentially equivalent to conversions of human PrP^{C} by scrapie and BSE PrP^{res} (Raymond et al. 2000). However, lingering uncertainty about interpreting these data and assessing any potential risk that CWD may pose to humans is fostered by differing experiences with two more common animal TSEs. Although there is a long history of human exposure to scrapie through handling and consuming sheep tissues, including brain, there is no evidence that this presents a risk to human health. In contrast, massive exposure (Ghani et al. 2000) of British and perhaps other European citizens to the BSE agent resulted in approximately 106 deaths due to variant Creutzfeldt-Jakob disease, as of February 2002 (The United Kingdom Creutzfeldt-Jakob Disease Surveillance Unit University of Edinburgh 2002).

In the absence of complete information on the risks and in light of similarities of animal and human TSEs, public health officials and wildlife management professionals recommend that hunters harvesting deer and elk in the endemic area, as well as meat processors and taxidermists handling cervid carcasses, should take some common sense measures to avoid exposure to the CWD agent and to other known zoonotic pathogens (Table 2). Because TSE agents have never been demonstrated in skeletal muscle (Spraker et al. 2002), boning game meat is recommended as an effective way to further reduce the potential for exposure. Raw velvet antler, a product unique to the farmed cervid industry, may deserve further evaluation for presence of PrP^{CWD} in order to preserve markets for this commodity.

Management Implications

Where it occurs, CWD in captive and free-ranging cervids represents serious management problems. Captive populations are quarantined, thus limiting use and value of infected or exposed animals. Indemnity for depopulated cervids has been made available only recently in the US; in Canada, the magnitude of infection in farmed elk herds detected thus far has cost the Canadian government over $30 million (Canadian currency) in indemnity and clean-up funds (United States Animal Health Association 2001; Luterbach, personal communication: 2001). Guidelines for management of captive herds with CWD are being developed by state and provincial animal health officials. A national program is nearing adoption in Canada, and a similar program is

Table 2. Recommendations for deer and elk harvested in the chronic wasting disease endemic area.

	Recommendations
During the hunt	harvest only animals that look and behave normally
During dressing	wear latex or rubber gloves
	avoid direct contact with the brain and spinal cord
	dispose of head (if not required to remain attached to carcass) or submit chilled head for CWD testing at a veterinary diagnostic laboratory[a]
	discard superficial lymph nodes with the hide and deep lymph nodes and spleen with the viscera
	use strong household bleach solution for cleaning knives and saws
During processing	avoid contamination of meat with nervous tissue
	debone the meat and discard[b] the vertebrae and head or submit for testing
	use strong household bleach solution for cleaning knives, saws, cutting boards or tables

[a] The World Health Organization, Centers for Disease Control and Prevention, and state public health departments recommend that meat from CWD-test positive deer and elk be discarded and not consumed by humans or other animals.
[b] Dispose of bones and head by incineration, deep burial or sanitary landfill.

currently under review in the United States (United States Department of Agriculture 2001). Spillover of CWD into local free-ranging cervid populations may have occurred in two locations; further spillover could establish more endemic foci, thereby impairing long-term viability of both cervid farming and wildlife management in those areas.

Implications for free-ranging populations of deer and elk may be even more significant. Agencies do not translocate deer and elk from CWD endemic areas. Ongoing surveillance programs are expensive and draw resources from other wildlife management needs. Perhaps most important, impacts of CWD on population dynamics of deer and elk are presently unknown. Modeling suggests that CWD substantially could harm infected cervid populations by lowering adult survival rates and destabilizing long-term population dynamics (Gross and Miller 2001). Ultimately, public and agency concerns and perceptions about human health risks associated with all TSEs may erode participation in sport hunting in the endemic area, and they also may have dramatic influence on management of free-ranging cervid herds where CWD is endemic. It follows that responsible wildlife management and animal health agencies should continue working to understand and limit distribution and occurrence of CWD in free-ranging and farmed cervids.

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The Influence of Sylvatic Plague on North American Wildlife at the Landscape Level, with Special Emphasis on Black-footed Ferret and Prairie Dog Conservation

Michael F. Antolin
Colorado State University
Fort Collins

Pete Gober
US Fish and Wildlife Service
Pierre, South Dakota

Bob Luce
Wyoming Game and Fish Department
Cheyenne

Dean E. Biggins
US Geological Survey
Fort Collins, Colorado

William E. Van Pelt
Arizona Game and Fish Department
Phoenix

David B. Seery
US Fish and Wildlife Service
Commerce City, Colorado

Michael Lockhart
US Fish and Wildlife Service
Laramie, Wyoming

Mark Ball
US Forest Service
Greeley, Colorado

Introduction

"Prairie-dogs are distributed over a large part of the Great Plains and Rocky Mountain regions. Their colonies often number thousands of individuals, and their destruction of grasses and other forage plants makes them of considerable economic importance. Drastic measures are frequently necessary to prevent the destruction of crops of grain and hay. The Biological Survey is exterminating these rodents in national forests and in the public domain. The information in this report, in regards to the several species and their distribution, as indicated by maps, will aid materially in efforts, national or state, to control or exterminate them," said Henry W. Henshaw in 1915 (Hollister 1916).

The short-sighted goal of exterminating or severely limiting prairie dogs (*Cynomys* spp.) may be met, but not because of the control campaigns set forth by Henshaw's call to arms. Rather, prairie dogs continue to be devastated by plague, the infectious disease caused by the bacterium, *Yersinia pestis*, whose inadvertent introduction and spread into the western United States coincided with the poisoning programs. This is the same pathogen that was primarily responsible for three known world pandemics of plague in humans, including an outbreak in the 5th century in the eastern Mediterranean region, the Black Death of medieval Europe and the last pandemic that began in China the 1870s and continues in parts of the world today (Poland and Dennis 1998). Indeed, it appears that infectious diseases of all kinds, including those caused by bacteria (plague, anthrax), viruses (human immunodeficiency virus, West Nile encephalitis), protozoans (malaria) and prions (chronic wasting disease), now rapidly move around the globe, causing morbidity and mortality in humans. The same infectious diseases that afflict humans often have devastating consequences for wildlife species because many have an animal (zoonotic) origin, infect more than a single host species and efficiently travel among hosts via arthropod vectors (Gratz 1999, Dobson and Foufopoulos 2001, Woodhouse et al. 2001). This is certainly the case for sylvatic plague, as the disease caused by *Y. pestis* is known when it cycles in natural populations of mammalian hosts and flea vectors (Barnes 1993, Poland et al. 1994, Biggins and Kosoy 2001). Sylvatic plague is now firmly established in the western United States, reported from at least 76 species of mammals (Barnes 1993).

Here, we briefly review the natural history of sylvatic plague. We consider the consequences of plague on human health and the conservation of prairie dogs and associated animals. Particularly, we examine how plague has affected population dynamics of prairie dogs and recovery of the black-footed ferret (*Mustela nigripes*) in Wyoming and Montana. Finally, we outline efforts aimed toward improving management of prairie dog populations and how management of grassland and shrubland ecosystems must consider both direct and indirect effects of sylvatic plague.

Natural History of Plague in the United States

The bacterium, *Y. pestis*, was first recorded in the United States in 1899 on ships in port in California, Washington, Delaware and New York (Dicke 1926, Link 1955), during the early stages of last worldwide pandemic that originated in China. Plague was also found on ships in Texas, Louisiana and Florida. Early human cases were associated with commensal rats (*Rattus* spp.), particularly the black rat (*R. rattus*) and its fleas. The primary flea vector implicated in human bubonic plague is the oriental rat flea, *Xenopsylla cheopis*, although, worldwide, more than 150 flea species are capable of transmitting plague (Gage 1998). Soon after, mortality from deadly pneumonic (person-to-person) transmission, rather than by flea bite,s occurred, but this form of transmission is rare in the United States (Levy and Gage 1999). The first confirmation of plague in a wild species was in California ground squirrels (*Spermophilus beecheyi*) near San Francisco in 1908, although large die-offs of ground squirrels were noted in 1903 (Eskey and Haas 1940). Afterward, plague quickly spread to its eastern boundary (Figure 1). Monitoring by scientists from the Centers for Disease Control and Prevention's Division of Vector-Borne Infectious Diseases, in Fort Collins, in addition to extensive surveys conducted by the US Public Health Service in the 1930s and 1940s, determined the eastern extent of plague to be near the 97th meridian, in Texas, extending northward to the 102nd meridian, in North Dakota (Barnes 1982). Extensive spread farther eastward is not expected. Worldwide, plague foci are found in natural rodent populations in semiarid regions, like the western United States (Poland and Barnes 1979, Poland and Dennis 1998), and introductions of plague into ports along the Atlantic and Gulf coasts of the United States failed to establish sylvatic plague in the eastern part of the country.

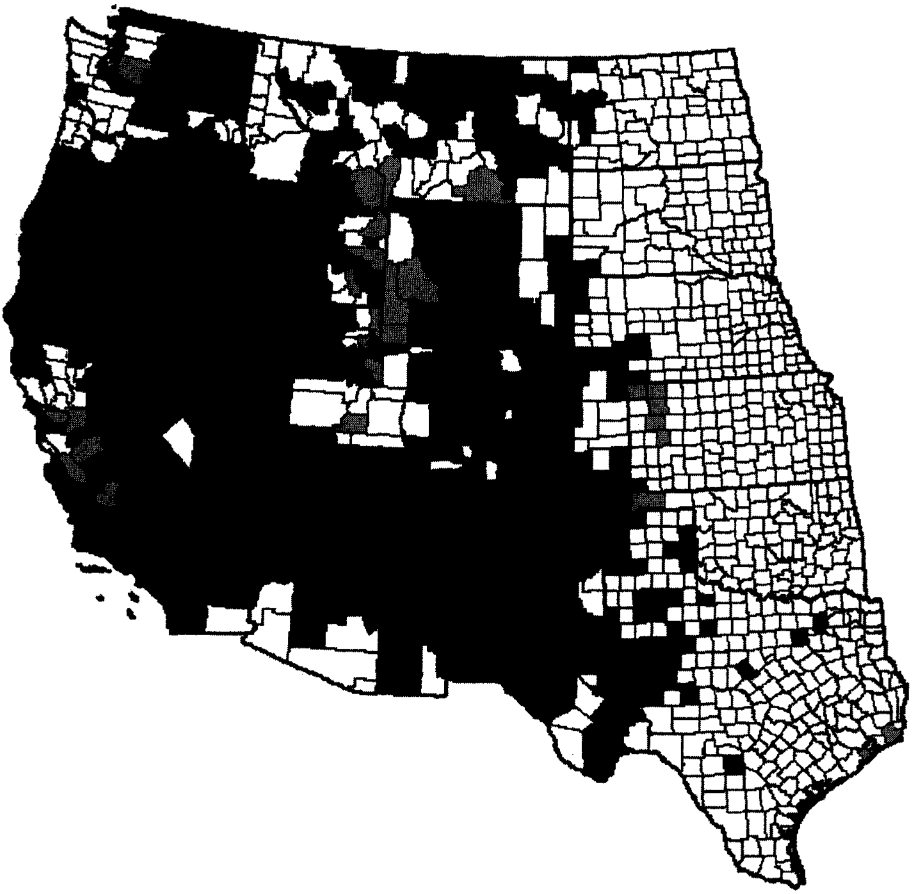

Figure 1. Geographic distribution of plague in humans and other animals in the United States by county of origin, as determined by human cases, presence of antibodies in domestic and wild animals, and plague positive fleas, between 1970 and 2001 (counties in dark gray). Some counties (light gray) had positive samples before 1970 but have no reported positives since. Map courtesy of the Division of Vector-Borne Infectious Diseases, CDC, Fort Collins, Colorado. Additional data from Link (1955) and Kartmann (1970).

In recent decades, 10 to 15 cases of plague in humans were reported each year in the United States, although deaths are uncommon as antibiotic treatment against plague is highly effective. Most human cases are of zoonotic origin, either directly or secondarily if household pets come into contact with infected rodents (Levy and Gage 1999). Although primary pneumonic cases occur, no outbreaks of plague caused by pneumonic transmission have occurred in the United States since 1925, in Los Angeles (Link 1955, Levy and Gage 1999). For the last 50 years, plague foci where human cases are common have persisted in northern Arizona and New Mexico, and, in those areas, plague in humans increased after high spring rainfall and decreased after summers with especially high temperatures (Parmenter et al. 1999, Enscore et al. 2002). The rainfall effect is hypothesized to relate to population increases of rodents that act as reservoirs; the temperature effect is thought to act through lower transmission potential and survival of fleas during hot summers.

Although the distribution of plague in the United States appears to be stable, the ecology of sylvatic plague is not completely understood, even in its native range in central Asia (Biggins and Kosoy 2001). It is clear, however, that some rodent species act as enzootic hosts, since they have high resistance to the disease and plague cycles between these hosts and their fleas exist without causing large die-offs (Barnes 1983, 1993; Biggins and Kosoy 2001). In western North America, virtually every rodent species has tested positive for plague at one time or another, but those showing high levels of resistance are few and include California voles (*Microtus californicus*), deer mice (*Peromyscus maniculatus*) and two species of kangaroo rats (*Dipodomys spectabilis* and *D. ordii*). It also appears that the enzootic cycle includes changes in susceptibility to plague (Biggins and Kosoy 2001). A population of the northern grasshopper mouse, *Onychomys leucogaster*, from the Pawnee National Grassland where plague is known to occur, had higher resistance to laboratory plague challenges than did a population from central Oklahoma, where plague has never been reported (Thomas et al. 1988).

The most dramatic effect of plague on rodents is seen in the wood rats (*Neotoma* spp.) and sciurid rodents, including ground squirrels (*Spermophilus* spp., *Ammospermophilus* spp), tree squirrels (*Sciurus*), chipmunks (*Tamias, Eutamias*), prairie dogs (*Cynomys* spp.) and marmots (*Marmota* spp.) (Poland and Barnes 1979, Barnes 1993, Biggins and Kosoy 2001). These have received more attention than most other rodents because of their involvement in human plague cases (Barnes 1993). Outbreaks in these species are explosive, with low resistance, high mortality and rapid spread of the disease in host populations. In contrast to rodents responsible for maintaining plague in its enzootic sylvatic phase, these epizootic hosts are thought to greatly amplify the pathogen in the surrounding environment and increase plague transmission back to enzootic rodent hosts, to predators like coyotes (*Canis latrans*) and to rodents that are commensal with humans, humans' pets and humans themselves (Gage et al. 1994). Complexes of epizootic host species and their fleas living in areas near human populations are implicated in maintaining human plague foci. For instance, the foci in northern New Mexico and Arizona relate to plague in Gunnison's prairie dogs (*C. gunnisoni*) in grassland habitats and in rock squirrels (*S. variegatus*) in pinon-juniper and Gambel oak woodland (Barnes 1993). Also, in contrast to enzootic host species, epizootic hosts are probably not responsible for the overall persistence of plague. It is more likely that plague epizootics break out in these susceptible hosts when they come into contact with enzootic hosts or their fleas, and conditions like temperature, moisture, flea population size and host population density favor rapid transmission of the plague pathogen (Barnes 1993, Biggins and Kosoy 2001, Cully and Williams 2001). The patchy and idiosyncratic patterns of plague outbreaks in North America over the last century are consistent with occasional transmission from resistant enzootic hosts to susceptible epizootic hosts, as opposed to large pandemics sweeping throughout the land.

The role of carnivores in plague ecology deserves mention (Poland and Barnes 1979, Gage et al. 1994, Poland et al. 1994). Mammalian predators, including canids, felids, mustelids, procyonids and ursids, can become infected with plague after ingesting infected rodent prey or being bitten by the prey's fleas. Carnivores sampled in areas where plague occurs show evidence of plague exposure in the form of antibodies to the pathogen (Barnes 1982). This evidence, together with laboratory challenges, points to the resistance of many carnivores to plague infection and to their potential role as long distance carriers of the disease. Not all carnivores are equally capable long-distance vectors. For instance, wild cats (*Lynx* spp.) in North America, suffer higher rates of mortality from plague than do coyotes, foxes (*Vulpes* spp., *Urocyon cinereoargenteus*) and badgers (*Taxidea taxus*) (Barnes 1982, Fitzgerald 1993). Further, the ability to transmit disease by the many different flea species carried by carnivores is sure to differ (Gage et al. 1994). Finally, testing carnivores for plague antibodies may provide powerful means for detecting plague in small mammal populations (Barnes 1982, Gage et al. 1994). However, when plague is prevalent in an area, carnivores show uniformly high antibody titers (Luce et al. 1997), and it remains to be seen whether carnivore surveillance will predict outbreaks in epizootic species, like ground squirrels and prairie dogs, before they occur.

Prairie Dogs and Their Ecosystem

Prairie dogs are an integral part of the American West and are characterized by diurnal activity, a herbivorous diet, digging of underground burrows for shelter and nesting, and living socially in towns of extended families (Hollister 1916, Pizzimenti 1975, Hoogland 1995). At one time, prairie dogs were not only numerous in North America, their historical geographic ranges defined the short grass and mixed-grass Great Plains and the relatively dry shrub-steppe valleys of the Rocky Mountains and Intermountain West (Figure 2). The accounts of early western explorers regularly included prairie dogs, and the first scientific specimens of black-tailed prairie dogs (*C. ludovicianus*) were collected during Lewis and Clark's expedition to the upper reaches of the Missouri River (Hollister 1916). During the last century, however, prairie dog populations have declined drastically as the result of four main causes: habitat loss from conversion of land for agriculture and human habitation, poisoning for population control and eradication programs, recreational shooting, and sylvatic plague (van Pelt 1999, Van Putten and Miller 1999). Consequently, the native habitat available to prairie dogs has declined from that described by Hollister (1916), and currently most prairie dog populations are reduced or fragmented, with occasional plague outbreaks that may cause local extinctions.

Even if all prairie dog habitats could be restored, and even if all controls of prairie dog populations by poisoning were to stop, it is unlikely that prairie dogs would completely regain their prominent role in the ecosystems of the Great Plains and valleys of the Intermountain West. Whether prairie dogs, especially black-tailed prairie dogs, rise to the level of keystone species is debatable (Miller et al. 1994, Stapp 1998, Kotliar et al. 1999, Kotliar 2000, Miller et al. 2000). However, we cannot ignore that prairie dogs cause landscape level effects by the disturbance of digging burrows, by clipping and eating vegetation, by the underground shelter created by burrows, and by serving as prey to a myriad of predators (Koford 1958, Whicker and Detling 1988, Hoogland 1995, Kotliar et al. 1999). Ties between prairie dogs and grassland biodiversity have been permanently changed by plague, as prairie dogs are highly susceptible epizootic hosts and suffer high mortality–nearly 100 percent in black-tailed, Gunnison's and Utah (*C. parvidens*) prairie dogs, and approximately 85 percent in white-tailed prairie dogs (*C. leucurus*) (Barnes

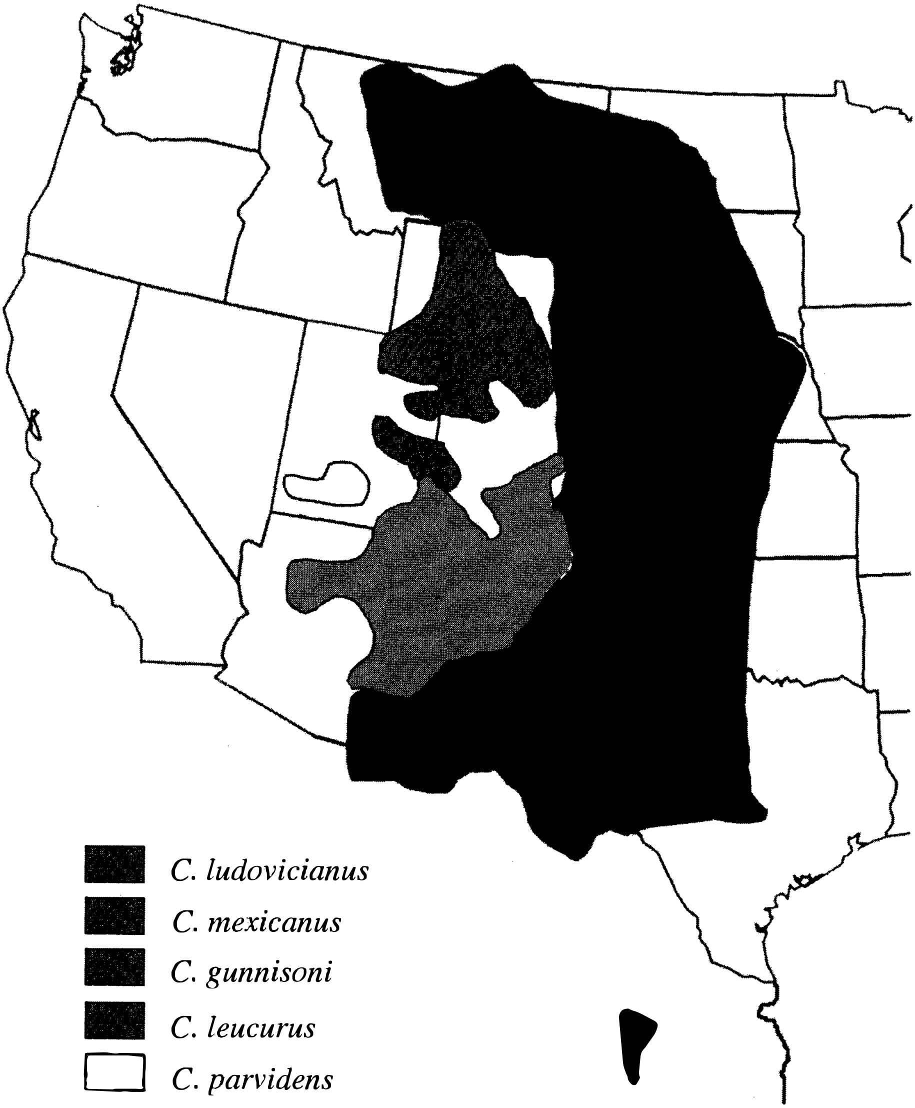

Figure 2. Historical geographic ranges of five recognized species of prairie dogs (*Cynomys*). *C. ludovicianus* = black-tailed prairie dog. *C. mexicanus* = Mexican prairie dog. *C. gunnisoni* = Gunnison's prairie dog. *C. leucurus* = white-tailed prairie dog. *C. parvidens* =Utah prairie dog. Map based on Hoffman (1981).

1993, Cully and Williams 2001). Only a relatively small portion of the range of the black-tailed prairie dog lies to the east of the plague-free line, but that part of the range is under intensive cultivation for agriculture and offers little relief.

Whether prairie dogs will gain protection from further declines under the Endangered Species Act is uncertain. In terms of protection, the status of prairie dogs differs among species. The Utah prairie dog was federally listed as an endangered species in 1973 and then changed to threatened in 1983. A recovery plan that includes translocation of Utah prairie dogs from private to public lands is being implemented (US Fish and Wildlife Service 1991). The black-tailed prairie dog was petitioned for listing as threatened in 1998 (Van Putten and Miller 1999), and it currently stands as "warranted but precluded" (US Fish and Wildlife Service 2000) with management plans being crafted in most of the 11 states that include the historic range (van Pelt 1999, Luce 2001). The black-tailed prairie dog in Mexico and Canada is protected by special statutes. Neither the white-tailed prairie dog nor Gunnison's prairie dog are currently listed or under formal petition for listing. The Mexican prairie dog (*C. mexicanus*), which has a small range near Monterey, Mexico, is listed as endangered.

In the following section, we present data showing how plague has changed population dynamics of prairie dogs, focusing on white-tailed and black-tailed prairie dogs. We also discuss how declines of prairie dogs have affected other species in the same ecosystem, especially the black-footed ferret, which is federally listed as an endangered species.

Population Trends in Prairie Dogs with Plague

Plague was first recorded in prairie dogs during the expansion of the range of the disease in the 1930s and 1940s (Eskey and Haas 1940, Ecke and Johnson 1952, Cully and Williams 2001). Few data describing changes in colonies of Utah prairie dogs related to plague outbreaks are available, and we will not mention them further here. On the other hand, several studies have detailed the effects of plague on Gunnison's prairie dogs (Barnes 1982, Rayor 1985, Fitzgerald 1993, Cully and Williams 2001), which suffer high mortality, have colonies that may not recover to pre-plague abundance and have experienced range retraction from some isolated mountain valleys. For instance, Gunnison's prairie dogs were abundant at the northern edge of their range in the large high altitude valley called South Park, which surrounds the town of Fairplay, Colorado. Along with poisoning campaigns, a series of plague epizootics in South Park, beginning in 1945, led to the extinction of Gunnison's prairie dogs from that area by the mid 1960s (Ecke and Johnson

1952, Fitzgerald 1993). A similar history of population decline and range reduction occurred in the Moreno Valley of northern New Mexico in the 1980s and 1990s (Cully and Williams 2001).

Black-tailed prairie dogs still exist in most of what constituted their original range (Luce 2001), except for Arizona where they were extirpated in 1960 (van Pelt 1999). Long-term surveys of black-tailed prairie dog towns have been conducted, in which town sizes were measured as the area that remains active, determined by ground surveys, interpretation of aerial photography and geographic coordinates recorded from Global Positioning Satellites. The amount of active area indicates relative changes of population size within an area because black-tailed prairie dog towns expand at their edges, and recolonizing prairie dogs tend to aggregate in empty habitats (Cincotta et al. 1987). Plague has changed the population dynamics of black-tailed prairie dogs; die-offs of prairie dogs have been regularly reported since the first instances in Texas and Colorado in the late 1940s (Ecke and Johnson 1952; Barnes 1982, 1993; Cully and Williams 2001; Roach et al. 2001). By contrast, in places on the east side of the plague-free line, where suitable habitats still exist, prairie dog towns have remained stable or have increased. A good example is Wind Cave National Park, near Hot Springs, South Dakota, where surveys conducted since 1938 reveal that towns remained stable over long periods of time or rapidly expanded when control programs ended (Hoogland 1995; Muenchau, personal communication 2000).

A typical pattern in areas where plague is established is seen in Philips County, in north-central Montana (Figure 3), where the area of black-tailed prairie dog towns increased during the 1970s and 1980s. The Charles M. Russell National Wildlife Refuge (CMR) became a site for reintroduction of black-footed ferrets in 1994. At approximately the same time, a plague epizootic began to decimate prairie dog towns north of the ferret release area (Matchett, personal communication 2002), and interventions to protect and increase the prairie dog population on CMR included treating prairie dog burrows with insecticides to control fleas and translocation of prairie dogs (Figure 3). The active area of prairie dog towns has increased since the first epizootics in 1992, but the increase also occurred in parts of southern Phillips County besides CMR, making it difficult to conclude that insecticide treatment and prairie dog translocation caused the increases in prairie dog numbers. Black-tailed prairie dog towns in Phillips County continue to be affected by

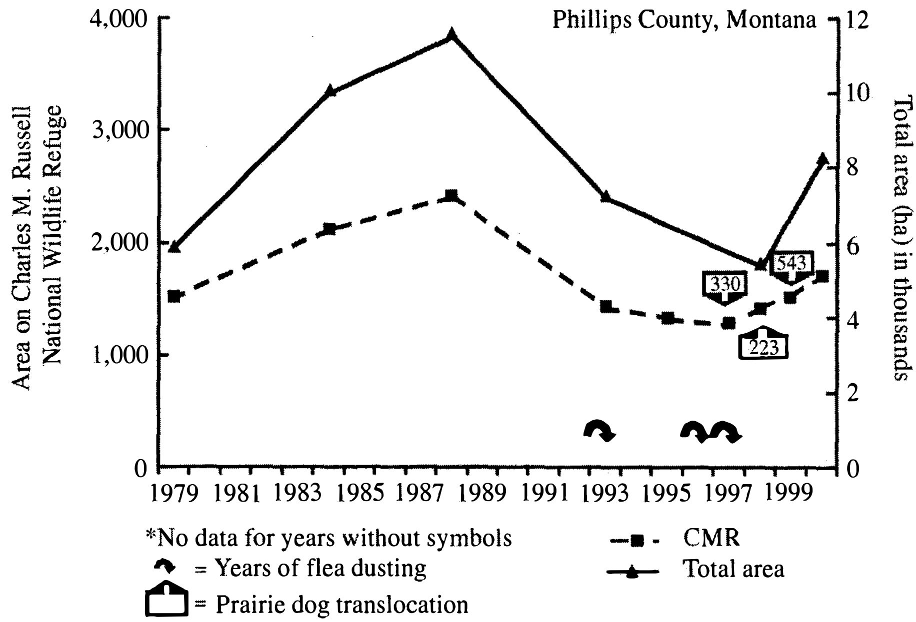

Figure 3. Area of active black-tailed prairie dog towns in southern Phillips County, Montana and the Charles M. Russell National Wildlife Refuge. Data compliments of Randy Matchett, US Fish and Wildlife Service, Lewiston, Montana.

plague, with die-offs noted during summer 2001 (Matchett, personal communication 2002).

Results from black-tailed prairie dog surveys conducted on the panhandle of Oklahoma (Lomolino and Smith 2001) show how these prairie dogs are affected by plague in the west and by habitat loss to the east of the plague line (Figure 4). In Oklahoma, in Beaver County, where plague has never been recorded and where intensive cultivation occurs, prairie dogs have steadily declined over the last 30 years. In the westernmost Cimarron and Texas Counties, plague epizootics beginning in the late 1940s have caused a steeper decline, especially in the 1990s. The plague has decreased overall population and reduced the sizes of prairie dog towns. The average size of towns in the non-plague is between 25 and 38 acres (10 and 15 ha) in the state and parts of the panhandle, where plague does not occur (Figure 4). On the other hand, in Cimarron County, where plague epizootics occurred regularly during the late 1990s (Cully and Williams 2001), average town size decreased from 90 acres (36 ha) to less than 38 acres (15 ha). The plague has shortened the time those

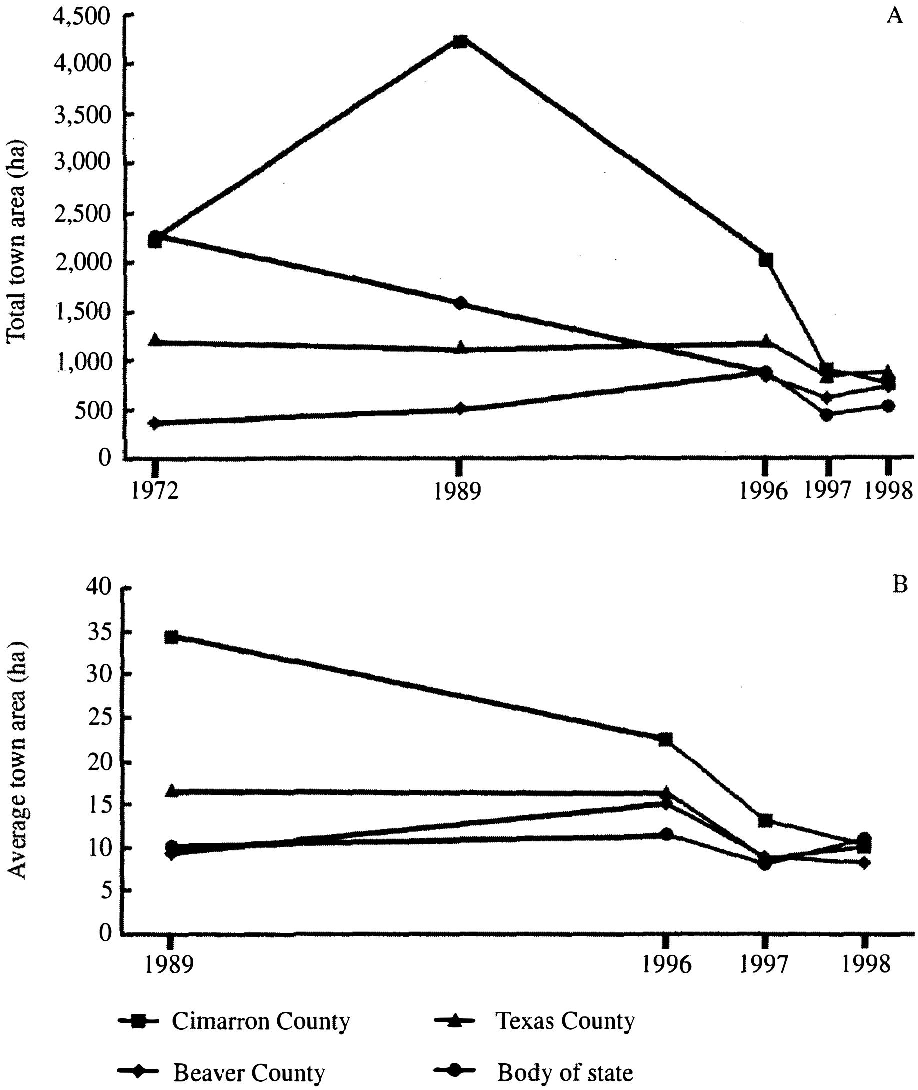

Figure 4. Area of active black tailed prairie dog towns in three western (panhandle) counties of Oklahoma, compared to towns on the remainder of the state. A. Total area of active prairie dog towns. B. Average area of individual towns. Data from Lomolino and Smith (2001).

black-tailed prairie dog towns persist, leading to population fragmentation similar to that in non-plague areas to the east, caused by cultivation of land for agriculture (Lomolino and Smith 2001).

The history of black-tailed prairie dog town occupancy on the Pawnee National Grassland (PNG) in north-central Colorado shows how much the population dynamics of these prairie dogs has changed. Sixty-two prairie dog towns have been regularly measured each year for the last 20 years. Although there was sporadic recreational shooting on the PNG during that time, there has been no poisoning of prairie dogs on the PNG since the 1960s. Overall, the areas occupied by prairie dogs increased over the 20 years (Figure 5), but most striking are the fluctuations in town size. The six representative towns graphed in figure 5 demonstrate the boom and bust cycles of town size, caused by exponential growth after recolonization, punctuated by plague epizootics. For instance, town 62 increased to approximately 100 acres (40 ha) in 1989, was struck by plague in 1990, and only now is it attaining its previous size. Town 66 increased to fill a quarter section (70 ha) in 1999, then it was decimated by plague. Other towns increased modestly before succumbing to plague in the early 1990s. The rapidity of deaths of black-tailed prairie dogs on the PNG suggests that plague is not only transmitted by fleas, but that direct transmission between prairie dogs during their various social encounters leads to deadly pneumonic plague. We have seen diseased prairie dogs on the PNG that showed classic signs of plague, including bloody froth emanating from the nasal passages (Savage and Antolin, personal communication 2000).

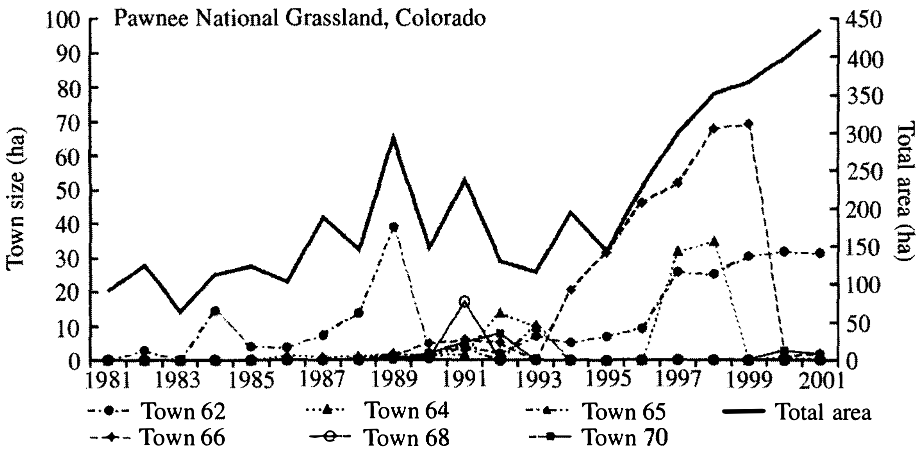

Figure 5. Area of active black tailed prairie dog towns on the Pawnee National Grassland in north-central Colorado, showing both the total area (dark line) and areas of six representative towns (broken lines). Data are from the Pawnee National Grassland, Greeley, Colorado and from Short Grass Steppe Long-term Ecological Research, Colorado State University, Fort Collins, Colorado

The overall persistence of black-tailed prairie dogs in northern Colorado, where die-offs were first reported in 1948 (Ecke and Johnson 1952), depends upon successful recolonization after local extinctions. This pattern was reported for the Cimarron National Grassland in southeastern Kansas (Cully and Williams 2001), and it may indicate a permanent change in population structure of black-tailed prairie dogs (Roach et al. 2001). A genetic study of the PNG population (Roach et al. 2001) showed that almost 40 percent of prairie dogs captured were either immigrants or the offspring of immigrants from towns other than where they were trapped. Dispersers between towns on the PNG likely moved along drainages that connect towns, and recolonization and dispersal was frequent enough to prevent great overall loss of genetic diversity. How this compares to genetic diversity on the east side of the plague line is the subject of an ongoing study (Savage and Antolin, personal communication 2002).

Populations of white-tailed prairie dogs can still be found in most parts of their historic range, but patterns of decline in white-tailed prairie dogs are different from those of black-tailed and Gunnison's prairie dogs. Long-term monitoring of white-tailed prairie dogs in Wyoming was carried out in conjunction with habitat assessment for recovery of black-footed ferrets, using methods described in Biggins et al. (1993). Plague was reported in Meeteetse in 1985 and Shirley Basin in 1987. In addition to experiencing epizootics that caused some local extinctions, overall population sizes of white-tailed prairie dogs have declined (Figure 6). However, even after plague epizootics subsided, densities of white-tailed prairie dogs have remained low. It should be noted that the low densities and diffuse burrow systems of white-tailed prairie dogs create a bias against detection of both local extinctions and recolonization after plague subsides. White-tailed prairie dogs may have fit the definition of epizootic amplifying hosts in the past when plague first spread into Wyoming in the 1930s, since they are highly susceptible and died in great numbers. The data suggest that white-tailed prairie dogs, which are the least social *Cynomys*, currently have a different relationship to plague than do other prairie dog species (Cully and Williams 2001). It is possible that plague in white-tailed prairie dogs is now maintained as an enzootic disease, primarily transmitted between individuals by fleas, and explosive die-offs seen in other ground squirrel and prairie dog species are prevented because low population density and fewer social contacts between individuals reduce transmission rates.

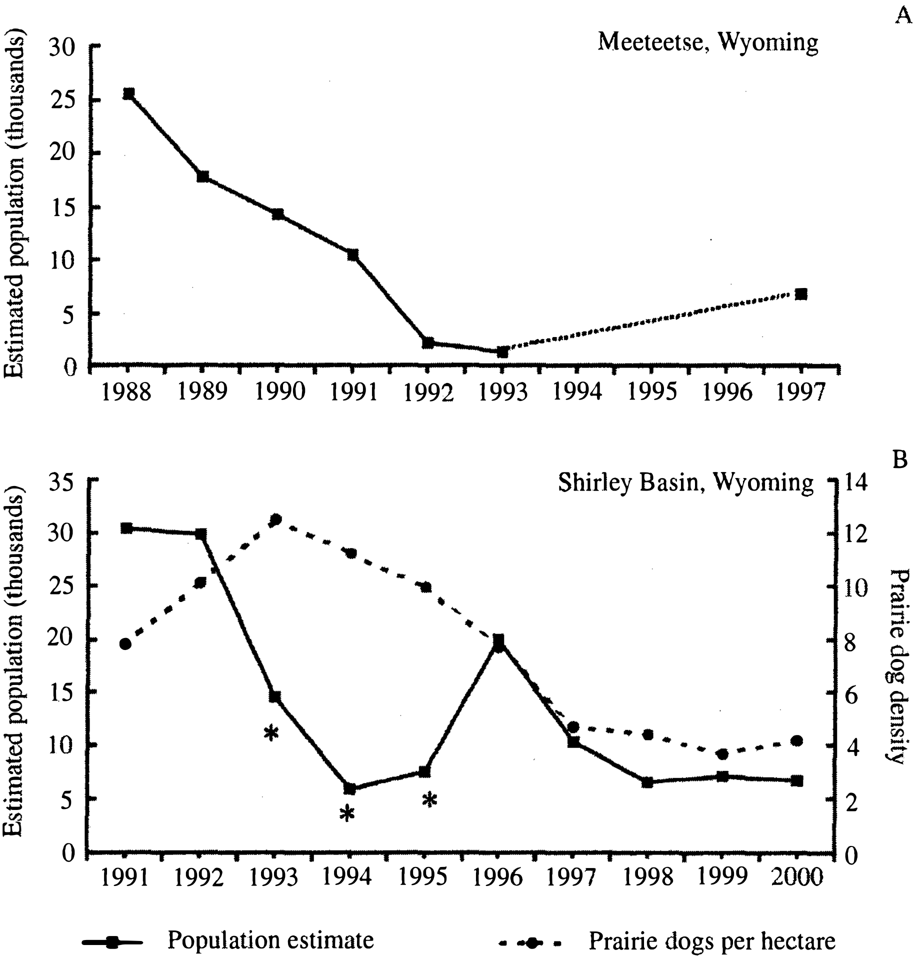

Figure 6. Population estimates of white-tailed prairie dogs. A. Meeteetse, data from Mid-Continent Ecological Sciences Center, United States Geological Service, Fort Collins, Colorado. B. Shirley Basin Primary Management Zone 1, data from Wyoming Game and Fish Department, Cheyenne, Wyoming. Fewer towns were sampled in 1993, 1994 and 1995 (marked with asterisks), so estimates of total population are artificially low for those years.

Effects of Prairie Dog Declines on Other Species

Plague's influence in western North America cascades through the ecological community that either associates with or directly depends on prairie dogs and the habitat they create. As mentioned, evidence of exposure to the disease at one time or another exists for every mammal species within the current distribution of plague (Barnes 1993). Unfortunately, we may never know how extensive plague's influence has been, as many wildlife species are not regularly monitored for disease, and data are lacking for comparisons of current abundance to that before plague was introduced. Much of the information needed to manage for biodiversity in the era of plague is not available, but we can assess how the relationship between prairie dogs and plague will influence some of the associates. The list of species that associate with black-tailed and white-tailed prairie dogs is quite extensive (Koford 1958, Campbell and Clark 1981, Miller et al. 1994, Hoogland 1995, Stapp 1998, Kotliar et al. 1999). They fall into every trophic level, from plants to scavengers to predators, and on a continuum from accidental to obligate (Kotliar et al. 1999). The majority of species sighted on prairie dog towns are simply associated; they may opportunistically use resources on prairie dog towns but are more abundant on other parts of the grasslands (Stapp 1998, Kotliar et al. 1999). Relatively few species are dependent on prairie dogs, meaning their abundance decreases in concert with decreases in prairie dog abundance.

The only vertebrate species that is known to be obligate on prairie dogs is the black-footed ferret, which will likely become extinct in the wild unless sufficient prairie dog habitats are conserved to support breeding populations (Kotliar et al. 1999). Plague has jeopardized release and recovery of black-footed ferret populations, with the exception of the program in central South Dakota, on the Buffalo Gap National Grassland and Badlands National Park, which lie to the east of the current distribution of plague. Loss of ferrets can be from lack of prey, but black-footed ferrets contract plague directly and die of the disease (Williams et al. 1994). For example, a plague outbreak on the Fort Belknap Tribal Lands, in September 1999, immediately followed the release of 33 ferrets on Peoples Creek, and, by mid-November, none of the ferrets could be found despite extensive searches (Vosburgh, personal communication 2002). Subsequent releases were diverted to Snake Butte. Plague epizootics during 2000 and 2001 on the Thunder Basin National Grassland, in eastern Wyoming, have curtailed plans for ferret releases on what were extensive black-tailed prairie dog towns. In white-tailed prairie dog habitats, the last remaining wild ferrets were removed from Meeteetse, Wyoming, in 1987, in the wake of outbreaks of both plague and canine distemper. Because of the decline of prairie dogs, this site was not considered for ferret releases from the captive-bred population when the release program began in 1991. Releases in Shirley Basin, Wyoming, began in 1991, but were halted in 1995 after a series of plague epizootics began in 1992. This population of ferrets has persisted since that time.

Other dependent species, especially burrowing owls (*Athene cunicularia*), ferruginous hawks (*Buteo regalis*) and mountain plovers (*Charadrius montanus*), change in abundance as prairie dog towns expand or decline. Plague epizootics during the past 14 years on the Rocky Mountain Arsenal National Wildlife Refuge (RMA), near Denver, caused severe declines in black-tailed prairie dog populations, despite the use of insecticides to control fleas and the translocation of thousands of prairie dogs onto the site after each plague outbreak. The numbers of burrowing owls nesting on RMA tracked the fluctuations in prairie dog population size and town area (Figure 7). An extensive survey of burrowing owls on the 14 National Grasslands from Texas to North Dakota, in 1998, found burrowing owls on 307 of 444 (69 %) active black-tailed prairie dog towns, but only on 15 of 138 (11 %) towns that had experienced plague epizootics (Sidle et al. 2001). Similarly, on the RMA, the number of overwintering ferruginous hawks, but not red-tailed (*B. jamaicensis*) or rough-legged hawks (*B. lagopus*), correlated with the area of prairie dog towns (Seery and Matiatos 2000) (Figure 7). Finally, a detailed analysis of mountain plover populations, conducted from 1995 to 2000 in Phillips County, Montana, demonstrated that both recruitment of birds and population growth were related to the size of black-tailed prairie dog towns (Dinsmore 2001).

The Outlook for Management

If management of grassland and shrubland ecosystems is to be conducted on the level of landscapes, with conservation of both prairie dogs and their associated biodiversity as a goal, then spatial context of prairie dog towns must be taken into account. This is the basis of designating complexes of prairie dogs, where complexes comprise the towns lying within a polygon in which no town is more than 7 kilometers (4.4 mi.) from any one of the other towns. The rule is meant to include average distances that dispersing prairie dogs are likely to travel, but also refers to the longest nightly movements by black-footed ferrets at Meeteetse, Wyoming (Biggins et al. 1993, Luce 2001). With plague epizootics causing local extinctions of prairie dogs, management must account

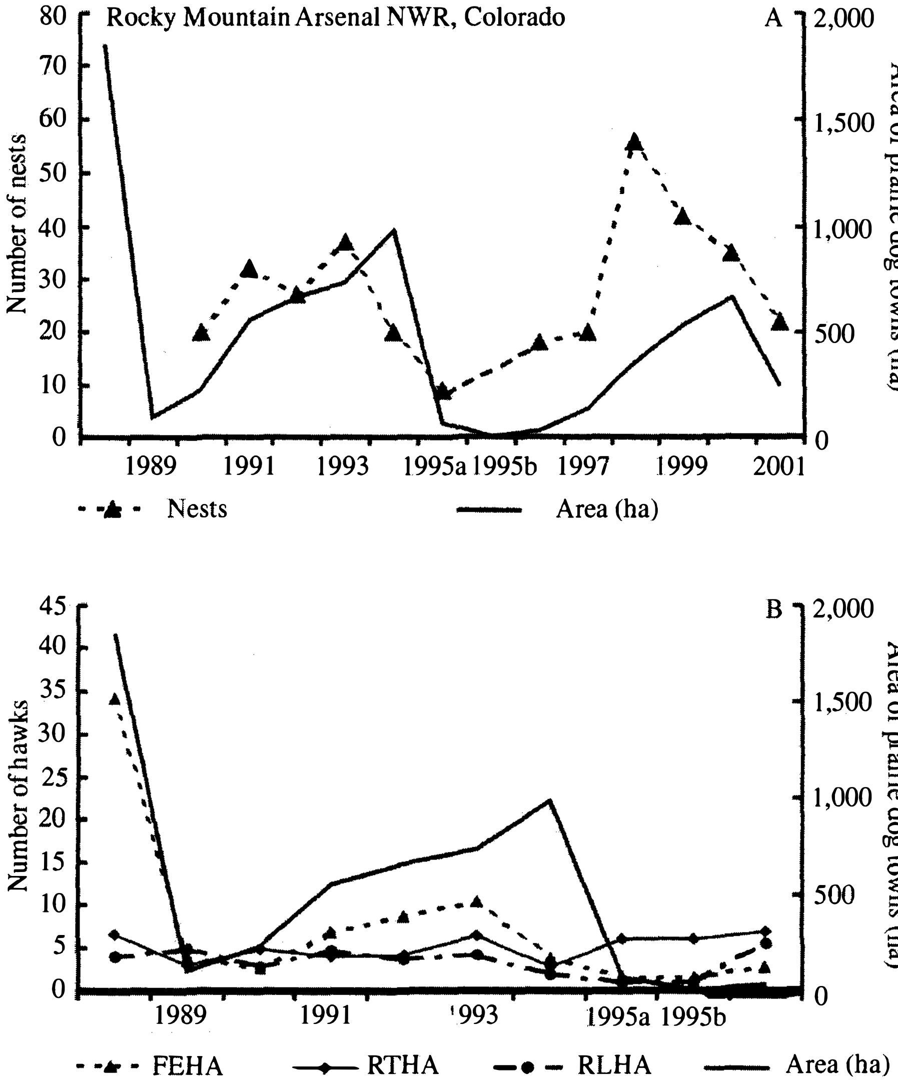

Figure 7. Relationships between black-tailed prairie dogs birds on RMA. A. Burrowing owls. B. hawks at the RMA near Denver, Colorado. FEHA = Ferruginous hawk (*Buteo regalis*), RTHA = Red-tailed hawk (*B. jamaicensis*), RLHA = Rough-legged hawk (*B. lagopus*). Burrowing owl data from the Rocky Mountain Arsenal National Wildlife Refuge, US Fish and Wildlife Service, Commerce City, Colorado.

for both the distances between towns that will allow recolonization and the landscape attributes that prairie dogs are likely to use for dispersal. Potential dispersal corridors, such as drainages, need to be maintained to ensure recolonization of unoccupied colonies and continuous dispersal among towns by prairie dogs (Roach et al. 2001). Additionally, we must have an understanding of the responses of other species to fluctuations in prairie dog numbers and whether their movements will allow recruitment to occupied towns when the towns they regularly use are lost in plague epizootics.

Unfortunately, plague makes management decisions less certain. It is possible that sylvatic plague outbreaks are more likely in large and dense prairie dog towns because greater densities provide more opportunities for the exchange of plague-infected fleas and increase the rate with which plague moves through towns (Barnes 1993, Cully and Williams 2001, Lomolino and Smith 2001). Further, predicting which towns will persist is difficult because we do not understand how plague moves from potential enzootic hosts near towns or how plague moves long distances between towns. Managing for uncertainty may mean expanding beyond the current concept of prairie dog complexes; in the wake of plague no large complex has recovered to numbers originally censussed (US Fish and Wildlife Service 2000). Successful management of biodiversity in the West will almost certainly have to include the large areas needed to assure long-term persistence of prairie dogs.

Management of prairie dogs to increase regional persistence, rather than on a town-by-town basis, will be difficult in the face of plague. Possible management interventions include use of insecticides to destroy fleas in burrows and on the animals themselves, translocation of prairie dogs back into decimated areas, and use of vaccines. However, interventions like these are intense and expensive, and they may not encompass an area large enough to control plague. One hope for management lies in the ability of mangers to break plague-amplifying epizootics in prairie dogs and ground squirrels. If the persistence of plague in the environment depends upon local amplification that increases the amount of plague cycling back to resistant enzootic hosts, then a program that includes monitoring and surveillance with local intervention when plague begins to increase may reduce plague to lower levels overall. This management scheme depends on the supposition that plague persists as a rare enzootic disease of reservoir rodents, and that plague surveillance can be aided by predictive models that include broad weather patterns, as is the case for human plague (Parmenter et al. 1999, Enscore et al. 2002). Understanding the dynamics of plague may be crucial not only for survival of prairie dogs, but for maintaining biodiversity and functioning of grassland ecosystems.

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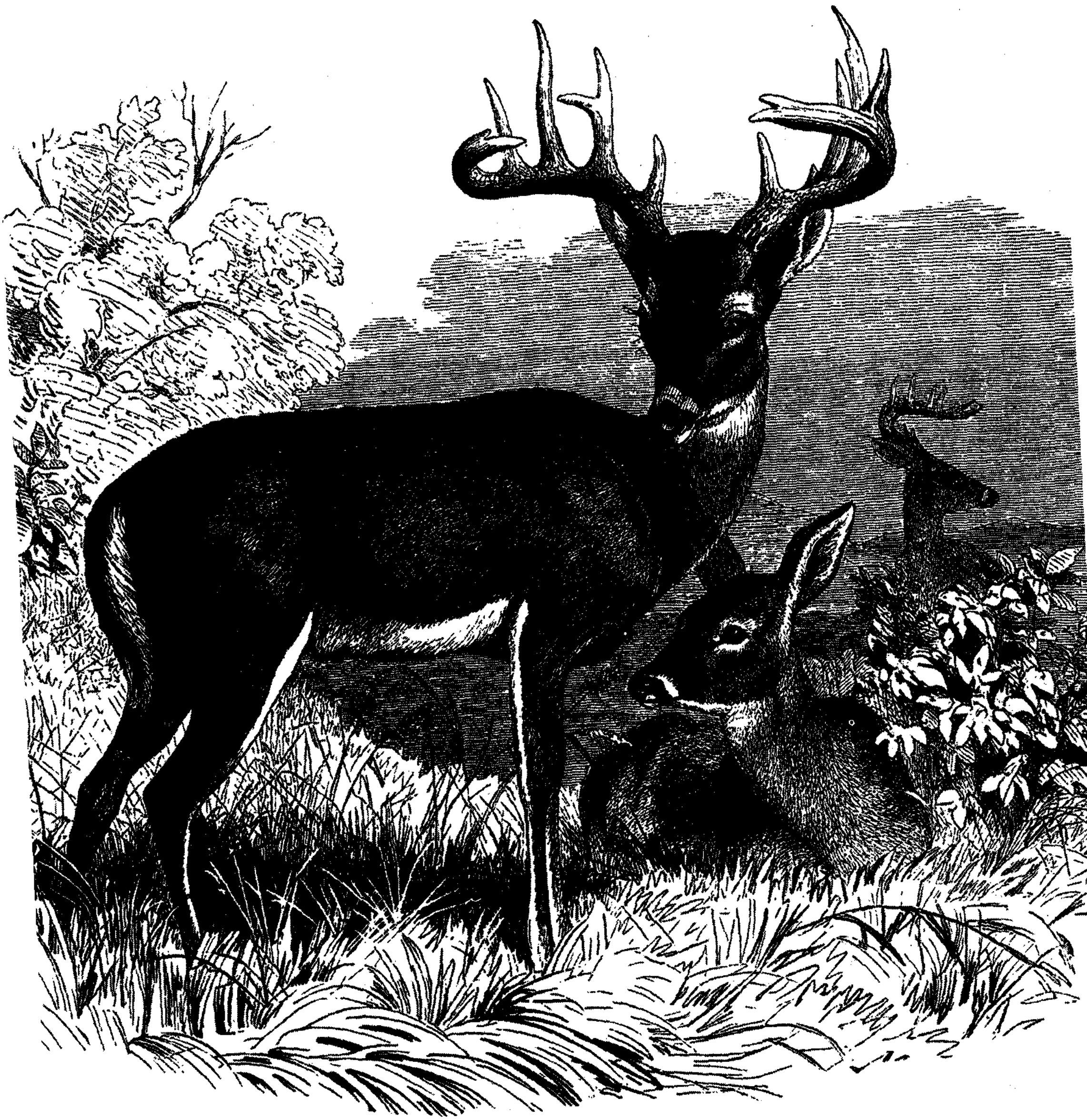

Special Session Two.
Our Changing Professional Culture: Throwing Out the Baby Boomers with the Bath Water?

Chair
Duane L. Shroufe
Arizona Game and Fish Department
Phoenix

Cochair
Dwight E. Guynn
US Fish and Wildlife Service
Shepherdstown, West Virginia

Implications of Massive Agency Retirements on Future Fish and Wildlife Employment and Education

Gary J. San Julian
Pennsylvania State University
University Park

Amanda B. Yeager
Pennsylvania State University
University Park

When researching this paper, it was our goal to examine how much of the nation's fish and wildlife workforce soon will be retiring to the bliss of sunnier climes and better fishing grounds, and we wished to evaluate how this trend will coincide with the needs and opportunities of the agencies they are leaving. We found that the fish and wildlife agency directors that answered our survey, for the most part, were in the group close to retirement. They will have a tremendous amount of insight to pass on to new generations.

Directors provided invaluable knowledge regarding what they want in their agencies' future employees and the goals for making agencies and professionals more effective. This wealth of information provided data that would allow us to springboard into a dozen different issues that deserve examination. We are able to address only a handful, but we encourage our peers to further examine the questions left unanswered at the completion of this paper.

Before continuing, we would like to thank the agency staff members who responded to our questionnaire. Without their support, our research would have been far less enlightening. We received a gratifying 74-percent response rate from the fish and wildlife agencies of the United States and its territories. The events of last year also impacted the response; none of the federal agencies we sent surveys to responded, however several called after the deadline. They had just received our mailing because of security concerns. For this reason we did not include them in the study.

Looking Backward and Forward

Decades ago, Aldo Leopold and his generation of land managers fostered professions like wildlife and fisheries biology, soil conservation and forestry. Since then, several generations have fulfilled the duties of safeguarding and managing wildlife and natural resources for the public. Today, a generation referred to as baby boomers is beginning to retire, leaving a hole in America's natural resources workforce. With these retirements, years of agency talent will be lost, but new opportunities for rising wildlife professionals and graduates appear. This changing of the guard comes at a time when the public is taking a greater interest in the way wildlife is managed. Today, wildlife is truly a common property resource and agencies face increasingly complex challenges when in managing the public's competing desires for its use. Agencies identified social issues as one of their top three challenges, with political and organizational issues as the other two (McMullin 1993). Many more agencies now receive at least partial funding from taxpayers and the growth in public relations and public education programs require agencies and citizens to interact more each year. These rising social needs are leading agencies to seek a new type of employee, one who is capable of mediating conflicting interests concerning resource management issues by combining strong science and social backgrounds.

In this paper, we investigate the magnitude of today's wildlife and fisheries retirement trend and how agencies plan to replace this expertise. We examine the types of skills, both technical and social, which fish and wildlife agencies will require of future employees. We will discuss how students and universities may address these skill needs. Specifically, how students might become more marketable by designing their education experience to make themselves better twenty-first century employees.

Methods

We examined how state fish and wildlife agencies expect to be affected by the ongoing and imminent retirements of the baby boomer generation and how they plan to compensate for these losses. Surveys (Appendix A) were distributed to 58 state and US territory fish and wildlife agencies to obtain information about their retirement levels in the last five years and expectations in the next five. Questions were asked to determine the skills that agencies desire in their employees and how they plan to replace the expertise they will soon lose to retirement.

When making subsequent recommendations for universities and students, we understand that the role of universities is to educate students and to prepare them for the future, not necessarily produce employees for agencies. However, state agencies employ many of these students, thus it is important to recognize their needs.

The Agency Employee: Then and Now

Historically, the wildlife and fisheries employee has earned a Bachelor's of Science degree or more, in the subject, has a strong biology background and is well versed in field skills. For such a worker, people skills often came on the job. As managing public needs became more complicated, administrative employees, who may have begun as biologists, have frequently gained the knowledge to do their jobs by teaching themselves (Nielsen et al. 1991).

As our survey validated, baby boomers are leaving the profession for the joys of retirement. From all levels of employment, including technicians, biologists, managers and administrators, the reporting agencies indicated they have lost about 1,900 employees in the last five years, and, if we project that trend for the 58 agencies we contacted, the number is closer to 2,500. In the next five years, a loss of, on average, 47 workers from each agency is expected for all 58 agencies; that is more than 2,700 individuals. Responding agencies indicated that the average time of service for these employees is more than 27 years. If we extrapolate that figure for the 58 agencies for that 10-year-period, we will have lost over 140,000 years of experience. While these numbers are just estimates, even half of this number is a tremendous loss of institutional memory.

How will this void be filled in coming years? We were interested to know whether this challenge would involve finding replacement workers with similar skills for the same positions from which these employees are retiring, or if agencies would take this transitional period to make changes to their employment structure. The majority of fish and wildlife agencies indicated that merely replacing these employees was not sufficient. Fifty-six percent indicated the need to change job descriptions in response to changes in policies or because the old positions are no longer necessary.

Our subsequent goal was to identify the type of employee required to fill these new jobs and whether today's new graduates and rising professionals are prepared for the mounting social responsibilities that surround wildlife agencies. Through their responses, agencies seemed to agreement with Arnold's (1976) assertion that tomorrow's wildlife professional must wear the title, "Manager of Resource Affairs," as a professional co-committed to managing natural resources and managing the social resources associated with them. These individuals should have both strong social skills and strong science backgrounds, to successfully perform these tasks.

Who Agencies Want

We asked agencies who responded to our survey to rate the importance of eight classes of technical and social skills for state-level administrators, regional administrators, middle-level managers, biologists and field technicians. Table 1 summarizes these results.

Communications, conflict resolution, team concepts and other social skills ranked higher, for the most part, than scientific knowledge and field skills for state and regional administrators and middle managers. These skills are not only desired, but, in most cases, required skills for employees. Communication,

Table 1. Importance of skills to state fish and wildlife agencies for five different levels of employment. Rankings are from 1 to 5. Skills ranked (1) are not important, (3) are important, (5) are required for potential employees.

State Level Administration		Biologists	
Scientific Knowledge	3	Scientific Knowledge	5
Communication	5	Communication	5
Conflict Resolution	5	Conflict Resolution	3
Human Dimensions	5	Human Dimensions	3
Field Skills	3	Field Skills	5
Management	5	Management	3
Team Concepts	5	Team Concepts	4
Public Relations	5	Public Relations	3
Regional Administration		Field Technicians	
Scientific Knowledge	4	Scientific Knowledge	5
Communication	5	Communication	3
Conflict Resolution	5	Conflict Resolution	2
Human Dimensions	5	Human Dimensions	2
Field Skills	4	Field Skills	5
Management	5	Management	2
Team Concepts	5	Team Concepts	3
Public Relations	5	Public Relations	3
Middle Management			
Scientific Knowledge	5		
Communication	5		
Conflict Resolution	4		
Human Dimensions	3		
Field Skills	3		
Management	5		
Team Concepts	5		
Public Relations	4		

team concept and public relations skills were valued for all job positions. Emphasis also is placed on scientific and technical abilities, which are ranked as required skills only for middle management, biologists and field technicians.

The increasing need for social abilities found in our work supports a theme that has been expressed for decades. Studies in the 1980s (Knuth 1987) and 1990s (McMullin et al. 1991, Adelman et al. 1994, Murphy et al. 1995, Kessler et al. 1998) indicated that agencies lacked employees with skills in communications, problem-solving, leadership ability, public relations, team decision-making and other management and communication attributes.

Many employers consider these abilities to be basic skills. Our surveyed agencies also had the opportunity to indicate additional technical and social skills related to the wildlife and fisheries sciences, skills that they would like their potential employees to possess (Table 2). Agencies are searching for well-rounded individuals who bring specialized skills to their work team. Employers felt so strongly about the need for special skills that they consistently wrote in skills not included on the survey's provided list (Table 3).

Table 2. Number of state fish and wildlife agencies that desire employee knowledge in the indicated subjects. Subjects were listed as part of survey.

Writing	38
Environmental policy	27
Water resources	25
Forest science	22
Education	17
Environmental education	17
Plant science	16
Soil science	10
Agricultural and environmental engineering	8
Recreational park management	3
Consulting	1

Table 3. Number of state fish and wildlife agencies that desire employee knowledge in the indicated subjects. Subjects were volunteered by agencies through write-in responses.

Human dimensions of wildlife	8
Computer skills	4
GIS training	4
Communications	3
Habitat management	3
Marketing	3
Planning	2
Plant taxonomy	2
Personnel management	2
Agriculture	1
Database management	1
Political science	1
Silviculture	1

Education and Rising Professionals

Two questions naturally follow: "are graduates preparing themselves to be the skilled professionals needed" and "are universities giving students the skills needed to become good professionals?"

The huge demands for continuing education (CE) by fish and wildlife professionals (McMullin 1998) may be one sign that wildlife employees are lacking skills for their professions. The value of continuing education programs as a tool for supplementing skills throughout careers is important, but it is the popularity of certain CE topics that is a concern. Survey studies have reported the most popular workshops are often in public relations, computer skills, conflict resolution and human dimensions (McMullin 1998). The 1995 CE study, performed by Murphy et al. (1995), polled natural resource agency administrators, which found it was expected that fishery biologists pursue nontechnical CE programs, citing a need for employees to gain instruction in interpersonal skills, communications, decision-making, conflict resolution, networking and mass media skills. Administrators and professionals agree on needs regarding CE courses.

A wildlife agency operates on a tight budget. Since so many agencies are willing to pay for employees to attend these workshops, they must value these skills highly. The fact that such fundamental and valuable subjects as communications or interpersonal skills are the most popular CE courses may indicate that graduates lack in some basic skills. If graduates instead possessed these skills before entering the workforce, CE might be utilized as a tool to refresh and develop specialized science and social skills like those in table 2 and table 3, which is more cost effective to employers.

Where Do We Go From Here?

Our research indicated changing emphases in how agencies do business. We also identified a growing list of skills that may soon be non-negotiable for tomorrow's job applicants, as well as a shortage of certain skills among agency staff who must prepare to address today's new resource management needs. Meshing the desires of employers for competent employees with the abilities and skills of wildlife graduates and management professionals can be a challenge. Yet, we believe that wildlife and fisheries agencies and the schools can make, and in some cases are making, these links.

Recommendations for Agencies

The first objective of fish and wildlife agencies must be to actively pursue employees who possess the skills they desire and need. If an agency wants competent employees, it must advertise for such. Agencies consistently require strong undergraduate and graduate backgrounds in the biological sciences, but they must be more stringent when requiring the less tangible social background. This may mean changing the standard job descriptions and being more selective when separating the biologist with an impressive research portfolio from the biologist who is also an excellent communicator and team worker. Research shows several agencies are already heading in this direction (Schmidly et al. 1990).

Professional organizations, like The Wildlife Society and the American Fisheries Society, have recognized that resource management is a people management business and are requiring more social skills for students to become professionally certified. To obtain exceptional employees, agencies should utilize programs by making certification part of the job requirements.

Furthermore, to cultivate potential employees with the skills that may be difficult to learn in a classroom, agencies must be willing to provide more internships and cooperative positions to university students. By adjusting to a seasonal turnover of temporary workers, agencies will gain part-time employees with the skills needed in full-time employees.

Agencies should closely examine the jobs for which they have identified social skills as being especially imperative (state administrators, regional administrators, and middle management). For these positions, administrative and leadership skills are key. In the 1990s, two-thirds of state agencies' directors were replaced over a three-year span, indicating that wildlife professionals assuming these positions may not have been prepared for the roles that extended beyond their scientific training (McMullin et al. 1997). Agencies may need to examine the historical practice, in which administrators often ascend from a biologist position to an administrative one, accumulating management skills by self-instruction. The immediacy of the issues an administrator handles, does not afford a worker the luxury of learning on the job. Thus, to ensure the stability of top directorships, the fish and wildlife agency must be more willing to require experience in public administration, a quality that professionals have been progressively recommending for their employees since the 1950s (Nielsen et al. 1991). When no internal candidates exist with the skills needed, agencies should choose employees from outside the organization to find a candidate who has administrative experience, management skills or an education background, but who may not have as strong a biological background as their administrators of the past. Of course, at the same time, agencies must find new ways to reward the work ethic of their employees, when promoting them to a managerial position is not the answer.

Recommendations for Universities

Universities are excellent at producing critical thinkers with strong scientific knowledge, and, while it is their job to produce good scientists rather than future agency employees, they must also respond to the need for strengthening professionals' skills in areas like public relations and conflict resolution. Agencies have repeatedly questioned whether their employees received adequate social and workplace skills in school (Cookingham et al. 1980, Schmidly et al. 1990). Some universities have recognized this need and have modified fish and wildlife biology curriculums to include more social and management classes. However, these additional courses require the redirection of hours from traditional areas. If students have good basic biological knowledge and critical thinking skills, the field techniques can be learned quickly. Today, universities believe that credit hours are a zero sum game–to add courses, one must subtract others. The goal is to graduate students in eight semesters not nine or more (Richard Noble, personal communication 2002).

We have not investigated university curriculums for this paper to see how many have responded to the idea of changing courses, but we suggest this is an option to be pursued. While some universities resist curriculum changes due to resource or administrative constraints (Fritzell et al. 1991), institutions can still effect an improvement in student skills by using adaptive advising. Universities can develop public management skills in their students by encouraging career-related internships, volunteer work and by allowing curriculums to accommodate internship and co-op programs.

Advisors can also encourage students to work with professionals in on- and off-campus research programs. Therefore, advisors should encourage research programs that are interdisciplinary or cooperative, where students work with researchers from other fields of study.

Recommendations for Students

The agencies we surveyed indicated there are certain standards all students must achieve, both in skills and in academics, if they are to compete for agency jobs. Agencies consistently require a minimum of six years of formal education for state and regional administration jobs, middle management, and biologists. Field technicians generally must have a Bachelor's degree. If students choose to be competitive and pursue a Master's degree or other graduate education, they may also consider using this investment to develop some of the social skills agencies have indicated are important. If a student is interested in one of the jobs that rely on social skills, he or she should also explore graduate curriculums, like public administration, communications or public education, to adequately prepare themselves.

Obviously, agencies are still science-based, and they still expect students to have a diverse understanding of technical and biological topics. Students should also be sure to pursue marketable science and technical areas, like water resources, environmental policy, GIS, forest science, and other topics like those listed in table 2 and table 3.

While state and federal fish and wildlife agencies employ significant numbers of graduates, it is by no means the only game in town. It is not only fish and wildlife agencies that look favorably on students with a wildlife and fisheries science degree. Other natural resource organizations, both public and private, are looking for employees who have specialized wildlife skills. There are jobs as environmental educators, soil conservation district biologists and county resource planners. Many natural resource-related agencies are pleased to have an employee versed in both the biological and social sciences.

Beyond Boomers

Our survey verified that the retirement of the baby boomers has and will provide many employment opportunities for fish and wildlife graduates. Agencies want employees with good science backgrounds, but they also value the human dimension and marketing skills almost as much as the science skills.

More than 80 percent of the respondents mentioned communications as a skill wanted in future employees. Even at the field technician level, employers wanted employees to be skilled in team concepts and public relations.

More than half of the agencies indicated that, when filling vacated positions, they will change the expertise required for jobs. Some professional societies require more social science courses to gain certification, however few agencies have included certification as criteria for employment. Influencing state agencies and universities to change often requires constant pressure. The time is now and the pressure will come from baby boomer retirements. And, as agencies require different skills from their employees, universities will adjust their fish and wildlife curriculums and students will seek the advanced skills needed.

Our paper suggests some of the changes in skill requirements for natural resources agencies. It identifies the need to examine these ideas in a more scientific and substantial manner. Both employers and potential employees will benefit from this investigation, but, most importantly, our resources will be better managed.

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Appendix A

1. a. How many employees have retired from your agency in the last five years? ________
   b. At what levels of employment have you lost the most workers? (Please rate from 1 to 5, with 1 being the highest and 5 the lowest number of workers.)

   _____State-Level Administration
   _____Regional Administration
   _____Middle Management
   _____Biologists
   _____Field Technicians

2. a. How many employees do you expect to retire in the next five years? __________
   b. At what levels of employment do you expect to lose the most of these workers? (Please rate from 1 to 5, with 1 being the highest and 5 the lowest number of workers.)

   _____State-Level Administration
   _____Regional Administration
   _____Middle Management
   _____Biologists
   _____Field Technicians

3. What is the average number of years that retiring employees have worked for your agency? __________

4. How many new workers do you expect to hire in the next five years? ________________

5. How does your agency plan to replace the retiring expertise? (Please check the appropriate response.)

   ______ fill the positions with the same types of skills OR ______ change job descriptions in response to changes in policy or because old positions are no longer needed.

6. Please list any new types of positions your agency plans to develop during the next five years: ____

7. How many years of post-high school education will you prefer when hiring new employees for the following positions: (Please list a response for each item.)

_____State-Level Administration
_____Regional Administration
_____Middle Management
_____Biologists
_____Field Technicians

8. How important do you consider the following skills for potential employees in these positions? (Please indicate the degree of importance for each skill.)

	Not Important	Important	Required
State-Level Administration			
Scientific Knowledge	_____	_____	_____
Communication	_____	_____	_____
Conflict Resolution	_____	_____	_____
Human Dimensions	_____	_____	_____
Field Skills	_____	_____	_____
Management	_____	_____	_____
Team Concepts	_____	_____	_____
Public Relations	_____	_____	_____
Regional Administration			
Scientific Knowledge	_____	_____	_____
Communication	_____	_____	_____
Conflict Resolution	_____	_____	_____
Human Dimensions	_____	_____	_____
Field Skills	_____	_____	_____
Management	_____	_____	_____
Team Concepts	_____	_____	_____
Public Relations	_____	_____	_____
Middle Management			
Scientific Knowledge	_____	_____	_____
Communication	_____	_____	_____
Conflict Resolution	_____	_____	_____
Human Dimensions	_____	_____	_____
Field Skills	_____	_____	_____
Management	_____	_____	_____
Team Concepts	_____	_____	_____
Public Relations	_____	_____	_____
Biologists			
Scientific Knowledge	_____	_____	_____
Communication	_____	_____	_____
Conflict Resolution	_____	_____	_____
Human Dimensions	_____	_____	_____
Field Skills	_____	_____	_____
Management	_____	_____	_____
Team Concepts	_____	_____	_____
Public Relations	_____	_____	_____

Field Technicians

Scientific Knowledge	________	________	________
Communication	________	________	________
Conflict Resolution	________	________	________
Human Dimensions	________	________	________
Field Skills	________	________	________
Management	________	________	________
Team Concepts	________	________	________

9. In what wildlife- and fisheries–related areas would you like future employees to have knowledge? (Please check all that apply.)

_______ Forest Science
_______ Soil Science
_______ Education
_______ Consulting
_______ Environmental Economics
_______ Plant Science
_______ Writing
_______ Water Resources
_______ Agricultural / Environmental Engineering
_______ Environmental Policy
_______ Recreational Park Management
_______ Other(s) ______________________________
____
____

10. Please give us some information about yourself:
Your job title ______________________________
The year in which you were born ______________________________
Your gender ______________________________

Who Says Fish and Wildlife Ain't Got No Culture?

Sally Angus Guynn
International Association of Fish and Wildlife Agencies
Shepherdstown, West Virginia

Introduction

The present dearth of studies describing the culture of the fish and wildlife profession (Kellert et al. 1985, Kennedy 1985) should not be interpreted to mean the profession has no culture. It is possible to come closer to an understanding of what the culture of fish and wildlife looks like by constructing an organizational rubric for culture in the fish and wildlife profession.

Looking carefully at the profession of fish and wildlife, and closer still at the state fish and wildlife agencies, reveals a number of traditional, unique characteristics when compared to other organizations and professions. When these characteristics are studied collectively, an argument can be made for the categorical, uniqueness of the fish and wildlife profession from an organizational perspective, which comprises only one dimension of such a cultural rubric (Angus 1997).

The rest of such a cultural rubric comes from a cultural collectiveness, found within state fish and wildlife agencies as a group of organizations. The cultural collectiveness factor represents a number of traditional, professional characteristics that have been subsumed into the organizations have persisted through time and are generic within the fish and wildlife organization from agency to agency, state to state. For sociological and management perspectives, I examined the following collection of cultural characteristics as they are specific to fish and wildlife agencies: clannish, institutionalized and organizational paradigm, transcendent values, multiple political masters, stereotypical biological management style, elitism, missionary zeal, a unique, historical bureaucratic development and structure, and various evident cultural components. Following is a discussion of the factors, which I found contributed to the peculiar culture of the profession.

The Collectiveness Factor

Hofstede (1991) referred to the collectiveness factor as "collectivism ," defining it as "pertaining to societies in which people from birth onwards are integrated into strong, cohesive groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty." Evidence of a type of collectiveness can be seen through various fish and wildlife organizational cultural attributes discussed as follows.

Clannishness

Deal and Kennedy (1982) suggested that organizations typically have cultures that are similar to tribal communities. State fish and wildlife agencies appear to have cultural aspects similar to the tribes described by anthropologists, thus supporting the argument for fish and wildlife organizational and cultural uniqueness. The following is an anthropological description, which summarizes the cultural style of a clan: "Apparently, what ethnographers have in mind is a 'well-defined community' (Conklin 1968:172) that has existed for some period of time and has employed relatively stable enculturation mechanisms (Redfield 1952). The result is that the people of the community come to share a rather complex understanding of their world, which is largely taken for granted and which they label with a special language. Because these socially acquired understandings are largely assumed, the patterned language and activities of such a community are 'thick' with meaning (Geertz 1973), which is relatively hidden to the outsider" (Wilkins et al. 1983:469).

Although many organizations are fragmented socially and do not come close to the communal, complex, social understandings implied by the paradigm above, there are some organizations which do (Wilkins et al. 1983). Some tribal clan characteristics and the conditions which facilitate their development suggest similarities between fish and wildlife agencies and the anthropologists' concept of a clan-like, local culture. Seven examples of certain clan characteristics and their conditions are:

- organizational age and stability,
- absence of institutional alternatives,
- frequent, internal interaction,
- small organizational size,

- significant technical advantage,
- external, closely aligned groups and
- goal congruence.

Organizational age. According to Schein (1981, 1991), enough "stable time" in an organization must occur in order to reach the level of complex social understanding necessary to produce a clan. When enough time with the same people has passed, the chances for passing the history to successive generations is increased. Berger and Luckmann (1967) claimed this was the beginning of the institutionalization of social knowledge. With a second generation, what had been the ad hoc conceptions and social routines of the first generation now become objective social traits inherent and usually taken for granted. To the extent that social knowledge is passed from generation to generation, it may harden into what anthropologists term culture.

An absence of institutional alternatives. This second condition for clan development within an organization is described by Wilkins and Ouchi (1983:473) as a type of "monocultural environmental exposure." Conversely, if employees are exposed to significantly different cultural perspectives (in spite of a long and stable membership within their organization), the development of a taken-for-granted social reality, described above by Berger and Luckmann (1967), is going to be lessened.

Frequent, internal interaction. A third condition encouraging clan formation is that there must be enough interaction among the organizational members in order for a common social knowledge to develop. "In spite of divisional subcultures which may exist within the typical state fish and wildlife agency (for example, Information and Education Division versus Law Enforcement Division versus Wildlife Division), most programs/ projects involve considerable collaboration of interdivisional staff, thus frequent interaction is always necessary" (Duane Shroufe, personal communication: 1996).

Small organizational size. A fourth condition is that the size of the organization needs to be small enough to permit the required frequent interaction of staff and to minimize exposure to cultural alternatives or differing cultural perspectives. The small size effectively insulates the staff, facilitating the effective passing of social knowledge between generations. The resulting frequent contact causes problems to be addressed using shared professional orientations and is likely to reinforce a shared professional clan as opposed to an overall organizational clan (Lawrence et al. 1967a, 1967b). The mean size of a state fish and wildlife agency is approximately 306 full time employees (Organization of Wildlife Planners 1996), which is considered a small organization according to the US Census (1996).

Significant technical advantage. A fifth consideration of clans emphasizes the condition that clans form more easily when they have a significant technical advantage, which affords the luxury of having minimal exposure with other groups or points of view. State fish and wildlife agencies are staffed by highly trained career biologists and wildlife management specialists responsible for improving the wildlife habitat, conducting research, managing wildlife populations, restocking programs and investigating of wildlife disease control and prevention (Council for Wildlife Conservation and Education 1995). "While this may be changing somewhat today, other than clerical and administrative support professionals (e.g., human resources, media, etc.) the majority of employees in a state fish and wildlife agency have traditionally held degrees in biology, wildlife management, forestry, or related areas regardless of their specific job duties" (Annette Dominguez, personal communication 1996).

External, closely aligned groups. The sixth consideration states that clan development is facilitated when there are closely aligned external groups to the organization. In addition, Wilkins and Ouchi (1983:474) suggested that, "clans are thus more likely to be concerned with the external legitimacy of the organization with respect to certain critical publics." Discussed later in this section, the development and operation of wildlife cohort groups (formal and informal) has played a significant and obvious part in the development of fish and wildlife management agencies and their cultures, which subsequently have evolved.

The influence of cohort groups is another factor which has compressed the autonomous character of the fish and wildlife agency, impacting its development to become something different from the typical government bureaucracy. There are sportspeople's groups, formal scientific groups, informal groups and non-consumptive recreational groups, and each group has its own special interest subgroups. All of these groups have an interest in how wildlife resources are to be managed. Their collective influence can be significant. For example, the passage of the Lacey Act in 1900 was described in 1971 by Cart as the social process which brought about the end to the market hunting industry and which demonstrated the power that is inherent in the political process when groups with different interests unite to press for a common cause (Langenau 1982). Today, effective wildlife conservation cannot be successful without broad public support (Council for Wildlife Conservation and Education).

Goal congruence. The seventh and final characteristic of clans is a common paradigm, or congruence, of goals that is shared by the organization's members. Wilkins and Ouchi (1983) emphasized that there also existed among clan members a belief in the general equity, or the belief that, in the long run, they will all be dealt with equitably. This pervasive belief is located within a general shared paradigm of goal congruence (implying shared values), that is "we are all members of the same club working for the cause."

Institutionalized Paradigm

Fish and wildlife agencies are characterized by a pervasive, institutional, traditional paradigm for doing business. Decision-making is dominated by a natural resource management philosophy, or paradigm, which has become entrenched for most of the 20th century (Langenau et al.1984, Peterson et al.1993).

Implicit since the early 1900s, three central tenets of the traditional conservation paradigm in America were made explicit in 1947 by Gifford Pinchot, the first Chief of the US Forest Service and a trained professional from Yale (Peterson et al. 1993). The tenets were: (a) exclusive reliance on scientific management for decisions, (b) the business of wildlife management should involve only those with specialized training–professionals, referring to the fifth clan consideration, significant technical advantage–and (c) productive sustainable use, not preservation, should be the goal. This basic model, adapted to professional wildlife management by Leopold in 1918 (Gill 1996), endures today (Twight et al. 1988, Decker et al., Peterson et al. 1993, Harris et al. 1994) and continues to effectively minimize organizational constituent exposure to alternative cultural perspectives, which is the second clan culture consideration, absence of institutional alternatives.

The underlying values of this utilitarian, conservation-defined paradigm of fish and wildlife agency professionals were internally strengthened over decades by influences of the dominant user groups, anglers and hunters (Peterson et al. 1993). In the professional pre-service training in universities, the biological-utilitarian focus espoused by Pinchot was also favored (Decker et al. 1992). Loyalty to the paradigm was ingrained by the operation of institutions–state fish and wildlife agencies, for example–which symbiotically developed with the evolution of the natural resources profession.

Several additional factors played a part in the entrenchment process of this pervasive paradigm. First, the paradigm was reinforced from the very top of the nation's leadership with President Theodore Roosevelt and his conservation movement. It stressed rational scientific planning to "promote the efficient development and use of all natural resources" (Hays 1959:2). Second, the rural and often isolated office locations of many fish and wildlife employees has served to effectively limit other cultural perspectives and provide the small size workforce and stable time for clan-like development. Typically, these decentralized offices also serve to reinforce rural values since the wildlife or forestry worker becomes somewhat buffered from direct influences other than the rural environment in which they work (Peterson et al. 1993).

Multiple Political Masters

The close alliance between wildlife agencies and their user groups, discussed as a component of clan-like development, has served as a factor in the development of a unique political environment through multiple masters. Kellert (1995:227) criticized the degree of exclusion from the political process, which state fish and wildlife agencies have typically shown to the public, stating that he knows no other area of government policy where such "continuous and complete exclusion" exists. Yet, influence affects the agencies of fish and wildlife like a force field.

The state fish and wildlife agency functions from a unique and duplicitous position of two separate masters, a political master and a scientific master. Each of these masters, or influences, are compounded further by the political influence from the agency's commission or board and the state legislative body. The scientific influence, from the technical education and expertise of staff as well as from the wildlife management conservation paradigm, exerts influence resulting in a dynamic interplay of power sources and influences affecting agency decisions and policy. In other words, "this is not a straight line, the hierarchical flow of power and influence affecting the agency, as is typical of most government agencies" (Richard McCabe, personal communication 1996).

Stereotypical Management Style

Fish and wildlife agencies may also have a management style that is stereotypical. In a study of biotechnology companies, Dubinskas (1988) found that when biologists, who had become entrepreneurs, worked with managers, who came from an economics of business background, subtle misunderstandings would occur over how long things would take, perceptions of milestones and perceptions of the future during the planning process. Dubinskas (1988) gave the following description of these differences: "The managers viewed time in a linear, monochronic way. With targets and milestones tied to external objective realities like market opportunities and the stock market. Dubinskas labeled this form of time 'planning time.' In contrast, the biologists seemed to operate from something he called 'development time,' best characterized as 'things will take as long as they will take,' referring to natural biological processes that have their own internal time cycles. The person operating from a planning time sees herself more in a world of objects that can be manipulated as a 'finished product.' The person operating from development time sees herself more in a process world, where her own development and that of other things in her world are more oriented to natural processes that cannot be easily speeded up or slowed down and where development is a never-ending open-ended process. Planning time seeks closure; development time is open ended and can extend far into the future. Managers and scientists operating in terms of these two types of time can work together and even influence each other's concepts, but they must first understand the differences in each other's assumptions."

Deal and Kennedy (1982) describe the management model of the US Forest Service as being an anomaly. Beginning with Gulick in 1951, then Kaufman in 1960, Hall et al. in 1970, Duerr and Duerr in 1971, Kennedy and Sutton in 1978, and Kennedy and Mincolla in 1982 (Kennedy 1985), forestry has been the best studied within the natural resource management professions. "In addition to forestry providing important habitat for a wide variety of fish and wildlife, categorically the profession of forestry is a very closely related organizational group to that of state fish and wildlife agencies with many obvious parallels" (Max Peterson, personal communication 1996).

Fish and wildlife, like forestry, is scattered geographically, often in remote areas, making formal supervision difficult. While a perfect candidate for a fragmented organization, Deal and Kennedy (1982) wrote that forestry was well-knit, accomplished its goals with less formal effort than most organizations half their size. They attributed the success of this type of organization, in spite of its anomalous management style, to the culture of forestry organizations—its complex, strong bonds.

The cultural differences among wildlifers, like forest rangers, compounded by the influences from the communities in which they reside could jeopardize the solidarity of their organization if left unchecked, but according to Kaufman (1960), checks safeguard the organizational cohesion. For example, rules, military fashion inspections, individual measures of authority, work plans, a tendency toward "musical chairs" in filling position vacancies, the requirement of a fraternal aura for new members, and a significant process of organizational acculturation all contribute to the cultural cohesion.

Deal and Kennedy (1982:194) reported that like forest rangers, wildlife law enforcement officers, or game wardens, act independently but in accord with the agency's mission. Many officers function rather autonomously, but like the forest rangers, "as if they had a supervisor looking over their shoulder." These researchers compared forestry's minimum incidents of sabotage or catering to special interest groups in local areas to McDonald's maintaining a common spirit among its franchisees.

Leaders within fish and wildlife are typically taken from within the agency or transplanted from another state agency, rarely from outside fish and wildlife. "Ours is an incestuous business, more so than most" (Mark Reeff, personal communication,: 1996). While this can work to strengthen shared cultural values, it has the potential of working against the organization as well. For example, Scheffer (1976) argued that professional management has been weakened by in-breeding, causing it to resemble the professions of education and medicine—narrow vision, decreased recognition of alternatives, resistance to change and emphasis on structure at the expense of broad helpfulness. The bottom line, however, is that, while a powerful acculturation process may have produced weaknesses in fish and wildlife agencies, it has also produced strengths, enabling its survival.

Transcendent Values

Traditionally held values have permitted the organizational culture of fish and wildlife agencies to transcend external changes going on around it, regardless of rapidly changing top leadership (e.g., a new director or governor every few years), and have cemented the organization's mission, in spite of fickle politics. Some values, while collectively held, are peculiarly relevant to the organization and profession. Kellert (1979) found a number of values related to the fish and wildlife profession that were in contrast to those held by the public at large.

Kennedy (1985) discussed the role of certain institutional guardians of the values and ethics for fish and wildlife professional managers. Cohort groups such as the International Association of Fish and Wildlife Agencies, the Wildlife Management Institute and the Wildlife Society are examples of institutional guardians. Regular meetings of regional, national and international conferences offer opportunities to learn and share from one another and, in the process, further solidify the culture (Poupart et al. 1989).

Common values, common symbols, education, and work rituals are the cultural connectors in organizations in general. In fish and wildlife agencies, these connectors can be found in the decisions based on long-term considerations for the environment and wildlife habitat, common symbols of the uniform and badge, training programs that inculcate values and the mission of the agency, and, finally, work rituals or specified procedures for reporting and responding to various problems.

Fish and wildlife agencies across the country show similarities to military or paramilitary organizations. For example, there is the reference to division leaders as chiefs, rather than heads, the usage of the term warden for the wildlife enforcement officer and the practice of requiring all agency personnel to wear military-like uniforms for public appearances. Generally, state fish and wildlife agencies will have an enforcement division as one of their principal components. As a formal subculture, enforcement is routinely accountable both to its agency and to the court, however there are differences of opinion within fish and wildlife as to where enforcement fits with an organizational structure or what its goals and tasks should be (Zahn 1990).

This inconsistency is itself a cultural constant for the organization of state fish and wildlife agencies.

Professional wildlife recruits are drawn disproportionately from rural backgrounds. They come into the wildlife profession already indoctrinated with utilitarian values (Kennedy 1985). Once they enter fish and wildlife agencies, most often they will be assigned to duty in rural communities because that is where most wild game is found (Gill 1996). Peer influence adds to this acculturation process, resulting in utilitarian values becoming rigidly reinforced, eventually creating a "defensive, bastille-mentality that views itself and dissenting publics as a contest of right and wrong, the informed versus the uninformed" (Kennedy 1985:571). The clan-like characteristic produced is a resistant culture (Gill 1996).

In a study of foresters, range managers and wildlife biologists, Kennedy and Mincolla (1982) found that the wildlifers grouped together when measured against certain variables. For example, their motivation to select a wildlife profession was more idealistically based, and the strength of their professional commitment was found to be much stronger than that of foresters or range managers. Angus (1995) compared managers from other science-related disciplines to those from fish and wildlife agencies and found similarly correlated group comparisons. Wildlifers, regardless of gender, were similar statistically, when compared to scientist supervisors outside the wildlife profession.

Elitism

Within the wildlife management domain, there is widely-held agreement that a level of elitism exists stemming from the ingrained perception that those in fish and wildlife agencies are the best qualified to do the job of fish and wildlife management (Teer 1988, Edwards 1989). Historically, this elitist, professional self-perception has worked both to strengthen agencies facing external threats as well as to hinder them in their responsiveness to change (Rollin Sparrowe, personal communication 1996).

One example illustrating this elitism can be found in the existence of two discreet professional organizations for the industry: The Wildlife Society (TWS) and the Society for Conservation Biology (SCB). While these societies have similar and often overlapping interests, they are perceived within the professional ranks of wildlife managers quite differently. TWS has a membership composed predominantly of wildlife professional managers (Rollin Sparrowe, personal communication 1996) who share a common demographic picture, having a wildlife management education from a land-grant university. On the other hand, the SCB biologists usually come from a more classical training in biology and from a wide diversity of colleges and universities. Professional associations function to self-seal commonly held values and perceptions (Poupart et al. 1989).

In addition, elitism can be seen in the separatist attitude historically exhibited by state fish and wildlife agencies toward other government entities. Possibly, this is because most state fish and wildlife agencies are not supported by general tax funds within their respective states. As a result, many may have evolved an autonomous, self-concept.

Missionary Zeal

Employees working for state fish and wildlife agencies have one common, cultural characteristic regarding their work, which has been repeatedly identified in the literature as a type of missionary zeal (Kennedy 1985, McMullin 1993, McMullin et al. 1991). There is a passion for working for wildlife similar to the altruistic calling of a missionary. "It is, essentially, this working for the 'cause' that sets apart professional wildlife managers within fish and wildlife regulatory agencies from others working, for example, in highway improvement, administrative services, or utilities. It is apparent that other government agencies are clearly lacking in the degree of passionate commitment found in fish and wildlife" (Rebecca Frank, personal communication 1996).

Professionals have been found to gain more satisfaction from their work, and their work plays a more important role in their life than it does for other groups of employees. This commitment is sometimes dissociated from the organization or the job and vested in the work itself, for which the profession, not the organization, serves as a reference group and object of involvement (Orzack 1959). In the case of fish and wildlife professionals, it may be the predominance of this professional zeal that sets apart the fish and wildlife agency from other organizations which house various professional, zealous employees.

Since state fish and wildlife agencies are regulatory by function, a level of employee compliance is an obvious requirement, particularly for those within law enforcement. Safety and security require a military-like adherence to going by the book. In addition, a rather high level of compliance is needed from the fish and wildlife staff who must interface with various legislative and constituent groups. Fish and wildlife agencies are public agencies and, therefore, must be on the same page when they address the diversity of publics with which they come in contact.

Historically, internal compliance has not been problematic for state fish and wildlife agencies. This fact may relate to the missionary-like zeal with which fish and wildlife professionals approach their work (Kennedy 1985, McMullin 1993, McMullin et al. 1991).

Unique Bureaucratic Development and Structure

The organizational structure of agencies which house fish and wildlife management professionals is bureaucratic. The hierarchical line of communication and authority typically characteristic of bureaucratic organizational structure is clearly evident. But, what may be different is that the bureaucratic structure of fish and wildlife agencies operate within another informal, but powerful structure. When public service professionals, such as agency fish and wildlife managers, practice their profession in an environment where there is a strong relationship between their related professional societies, university departments, and their government agency, then a stable and powerful triad is formed which "defines, defends, and renews a distinct professional subculture with unique characteristics and values" (Gill 1996:63).

The progressive era of the Roosevelt and Wilson presidential administrations facilitated the expansion of the bureaucracy that was organized to handle conservation issues. The public nature of policy toward wildlife in the United States has created the need for a sizeable bureaucracy. The relationship between public behavior and government response has created an inherent, organizationally unique dilemma for state fish and wildlife agencies–to respond to the will of the people while at the same time ensuring sufficient continuity of policy regarding the enhancement of wildlife resources. The bureaucratic structure of state fish and wildlife agencies, however, has not prevented effectiveness (Langenau 1982). It may not have maximized effectiveness, but, according to Langenau, it has not prevented it either.

In addition, state fish and wildlife agencies have not developed according to a typical, bureaucratic, regulatory agency model, such as suggested by Bernstein's theory (1955). His theory proposes that, after a series of stages, the agencies become obsolete. In fact, the opposite has been the case for fish and wildlife; there has been an increase in the activity of interest groups, rather than agency dissolution predicted by Bernstein. For example, the bureaucracy of the state fish and wildlife agency became more complicated with the emergence of commissions and boards, but did not die in the process as expected. If anything, it may have served to solidify the agency culture.

Unique Profession-related Cultural Components

In a comparison of five different organizational culture types, one is described as the "professional culture" (Poupart et al. 1989). The following description of a professional culture suggests much in the way of fish and wildlife agencies: "The professional culture defines productivity in terms of fostering and developing expertise, and concerns itself with the frontiers and borders of that expertise. The frontiers define the profession and the borders protect the professional's autonomy. The object of identification is the profession and its standards, to which the members of the culture profess a deep commitment. The main mechanisms of coordination and control are professional training and the standardization of qualifications, which are policed by self-governing professional associations. Information flows freely among colleagues of the same profession and is held back from members of a different profession. Therefore, in this culture information does not easily cross borders.

"The power of the professional is based on his or her expertise...believing as they do in the power of the intellect, the members of a professional culture tend to be disdainful of hierarchical power and question the legitimacy and relevance of its actions.

"The career path valued in this culture is the professional highway, and promotions are based on technical competence and specialized expertise. As for conflict resolution, a great deal of energy is spent defending the professional's autonomy...while conflicts between members of different professions can be rather bloody, professional solidarity comes into play when members of the same profession are involved. Because the members of this culture do not like to air their dirty linen in public, every effort is made to contain internal conflicts within the borders of self-governing professional associations and to solve them around the kitchen table" (239).

While this description may match the medical profession and others similar to it, adding the peculiar characteristics of fish and wildlife agencies to the professional organization profile strengthens the argument for fish and wildlife agencies' unique culture. Kennedy (1985) suggested that, because there are enough unique components to fish and wildlife managers, it should be considered a unique professional culture. He selected four components: language, technology and artifacts, social structure, and professional value system.

Kennedy described the professional language of the fish and wildlife profession as saturated with codified jargon, terms and acronyms, many scientific and biological, learned from pre-service training at the university and reinforced daily. Several examples of this code are: IAFWA, PR, DU, DJ, EIS, T & E, scat, LP Index, K-selected species, amensalism, density-dependent, carrying capacity, random-pair sampling, antis, greenies and tree huggers.

The technology and artifact components are represented by the tools, clothing and art of the fish and wildlife culture. The stereotypical look of the wildlife agency can be seen by the survey equipment, dart guns, official uniforms (typically khaki or tan and green semi-military look), unofficial L. L. Bean look, taxidermy mounts and wildlife posters, which dominate offices.

The social structure was described by Kennedy as hierarchical with the undergraduate at the bottom and various rites of passage, such as fall hunting and other *good ol' boy* rituals. Distinctions between agency divisions are pervasive and clear, that is a game warden is not an I & E officer, who is not a bean counter, etc.

Well-established occupations have cultures just as organizations do (Trice et al. 1993). As a consequence, various types of acculturation emerge between organizational cultures and occupational cultures. In some instances, occupational communities dominate the organization. For example, Van Maanen (1973) examined the process of organizational socialization in a large, urban police department. Socialization was found to progress from an individual in-the-same-boat mentality to a collective do-not-make-waves philosophy (407). Interestingly, this progression is similar to the socialization progress found in state fish and wildlife agencies.

Occupational stereotyping is not unknown. A wide range of studies indicated that early organizational learning is a major determinant to one's later beliefs, attitudes and behavior (Van Maanen 1973). Schein (1991) suggested that this process results in a psychological link between the goals of the individual and the constraints and purposes of the organization. In effect, this type of psychological contract between the person and the organization represents the outcomes of the socialization process.

Conclusion

Chandler (1992) conducted an inductive, organizational culture assessment of the Michigan Department of Natural Resources (DNR) in which he concluded ten summary phrases describing the agency's culture. It is my belief that Chandler's short, rich descriptions are not unique to Michigan, but poignantly describe the overall culture of fish and wildlife agencies. Chandler's descriptions were that the Michigan DNR was professionally competent, technically expert, geographically dispersed, legally powerful, politically controversial, historically resilient, organizationally unmanageable, personally independent, emotionally private and morally correct.

There may be different ways to assess the profession of fish and wildlife, but there exists enough organizational, cultural attributes, peculiar to the profession and its housing agencies, that reveal a type of organic solidarity. Such a solidarity asks, "Who says fish and wildlife ain't got no culture?"

For a more comprehensive discussion of culture in fish and wildlife, interested parties may wish to read *A Model for Cultural Audits in Fish and Wildlife Agencies* (Angus 1997).

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Move Ahead with the Past for Wildlife and Nature Conservation

Delwin E. Benson
Colorado State University
Fort Collins

Introduction

Learning what professionals say about the education of future professionals is useful. We can identify trends, explore gaps, agree or disagree. Good ideas often are taken out of context, thereby promoting a trend that could cause problems. Current writings about the merits of mathematical ecology are a case in point. Data are important. Yet, more use of better data alone will not solve environmental problems any better than will more communication, money or laws. The wildlife profession is a diverse discipline, and it can accommodate a diversity of students and education philosophies to address the many needs and actions. I will review suggestions from the literature, then offer my own thoughts about appropriate qualities of thinking and educational approaches that are vital for many future professionals who will perform best as multi-disciplinary, land-based naturalists, interdisciplinary communicators and hands-on learners.

Historical and Current Contexts of Thought about Wildlife Education

Much is asked of wildlife education programs because animals and humans are part of larger, ecological, human systems that must be understood if wildlife is to be managed. To understand the systems requires methods of inquiry and evaluation. Some wildlifers become focused on the analytical side of management, as literature that follows will attest. Other wildlifers make and enforce laws, lead and manage organizations, write and speak to people, apply theory and practices, raise money, interact with others of similar and divergent thoughts, and plan for an uncertain future.

Over the years, wildlife jobs have changed little: work with land, plants, animals, and people. However, what people think about those roles, what is known about doing the jobs and which components to emphasize, continues to change–sometimes daily. Managing land, wildlife and people change as problems and solutions evolve, but the wildlife profession still helps nature to function properly within the constraints of ecological and social changes.

A rich array of suggestions have been published about education for wildlifers. A brief overview of suggestions will reveal more of the diversity and biases that exist. If the premise that the environment and wildlife management have multi-disciplinary dimensions (Figure 1) and require interdisciplinary thought and action is believed, keep those holistic thoughts in mind to evaluate educational suggestions.

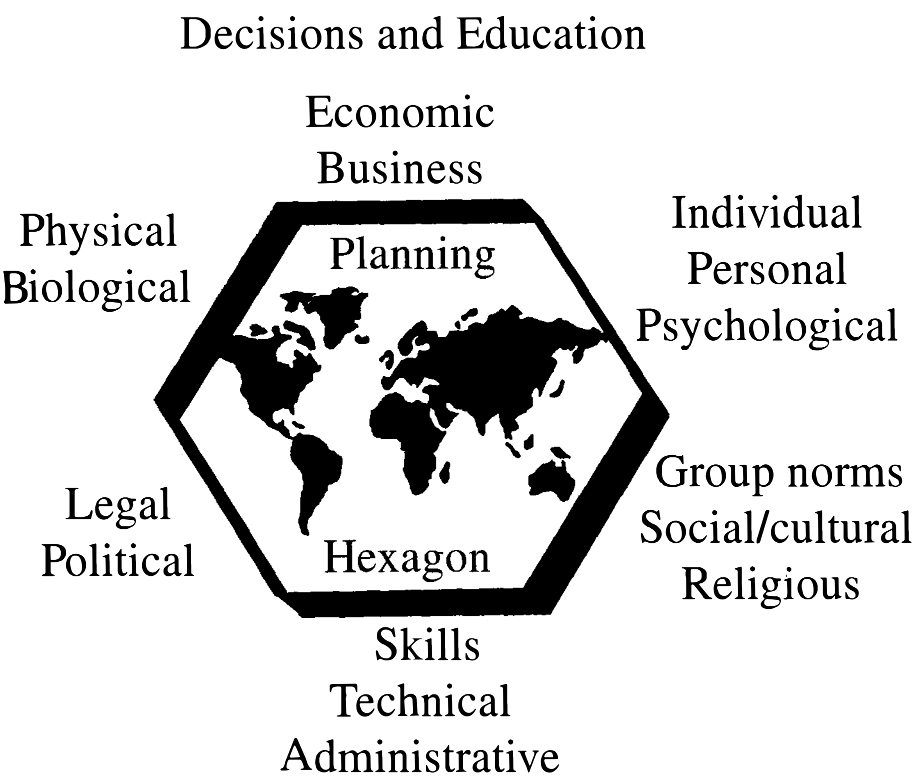

Figure 1. A useful framework to integrate multiple disciplines from the general categories of physical and biological sciences; economics and business; the individual and psychology; the sociology and normative behavior of groups; the application of skills, technology and administration; politics and law.

The Wildlife Society Bulletin (2001) contained a section addressing the importance of biometrics education to natural resource professionals. (Gould 2001) edited the unit and summarized common needs of wildlife biologists: (1) they must use good science whether they are managers or researchers; (2) they solve problems by collecting, interpreting and using data, thus statistical training would improve their performance; and (3) students must acquire skills beyond biology in the classroom, such as field competencies, effective communication and use of computers. People skills, such as speaking, mediation and conflict resolution, were acknowledged in the remaining articles, but emphasis was clearly focused on acquiring analytical skills for biological data and how best to package and to teach it.

Johnson et al. (2001), three statisticians, recognized that some students of wildlife are drawn to the field because they enjoy wildlife, and they perceive that their studies will be insulated from mathematics. If a strong analytical approach is taken, then reality does not match perception, and students will either exit the field or adapt. To leave is not to have failed, but should we lose good students merely because their gifts are not with mathematics?

Perhaps mathematical specialities are not necessary for everyone. Johnson et al. (2001) gave more importance to obtaining and recognizing good data than to analyzing it. They contend that statisticians who focus on their discipline exclusively cannot keep abreast of all the methods and approaches. They believed that biologists, whose primary role concerns animals and habitats, cannot be expected to master statistics. Biologists need the appreciation of controls, replication and randomization in studies that they conduct, and little mathematical sophistication is required. If everyone became analytical ecologists, then we would not need specialists to fill this key role in the profession. Remember context! The authors were asked to write about statistics for wildlifers not the role of law enforcement, public communications, leadership or the application of computer technology.

TheWildlife Society Bulletin (2000) also featured a special coverage of undergraduate and graduate training. Krausman (2000) reviewed the evolution of wildlife education, from the days when ammunition manufacturers established the first university faculty fellowships to study specific topics of management to the current focus on theory, basic sciences, ecology, analytical applications and the human dimensions. He said that the future of our wildlife resources is tied directly to solid education, both in and out of classrooms, of wildlife, their habitats and all of the anthropogenic forces that threaten their future. His key ingredient for success of wildlife management is students who have the desire, drive and dedication to become actively and passionately involved in the process of managing wildlife resources and the habitats on which they depend. Brown and Nielson (2000) indicated that there is too much to learn in four years, so students should learn how to learn and to prepare for a life of continuing education. They should learn to lead and not to merely respond.

If education is not relevant to students, then integration of knowledge, skills and attitudes into behaviors becomes limited. Good teaching and learning techniques are as essential to education as providing the appropriate content. The need to practice a better pedagogy, with content and teaching strategies that are active, mission-based and student-centered was emphasized by Brown and Nielsen (2000) and Matter and Steidl (2000). They also suggested that teachers need to relinquish some of their autonomy and develop meaningful avenues of exchange with students and with the agencies and organizations who are their eventual employers. Edge and Loegering (2000) reviewed how distance education is expanding opportunities for education, but stressed that some students and faculty prefer a more traditional approach. Most authors in the unit of the Wildlife Society Bulletin (2000) agreed that active and engaged students should become lifetime learners, with the capacity to find answers and to learn techniques.

Porter and Baldassarre (2000) use the thesis approach to promote active learning of technical and interpersonal skills for graduate students. The same interactive and experiential process could be applied to undergraduates also. They contend that students should become problem solvers and advocates for wildlife within a balance of the needs of wildlife and the needs of people. Their most common critique of new graduates is that the students lack polished, interpersonal skills. Students have little experience with personnel management, budget management, report writing or broad exposure to emerging paradigms in conservation. Finally, they assert that faculty should mentor their students.

Mentors provide motivation, and motivation enhances learning. All can recall important people in our lives who influenced us most. They influenced our interest in certain topics and helped to determine why they were important. They made content come to life.

Let us consider the 1980s, moving towards the present. Cutler (1982) said that wildlifers would make fewer decisions alone and that they must become partners in interdisciplinary teams with the capabilities of predicting habitat changes on wildlife populations to effectively advocate solutions to the resource management dilemmas. His concern that universities were training students to do animal research instead of managing habitats has been exacerbated in modern times by emphasizing biology programs over wildlife management programs. Cutler–and Leopold (1940) 40 years earlier–advocated that total ecosystem management was necessary. Leopold (1966:190), as the first wildlife educator, recognized that all parts of the biota were equally valuable, thus holism was taught from the beginning, even while he focused on specific issues such as wolves, deer and land use.

Progress was made to infuse more holistic thinking to the wildlife management system, thanks to public pressures, the conservation biology movement in academia and agencies addressing a wider array of species and larger ecosystems. Yet, solutions to the problems deal with hydrology, agronomy, economics, communications, sociology, vegetation, field techniques, etc., about which the academy seems to teach less. We can document problems better, but leadership to solve problems needs more work.

In the 1990s, Schmidly et al. (1990) reviewed the needs of federal and state natural resources agency employers about education needs of entry level employees. They found that the primary entrance degree was the Bachelor's, and skills with communications, public relations, technical processes and mechanical processes were as desirable as biological knowledge.

Have we progressed much in 20 years? Ledford (1996) voiced student perspectives that new students lacked outdoor experience and that universities needed to teach what students used to learn from time in the woods and fields. Are we doing that? Arner (1998) was concerned that the plant sciences were neglected, which is a reoccurring theme. Perhaps we have forgotten the basis of wildlife management, the habitats.

Kessler et al. (1998) expressed the need for incorporating international needs and perspectives into education. Working internationally, I have learned new ideas that apply to North America and observed that international wildlifers tend to work closely within the interface between land, wildlife and people. That is good news. The bad news is that my institution stopped teaching two courses with international wildlife and natural resources. What grade would you give your institution on its teaching and learning opportunities?

Hein (1995) gave university education a grade of B for the 1990s after reviewing roots and trends in natural resources education. I differ with his D or F given for "the inadequacy of yesterday's education to address tomorrow's needs," because I worked on my first degree where he taught–albeit 30 years ago–and contend that my education prepared me well for what I am doing. What was lacking with initial learning, we could improve upon through advanced degrees, on-the-job training and a little common sense. That reality should never change.

Hein and I agree that traditional methods of teaching and learning dominate, but lack effectiveness. He asserts that few professors have taken an education course or explored cognition and learning theory. We teach as we were taught–in a didactic manner. Innovation, which once meant using colored chalk, now means overheads from computer graphics. He questions if neater visual aids are the key to more effective teaching. We continue to proclaim the importance of "teaching students how to think" with little progress toward understanding what that means (Hein 1995).

The meaning of better teaching and learning will be addressed later in the essay, once my background and biases are revealed about how I was taught to think by a life and an institution that offered more opportunities then than now.

Biases Revealed, Explained and Appreciated

Colorado State University offered a wide array of topics (made possible by good planning and the quarter system). I was allowed to pick courses, within bounds, that matched my aptitudes and addressed my limitations. The guidance of good mentors was critical. They saw the potential and the flaws in their students, and they did not force one type of curricula onto all learning styles, aptitudes and interests.

Each learner is unique. Humans are filled with individual differences that can be detected and understood scientifically, while other attributes are more mysterious. Roles for wildlife and natural resources management may have similarities, but they too are varied and dynamic. I share my story because it reflects diversity. To know the background might help to understand the context of my recommendations.

I was born the year after Leopold died, but I still revere his life, thoughts and actions as a naturalist, artist, communicator and leader. I learned the history of conservation leadership from Gustav Swanson (a Leopold Award winner) and participated with him on local and national conservation issues. Now, I teach the subject, in classes and via distance education. Douglas L. Gilbert, the father of natural resources public relations, which we now call human dimensions, was my inspiration and first university administrator. His family and mine had rural roots as common people who knew the land, hunted, gathered its bounty and who wanted to mitigate its problems through good management. His family was educated and professional; mine was primarily ranchers and small business managers. I learned the ethic of work early from a father who worked too much but who inspired me to become part of the outdoors. The trauma of leaving the land for pursuits in the city was felt deeply. Watching development encroach on former open space caused me to work to slow the process.

I learned about land production and use as I helped to work with the land and its products, as I hunted and fished. There were some fascinating birds to learn about because I shot a few with my grandfather's .22 rifle, but not with his full blessing. Anatomy and ecology began to interest me because of those stiff tail feathers on woodpeckers and owl talons that moved when you pulled the tendons in its leg. I saw how rain eroded the pasture next to the stream where grass was overused. Water runoff did not cause the same problems where grass grew thicker and animals were more dispersed. The forests I walked through seemed pristine until I found tree stumps, small mine spoils and rusted cans from campers before me. I learned early that people alter environments and that they must also help where they can to protect and to usethem wisely.

My high school counselor knew that I was interested in conservation, so he helped me to apply for university study and to enter an essay contest. Winning the contest enabled me to work with radio-telemetry, repellents, data, field trappings, animal care, small mammals and birds during the summer before entering university. Good experiences with good professional mentors molded me further.

Colorado State University in the late 1960s enabled me to take a wide array of courses because of the program's ideology and because we had four quarters of classes per year, rather than the current three semesters. Students took about five courses per three quarters over four or more years, amounting to around 60 courses. Summers were devoted to work, special studies, a field wildlife studies class and a summer camp. Currently, five courses are taken each of two semesters over the four or more years, totaling 40 courses. With 20 extra slots for courses in earlier years, I studied soils, botany, genetics, anatomy, physiology, dendrology, mammalogy, ornithology, natural resources policy, wildlife values, wildlife nutrition, wildlife diseases, management of fish, big game and small game, wildlife management techniques, psychology, sociology, economics, logic, general biology, and ecology in addition to the basic math, chemistry, physics, statistics, speech, composition and natural resources survey courses. Gene Decker taught public relations in natural resource management principles to me when I was a sophomore because I was keenly interested. Advisors recognized that bending the guidelines was a good idea. Decker's teaching and Doug Gilbert's book and inspiration stuck. Now, I am the teacher.

I also teach a short field wildlife studies course that has been reduced to elective status rather than a requirement. The summer camp is shorter and the senior research project was abandoned. The techniques course is about analytical methods, not methods of the land and wildlife. Students with fewer field experiences than in the past are getting fewer opportunities to make up for their demographic deficits.

Finding ways to engage students as life-long learners has been my goal over the years whether through the classroom, off-campus activities, extension programs, research or continuing education. I provide continuing education opportunities through seven correspondence courses. Since no instructor is present, students must learn experientially, and I provide exercises to engage students in the subjects. Service learning is another pedagogy that I have used to link campus-based course learning objectives for students with natural resource agency professionals and their relevant current events. Students studying public relations in natural resources prepare strategic communications and public-relations plans that address current natural resources issues. They probe to understand the wants and needs of people, then recommend ways to communicate with them once decisions have been. Agency professionals help, providing both educational content and professional interaction. Cleary and Benson (1998) wrote that service learning brings student-centered, experiential learning into the community and the needs of community into the classroom. The relevance comes alive when students apply what they are learning to real situations. Agency cooperators get comprehensive plans for influencing relations with the public. As a professor, I benefit from students' projects because I learn the theories conveyed in books, articles and lectures are not learned well without their participation. Even after actual participation not all students learn equally, but instructors and students clearly recognize their successes and failures.

The past of wildlife management also is criticized as being over-consumption oriented. Young professionals might think that old teachings and teachers are biased toward hunted species. My educational experience suggests otherwise. Yes, past wildlife management dealt more with hunted species. There were important issues to address, people were interested in hunted species, and the demand made money available for hunted species and their habitats. However, my wildlife educational experiences came from holistic-thinking people with a wide range of disciplines.

Educators' attitudes and approaches to education were as meaningful as the contents. For example, Gus Swanson was a dedicated scholar, historian and naturalist. Ron Ryder, a library rat on every subject, was unequaled with a pair of binoculars and on the land. Years after retirement, he continues to share new books or articles with faculty and students about many topics. Dale Hein taught ecology and habitat management, not game ecology, and he challenged students to think about system functions and how to manage them. The Cooperative Wildlife Unit Leader, Fred Glover, took us afield, though he did not need to, and taught us how to read the land. He trained good field trial dogs, too. Gene Decker taught public relations before it was fashionable, but his grasp of ecological questions and international perspectives will likely never receive its rightful recognition. Harold Steinhoff was an economist, a wildlifer and a systems thinker who taught about big game and small mammals. Most of these professors hunted; all were general ecologists. None was environmentally narrow-minded. Persons with those same holistic attributes existed in education throughout the nation.

I worry about the narrowness of toad and butterfly biologists (as examples)–who would not hunt–more than I worry about the biologists who did. The issues of old might appear more narrow when looking back with a small rear view mirror. We should move ahead with the past.

Move Ahead with the Past

Several citations from novice professionals seem appropriate to my suggestions for the future. The first is from a new educator, Johnson, who has two approaches to teaching. First, teach both science and affection; second, help to cultivate a sense of place (2001). I hope that he and we always remember those two points.

The second quote is from a Master's graduate, Maestas. He reminds us that his Generation X is, "generally more disconnected from the land than their predecessors, but nonetheless adamantly concerned about the conservation of all organisms, both game and non-game" (2002). He concludes that the new students owe it to those who have come before and to those who will follow to work hard, think critically and adapt to new challenges to take advantage of the incredible opportunities that will be presented. To students with that attitude we owe them the best education possible.

David Orr provides my final thoughts from the literature about humans, the land and education. He says that now, more than ever, we need people who think broadly and who understand systems, connections, patterns and roots. He sees a danger that education will damage the sense of wonder about the world that is part of our original equipment at birth. It does so by reducing learning to routines and memorization, by excess abstractions divorced from experience, by boring curriculum, by too many rules, by over-stressed grades, by too much television, by too many computers, by too much indoor learning and, mostly, by deadening the feelings from which wonder grows (1994).

Jobs in wildlife require the eyes of naturalists, the heart of advocates and the pens of communicators. Administrators and technicians are equally important. Data gatherers and analysts are important, but no more important than anyone else. Today's students need the same naturalists' attributes of old, along with greater training to address broad ecological questions, more pluralistic wildlife constituents and a wider array of technical aids. Today, wildlifers still need to harvest the overabundant, protect the scarce, mitigate the impacts of clean farming, forestry and human habitation and provide for quality wildlife and nature-based outdoor recreation. Some species are at risk, while others are over-abundant. Hunters still hunt in large numbers and the balance of land, supply and demand for recreation, continues to dwindle.

The early wildlife educators and professionals were energetic, driven and enthusiastic. Yet, they had hard times convincing their constituents, critics and cooperators that wildlife was an integral part of landscape management. Wildlife professionals did not agree necessarily with land and plant managers about how landscape decisions and practices should be conducted. Wildlife management–game management as Leopold called it–was a by-product of the land (1966) and wildlife managers usually managed what foresters, agriculturalists and other extractors allowed as left-over resources. Wildlife concerns were hardly the elements that, in recent years, have stopped dam building and logging, influenced the Farm Bills, induced citizen initiatives and referenda, and encouraged a new set of constituents and students who think less about utilization and more about protection.

We might have more ears and helping hands applied to the cause of wildlife today, but the messages heard are tainted by a new socialization and education. Though laws exit to protect species, in reality, the journey is still filled with road blocks from impediments that are personal, social, economic, bureaucratic, legal, political, technical, skill-based, physical and biological (Figure 1). The student of tomorrow must learn to work with each consideration equally or belong to teams that do.

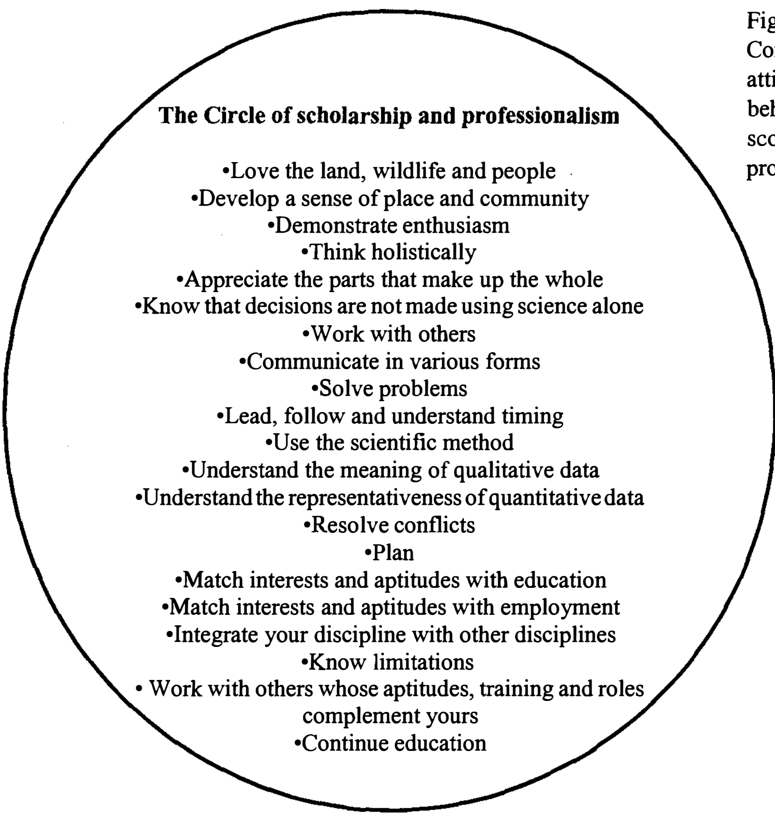

Figure 2. Common attitudes and behaviors for scolars and professionals.

Certainly, not all wildlifers should be trained as biometric automatons at the expense of their development as readers of the land, wildlife and people. Good people and future professionals have diverse aptitudes, interests and motivations. One job does not fit all. One type of training does not fit all. One approach to nature conservation does not fit all needs. Our wildlife profession is filled with expertise about the parts, now we must use it wisely.

I am relaxed about the future because the diverse educational advisors advocate quantitative skills, human dimensions capabilities, biological foundations, multidisciplinary interaction and interdisciplinary approaches (Benson and Darracq 2002) Each person needs a little of all disciplines at the Bachelor's level, with a hint of specialization. At the masters and doctoral levels, students can focus more, but, even at the highest education levels, narrow curriculums might promote myopia in students, if they are not properly advised. Myopia at the top of educational ladders might be a cause of our concerns and discussions today.

Recommendations for Curriculum and Educational Processes to Develop Wildlife Professionals

A few of the professional attributes that wildlifers need, individually and as a team, are summarized in figure 2. Figure 3 summarizes important learning principles and educational considerations needed for everyone to develop, as learners and teachers. Figure 4 is my list of educational topics that every professional must know in depth to address the many needs for land, wildlife and people management.

The following are 10 recommendations for developing more student-centered approaches to holistic education that helps students to become effective leaders and life-long learners. Students, educators and employers each have a role for learning and teaching that can be enhanced by cooperative planning and actions.

- Offer more, not less. Encourage a breadth of interests for students and provide opportunities to gain knowledge, skills and attitudes among an array of concepts, including science, economics, psychology, sociology, administration, politics and law (Figure 1).
- Integrate teaching and learning approaches to address multiple disciplines. Faculty, administrators and cooperators must start the

Learning Principles and Teaching Ideas

- **Learning**...means behavioral change.
- **Knowledge**...is needed to ask the right questions and to find appropriate answers.
- **Skills**...should be relevant to interests, aptitudes and work to perform.
- **Attitudes**...give meaning to work. Pluralistic and empathetic attitudes help to keep eyes wide open.
- **Purpose** - There are many tasks and jobs in the wildlife profession. Purpose gives meaning to life and to work.
- **Transfer of learning**...from the educational experience into practical application is required for true learning to take place.
- **Repetition**...in different forms, without redundancy, aids learning.
- **Concrete experiences**...add reality to education.
- **Abstract thinking**...helps to explore beyond the normal boundaries.
- **Active learning**...is better than passive learning.
- **Levels of experience**...differ among students.
- **Levels of challenge**...should relate to the experience levels of students.
- **Motivation**...comes most from within and is enhanced by others.
- **Individual differences**...in students can be easily detected visually, but differences also exist with interests, aptitudes and talents. Educational experiences are unique for each individual. Educational experiences should be appropriate to learning styles.

Figure 3. Learning principles and educational considerations needed for everyone to develop as learners and teachers.

process with clear and frequent communication among themselves about matters of curriculum and mentoring. Team teaching is more than multiple instructors and many topics. Team teaching should have interdisciplinary planning and those interrelationships should flow during learning opportunities within and among courses and years. If repetition is needed, it should be planned. If redundancy is evident, it should be stopped.

- Create measurable learning objectives for students. Identify: (1) what will be accomplished, (2) at what level of performance and (3) under what conditions.

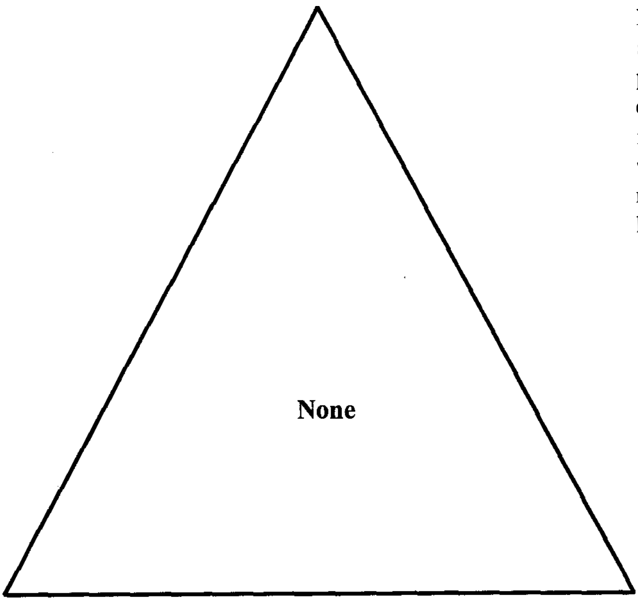

Figure 4. Educational specialities that every professional must have in common to address the many needs for land, wildlife and people management, ranked from least to most important.

- Learning includes knowledge, skills and attitudes. Teaching one without the others does not work well. Complete learning will not result.
- Change the way knowledge, skills and attitudes traditionally are addressed. Start with a clean head and curriculum. Old school procedures were developed to allow for classes during the hours of eight to five with daylight because there was no electricity. We did not teach during summers because students were needed in the fields. Students still need the field, but now for different reasons. Learning objectives can be placed within many contexts to include courses, parts of courses, short courses, long courses, learning modules, summer courses, night courses, courses off of campus, courses from other departments or institutions and independent study. Educators need to offer more in a year or more topics in a class because there is more to learn.
- Evaluations need to match objectives. Students might be evaluated by tests, discussions, projects, products and journals. Some evaluations might require mastery, while others might require participation.

Students should demonstrate knowledge, skills and attitudes to test out of some requirements. Certain objectives might be suggested to students without evaluation, such as books to read, plants and animals to know or concepts to understand.

- Use active student-centered pedagogy. Remember that education is not about teaching, rather it is about learning. Students learn best with concrete and active experiences. Traditional activities, such as laboratory work, thesis projects, senior special studies, honors programs, internships and jobs should be supplemented with service learning (Cleary and Benson 1998). Course objectives can come alive, if the students are working on practical applications of knowledge, skills and attitudes as part of addressing community needs. Students learn subjects better, and they find a sense of place. Faculty learn if students can apply the principles to real world situations, and community cooperators get help with their needs.
- Encourage independent learning, while in school, to effect the same behaviors out of school. Have courses available via distance education and correspondence, where students are the center of learning and not the faculty.
- Employers have responsibilities to train their employees for specific roles upon entrance and as continuing education. Universities can assist with this. Close cooperation can build each others' strengths.
- University educators should keep close contact with employers to ensure that education is provided to students in preparation for the issues and work that they will eventually address. Students, faculty and natural resources agencies and organizations can benefit from working, teaching and learning together. Each should help to build the others.

Conclusion

Wildlife management is the best discipline to incorporate multiple disciplines and interdisciplinary planning and action because it is related to everything else. Educators should use management as the catalyst to transfer learning across disciplines. Educators should not relegate teaching to departments of biology, English and statistics, rather they should incorporate appropriate biology, analytical techniques, words, etc., into management.

Creating a homogenous wildlifer is impossible, considering the many problems, solutions and roles within wildlife and natural resources management. Intellectual and personal heterogeneity in people prevents any thought of a homogenous education. One job does not fit all. One education does not fill all people or all jobs.

An important principle to remember is that education is about learning, not about teaching. When educators keep learners foremost in mind, they are likely to adjust approaches to give students a greater role in education. Teaching is the many processes used to affect behavioral change that includes knowledge, skills and attitudes.

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Passing the Torch of Wildlife and Fisheries Management: Comparing the Attitudes and Values of Younger and Older Conservation Professionals

Robert M. Muth
University of Massachusetts
Amherst

Rodney R. Zwick
Lyndon State College
Lyndonville, Vermont

Martha E. Mather
US Geological Survey, Biological Resources Division
Amherst, Massachusetts

John F. Organ
US Fish and Wildlife Service
Hadley, Massachusetts

Wildlife-related values in American society are undergoing considerable change. Within the last few decades, non-consumptive recreational use of wildlife has increased dramatically; groups that subscribe to animal protection values (ranging from animal welfare to animal rights to animal liberation) are exercising increasing influence over wildlife policy, and the ranks of people who practice wildlife rehabilitation have grown significantly. In this time of questioning and change, it should not be surprising that the attitudes and values of conservation professionals are in transition as well. Within many agencies and academic institutions, the traditional focus on game management (Geist et al. 2001) is giving way to an emphasis on biodiversity conservation, endangered species protection and ecosystem approaches to management. Changing professional values are reflected, to varying degrees, in changing curricula offered by academic departments in colleges and universities (Organ and Fritzell 2000) and in the changing management strategies of conservation organizations–non-governmental as well as state and federal agencies. Within many organizations and agencies, employees with more traditional-value perspectives often work alongside employees who possess non-traditional values, sometimes in an uneasy state of co-existence.

Managing the professional workforce is always a challenge. On the one hand, it is important for agencies to adapt to changes in a broad social and political environment. On the other hand, it is also important to be careful not to jeopardize their relationships with traditional constituencies that provide important political or financial support (Dizard and Muth 2001). The need to walk a fine line in changing an agency's policy direction dictates that agency leaders proceed cautiously, often in a trial-and-error process with small, incremental changes (Lindblom 1959). Changing the culture and organizational structure of an agency to be more responsive to changing legislative direction or sociopolitical values often necessitates hiring employees characterized by new kinds of professional or disciplinary expertise and associated values (Meyer and Rowan 1977). However, integrating new employees that possess non-traditional values into a traditional organizational culture can pose serious problems. When values conflict, socializing new employees into the organization can be problematic if the new employees find it difficult to support the agency's traditional policies, missions and programs.

The example of the US Forest Service is instructive. In the 1950s, the Forest Service, despite being a highly decentralized organization, was extremely cohesive in terms of organizational culture and in terms of making decisions that were consistent with the agency's mission. Staffed largely by professionally trained foresters, professional values were relatively homogeneous (Kaufman 1960). However, as broader societal values became more environmentally oriented in the 1960s and 1970s, changes in the legislative mandate of the Forest Service necessitated a shift in the agency's mission, programs, planning and administrative procedures. In adapting to new laws, regulations and public values, the Forest Service recruited new disciplines (e.g., wildlife and fisheries biologists, landscape architects, economists, sociologists) into the organization, and these professional values gradually became institutionalized, albeit oftentimes not without considerable organizational (and employee) stress. Forest Service wildlife biologists, for example, often found themselves in conflict over whether to support the values of their wildlife professional subculture (protect and enhance wildlife species and their habitats), or to support the cultural values of the Forest Service (emphasize meeting timber harvest goals). Organizations can quickly become dysfunctional when the traditional values of an organization collide with the values of new employees that oppose the agency's traditional culture.

Managing the professional workforce is bound to become more challenging as conservation organizations recruit new people or promote younger people to middle and upper management. The management challenge will be magnified if people entering the profession have different sociodemographic backgrounds (e.g., urban versus suburban upbringing, ethnic minorities, women, lack of experience in hunting, trapping or fishing), or have graduated from academic programs (e.g., environmental science, botany, human dimensions) that differ from traditional wildlife and fisheries curricula. In many cases, these newcomers may bring with them a set of personal or professional values that are at odds with the traditional values and culture of many resource management agencies.

Issues of organizational stability and change may become more problematic in the near future. As the leading edge of the baby-boom generation of resource managers, policy makers and academicians enters retirement, conservation organizations are facing the prospect of losing from one-quarter to one-half of their workforce in the next five years. These positions increasingly will be filled by younger professionals characterized by attitudes, values and sociodemographic backgrounds that may be markedly different from those of their older counterparts. To minimize organizational conflicts, agency administrators need to start thinking about how to proactively integrate large numbers of younger employees into the ranks of conservation organizations.

Methods

To compare the attitudes and values of younger conservation professionals to those of their elders, we sent a mail-back questionnaire in 1998 to a stratified, random sample of 1,000 members of each of the following four professional societies: The Wildlife Society, American Fisheries Society, Society for Conservation Biology and the North American Wildlife Enforcement Officers' Association. The questionnaire consisted of 119 questions related to management philosophy, ethical considerations, sociocultural factors, specific management practices, selected wildlife and fish harvest activities and uses, and sociodemographic characteristics (Muth et al. 1998). Of the 4,000 questionnaires originally mailed, 3,127 usable questionnaires were returned. After accounting for non-deliverables, the response rate was 81 percent.

Results and Discussion

Analytical Methods

One objective of this research was to examine the relationship between age and the attitudes, values and sociodemographic backgrounds of respondents. To achieve this, respondents were grouped into three age-based categories. The youngest age group was comprised of respondents under the age of 34; a middle group contained people whose ages ranged from 34 to 48, and the oldest group consisted of those respondents 49 or older. These age groups were then cross tabulated with selected sociodemographic variables to develop an age-based profile of the respondents.

These three age-group categories were also used as an independent variable to explore the relationship between age and selected attitudes and values. For the dependent variables, we used several questionnaire items that were framed in a five-point Likert-scale format, ranging from strongly agree (1) to strongly disagree (5). These questions measured respondents' views about management of fish and wildlife resources (four questions), their ethical considerations regarding harvest activities (seven questions) and sociocultural values (two questions). Using the collapsed age-groups as the independent variable, these 13 dependent variables were analyzed using one-way analysis of variance (ANOVA). Three additional questions were asked about whether or not to outlaw specific wildlife harvest activities, for example, the use of dogs to hunt back bears (*Ursus americanus*), the use of dogs to hunt upland game birds and the use of leghold traps to trap furbearer species. These questions were measured using responses of yes = 1, no = 2, and no opinion = 3. The relationships between the age of respondents and their responses to these questions were analyzed using chi-square analysis.

When interpreting the results, readers are reminded that statistical significance does not necessarily equate to sociological significance. Although statistically significant differences are often detected between the responses of the different age groups, in many cases the differences in their mean responses are very slight. In these cases, mean responses may reflect differences in degree (i.e., slight differences in level of agreement), rather than in magnitude (i.e., strong differences in levels of agreement versus disagreement). Differences in the overall pattern of responses between groups may, in fact, be more important than statistically significant differences in the responses to any one question.

Profile of Respondents

Differences were observed between respondents of different ages in terms of where they lived during childhood (Table 1). Approximately 43 percent of the youngest and middle age groups grew up in either a rural area or a town with 10,000 population or less, whereas 57.5 percent of the older age group lived in a rural area or town. In contrast, about 25 percent of the younger age group lived in a small city of 10,001 to 50,000 population while growing up, compared with 21.9 percent and 17.4 percent of the middle age group and older age group, respectively. Approximately 32.2 percent of the younger age group and 35 percent of the middle age group lived as a child in a medium or large city; only 25.2 percent of those over the age of 48 grew up in such an environment. A similar pattern of differences was detected among the three age groups when asked to describe the type of area where they currently reside (Table 2).

Table 1. Type of area in which respondent lived most of childhood, by age group, in percentage.

	Age group		
Type of area lived during childhood	< 34 Years	34-48 Years	> 48 Years
Rural area or town (< 10,001 population)	43.6	43.2	57.5
Small city (10,001-50,000 population)	24.2	21.9	17.4
Medium or large city (> 50,000 population)	32.2	35.0	25.2
Chi square df=4= 45.86, p < 0.00.	100.0	100.0	100.0
	n=795	n=1,569	n=702

Table 2. Type of area in which respondent currently lives, by age group, in percentage.

	Age group		
Type of area in which the respondent lives	< 34 Years	34-48 Years	> 48 Years
Rural area or Town (< 10,001 population)	36.1	45.1	46.9
Small city (10,001-50,000 population)	25.6	21.0	20.0
Medium or Large city (> 50,000 population)	38.2	33.9	33.0
Chi square df=4= 23.26, p < 0.00.	100.0	100.0	100.0
	n=792	n=1,581	n=714

Although differences were detected in terms of the highest levels of education achieved by people in the three age categories, respondents are highly educated relative to the educational levels of their society. The older age group reported the highest percentage of graduate or advanced professional (e.g., law, veterinary medicine) degrees as well as the highest percentage of respondents with less than a four-year college degree. The younger age group reported the lowest percentage of less than a four-year degree, the lowest percentage of graduate (or advanced professional) degrees and the highest percentage having a four-year degree as their highest level of education (Table 3). Not unexpectedly, respondents in the youngest age group contained the largest percentage (38.3 percent) of people reporting that they were either full- or part-time students, compared with 8.9 percent of the middle age group and 2.7 percent of the older age group.

Table 3. Respondents' educational level by age group, in percentage.

	Age group		
Respondent educational level	< 34 Years	34-48 Years	> 48 Years
Less than 4 year degree	8.1	13.1	16.7
College/university degree (Bachelor's)	48.2	30.1	23.3
Professional or graduate degree	43.8	56.9	59.8
Chi square df=4= 124.75, $p < 0.00$.	100.0	100.0	100.0
	n=793	n=1,584	n=716

In examining employment patterns among members of the age categories, differences were observed concerning their levels of employment or unemployment (chi square df = 2= 140.47, $p < 0.00$). Whereas 85.8 percent of the younger age group indicated that they were employed, 96.6 percent of the middle age group reported being employed, and 82.7 percent of the older age group affirmed they were employed.

Respondents reported being employed in several types of organizations (Table 4). State agencies employed the highest percentage of respondents in all three age categories. Among the youngest age group, 32.1 percent were employed with state agencies, in contrast to 43.7 percent of the middle age group, and 40.6 percent of the older age group. Federal agency employment was reported by 18.6 percent of the younger group, 22.9 percent of the middle age group and 21.4 percent of those over the age of 48. Relatively few

Table 4. Type of organizational employment by age group, in percentage.

	Age group		
Type of employment	< 34 Years	34-48 Years	> 48 Years
Federal agency	18.6	22.9	21.4
State agency	32.1	43.7	40.6
Local governmental agency	3.5	3.4	2.8
Private sector corporation or business	13.2	10.2	9.6
Institution of higher education	25.1	13.9	17.8
Non-profit/non-governmental organization	7.5	5.9	7.9
Chi square df=10= 58.65, $p < 0.00$.	100.0	100.0	100.0
	n=666	n=1,486	n=646

respondents were employed by local government agencies: 3.5 percent of the younger age group, 3.4 percent of the middle age group and 2.8 percent of the older age group. About 13 percent of the younger age group were employed in the private sector, compared to 10.2 percent of the middle age group, and 9.6 percent of the older age category. Perhaps reflecting the fact that over one-third of the younger age group reported being a full- or part-time student, 25.1 percent of respondents in this group reported being employed in an institution of higher education, which presumably includes employment through research and teaching assistantships. In contrast, only 13.9 percent of the middle age group and 17.8 percent of the older group were employed in academic institutions. Employment in non-governmental organizations (NGOs) was reported by 7.5, 5.9 and 7.9 percent of the younger, middle and older age group, respectively.

Age was also related to whether or not respondents considered themselves to be a hunter, trapper or recreational angler. In response to the questions, "Do you consider yourself a hunter," "Do you consider yourself a trapper" and "Do you consider yourself a sport angler," less than two-thirds (59.8 percent) of the younger age group answered yes to one or more of the questions; over three-quarters (77 percent) of the older age group did so, while approximately two-thirds (66.4 percent) of the middle age group answered in the affirmative (chi square df = 2 = 51.61, $p < 0.00$).

Views about Wildlife Management

In terms of respondents' views about selected fish and wildlife management issues, ANOVA detected significant differences among the age groups on all four dependent measures (Table 5). Scheffe post hoc tests were used to determine the nature of the difference among the age groups.

Age groups differed significantly in their responses to the statement that "fish and wildlife species have a value in and of themselves above and beyond use by humans." The older group had a lower level of agreement with this statement than the younger or the middle age group. The younger and middle age groups did not differ from each other. Similar differences were

Table 5. Age group views about selected management activities (1 = Strongly agree; 5= Strongly disagree) [Note: a, b, and c designate Scheffe post hoc differences among age groups. A superscript of a indicates that the age group differs from the younger (< 34) age group; a superscript of b indicates that the age group differs from the middle (34-48) age group, while a superscript of c indicates the age group differs from the older (> 40) age group.]

		Mean for age group				
Views about management	df= btw (w/in)	< 34 Years^{a}	34-48 Years^{b}	> 48 Years^{c}	F	p
Fish and wildlife species have value in and of themselves above and beyond use by humans	2 (3081)	1.27^{c}	1.23^{c}	1.35^{ab}	9.81	0.00
The focus of wildlife and fisheries management should be on the biodiversity of entire ecosystems rather than on individual species	2 (3066)	1.78^{c}	1.80^{c}	1.91^{ab}	5.44	0.00
Although biodiversity is important, managers should give priority to harvestable game species	2 (3067)	3.79^{c}	3.69^{c}	3.33^{ab}	36.41	0.00
Wildlife and fish species are resources to be harvested in a sustainable way and used for human benefit	2 (3058)	2.87^{bc}	2.69^{ac}	2.28^{ab}	53.48	0.00

detected regarding the statement that "the focus of wildlife and fisheries should be on the biodiversity of the entire ecosystem rather than on individual species." The older group had a lower level of agreement than the younger or middle age group. Regarding the statement, "although biodiversity is important, managers should give priority to harvestable game species," significant differences again were found. No significant differences existed between the younger group and the middle group, but both groups differed from the older age group in their mean responses.

The differences among groups were more complex with regard to the statement, "wildlife and fish species are resources to be harvested in a sustainable way and used for human benefit." The younger age group agreed less with this statement than the middle or older groups. Similarly, the middle age group exhibited less agreement with this statement than the older age group (Table 5).

Ethical Considerations

Using the three age groups as the independent variable, conservation professionals' views of seven ethical considerations were tested using ANOVA. Age groups differed in their mean responses on six of the seven dependent variables (Table 6). A significant difference was found among the age groups on the ethical statement, "I believe that wild animals have the same rights as human beings." The older group had a higher level of disagreement with this statement than either the younger or the middle age group. The latter two age groups also differed significantly from each other. A similar pattern of differences occurred among the groups on the statement, "It is morally wrong to kill wildlife for human sport or recreation." The older group disagreed the most with this statement, and significantly differed from both the younger group and the middle age group. The younger group also differed significantly from the middle age group on this statement. A significant difference was detected among the age groups regarding the statement, "Minimizing pain and suffering of individual animals should be an important criterion in managing wildlife." The post hoc test indicated that the older group differed from the middle age group, as the older age group agreed less with the statement. No statistically significant difference was detected between the mean responses of the older and the middle age groups when compared to the responses of the younger group.

Although no statistically significant differences were detected between the younger group and the other two groups, mean responses of the middle age

Table 6. Age group views about selected ethical considerations (1 = Strongly agree; 5= Strongly disagree) [Note: a, b, and c designate Scheffe post hoc differences among age groups. A superscript of a indicates that the age group differs from the younger (< 34) age group; a superscript of b indicates that the age group differs from the middle (34-48) age group, while a superscript of c indicates the age group differs from the older (> 40) age group.]

Ethical considerations	df= btw (w/in)	Mean for age group < 34 Years^{a}	34-48 Years^{b}	> 48 Years^{c}	F	p
I believe that wild animals have the same rights as human beings	2 (3027)	3.29^{bc}	3.65^{ac}	3.93^{ab}	58.74	0.00
It is morally wrong to kill wildlife for human sport or recreation	2 (3068)	3.76^{bc}	3.89^{ac}	4.09^{ab}	15.97	0.00
Minimizing pain and suffering of individual animals should be an important criterion in managing wildlife	2 (3050)	2.32	2.40^{c}	2.20^{b}	8.43	0.00
A resource harvest practice or technique is more ethically acceptable to me the more:						
it reduces the period of time a harvested animal suffers	2 (3064)	1.69	1.74	1.76	2.17	0.11
it involves traditional harvest methods and gear.	2 (2955)	2.62	2.71^{c}	2.59^{b}	5.29	0.00
it involves sportsmanship	2 (2994)	2.28^{bc}	2.13^{ac}	2.01^{ab}	12.32	0.00
that the harvested animal is utilized	2 (3069)	1.40^{bc}	1.51^{ac}	1.58^{ab}	16.36	0.00

group differed significantly from those of the older group regarding the statement, "A resource harvest practice is more ethically acceptable to me the more it involves traditional harvest methods and gear." Regarding the statement, "A resource harvest practice is more ethically acceptable to me the more it involves sportsmanship," significant differences were observed among all three of the age groups, with the older group having the highest agreement with this statement. Significant differences among the age groups were also evident concerning the statement, "A resource harvest practice is more ethically acceptable to me the more that the harvested animal is utilized." The younger group had the highest agreement with this statement and differed significantly from both the middle and older groups. The middle age group also differed from the older group on this statement.

In general, there are statistically significant differences among the three age groups on most of the ethics-related questions posed to them. One exception is that no significant differences were detected among any of the groups regarding the statement, "A resource harvest practice is more ethically acceptable to me the more it reduces the period of time that a harvested animal suffers."

Sociocultural Values

Differences to questions relating to broader professional sociocultural values were also examined (Table 7). On a statement, "Even though I may find certain regulated harvest activities objectionable, I believe that people who choose to participate in them should be allowed to do so," differences were detected between the middle and the older age groups. Neither the older or the middle age group differed significantly from the younger group. Similarly, regarding the statement, "The traditional North American conservation model is still highly relevant to achieve wildlife conservation objectives in the future," significant differences were detected between the middle and older age groups. Again, the older group agreed most with this statement compared to the other two age groups.

Wildlife Harvest Activities

Respondents were asked about their views regarding whether or not to outlaw specific wildlife harvest activities. Regarding the statement asking if the, "Use of dogs to hunt (pursue and tree) back bears should be outlawed," 63.2

Table 7. Age group sociocultural values (1 = Strongly agree; 5= Strongly disagree) [Note: a, b, and c designate Scheffe post hoc differences among age groups. A superscript of a indicates that the age group differs from the younger (< 34) age group; a superscript of b indicates that the age group differs from the middle (34-48) age group, while a superscript of c indicates the age group differs from the older (> 40) age group]

Sociocultural values	df= btw (w/in)	Mean for age group < 34 Years[a]	34-48 Years[b]	> 48 Years[c]	F	p
Even though I may find certain regulated harvest activities objectionable, I believe that people who choose to participate in them should be allowed to do so.	2 (2994)	2.02	2.04[c]	1.92[b]	4.84	0.00
The traditional North American conservation model (based on regulated harvest, intensive management, and sportsmanship) is still highly relevant to achieve wildlife conservation objectives in the future.	2 (2909)	2.47	2.30[c]	2.00[b]	5.44	0.00

percent of the younger group, 56.9 percent of the middle group and 50.7 percent of the older group responded in favor of outlawing dogs to hunt bears (chi square df = 4 = 40.91, p < 0.00, Table 8). Whereas, less than 20 percent of the younger group opposed outlawing the use of dogs to hunt bears, 26.6 percent of the middle age group and 34.2 percent of the older group opposed outlawing the use of dogs to hunt bears.

Similarly, differences were evident among the groups regarding the statement, "Use of dogs to hunt (point, flush, retrieve, etc.) upland game birds should be outlawed." Approximately 10 percent (chi square df = 4 = 29.72, p < 0.00, Table 8) of the younger age group were in favor of outlawing dogs to hunt upland game birds, nearly twice as many as the middle group (4.9 percent) and the older group (5.5 percent) that favored such a restriction.

Responses to the statement, "Use of leghold traps to trap furbearer species should be outlawed," reaffirmed the pattern of differences among these

Table 8. Views of three selected wildlife harvest activities by age group.

Wildlife Harvest Activities	Age group		
	< 34 Years	34-48 Years	> 48 Years
Use of dogs to hunt (pursue and tree) black bears should be outlawed			
Yes (favor)	63.2	56.9	50.7
No (oppose)	19.7	26.6	34.2
No Opinion	17.1	16.6	15.1
Chi square: df=4= 40.91, p < 0.00	100.0	100.0	100.0
	n=666	n=1,486	n=646
Use of dogs to hunt upland game birds should be outlawed			
Yes (favor)	9.5	4.9	5.5
No (oppose)	78.0	84.7	86.5
No Opinion	12.4	10.4	8.0
Chi square: df=4= 29.72, p < 0.00	100.0	100.0	100.0
	n=666	n=1,486	n=646
Use of leghold traps to trap furbearer species should be outlawed			
Yes (favor)	52.2	46.0	39.3
No (oppose)	31.4	39.2	48.4
No Opinion	16.4	14.8	12.3
Chi square: df=4= 45.30, p < 0.00	100.0	100.0	100.0
	n=666	n=1,486	n=646

age groups (chi square df = 14 = 45.30, $p < 0.00$, Table 8). The younger age group again emerged as being the most in favor of such a ban, with 52.2 percent agreeing. In contrast, 46 percent of the middle age group and 39.3 percent of the older group favored outlawing such traps. Among the younger age group, 31.4 percent opposed outlawing leghold traps. In comparison, 39.2 percent of the middle age group and 48.4 of the older group were against such a ban.

Summary and Conclusions

Data analyses indicate that there are consistent, statistically significant differences among the attitudes, values and sociodemographic characteristics of younger conservation professionals and their older counterparts. Respondents in the middle age group often fall somewhere in between, and they often differ significantly from either the younger group, the older group or both. In many cases, though the differences between the groups are statistically significant, they are relatively slight in terms of their importance. In other cases, however, differences between the three age groups indicate sociological significance that has the potential to erupt in conflict over the direction of policy and management.

What are the implications of these data for the future of wildlife conservation? What happens, for example, when a state wildlife agency, with a traditional focus on game management, promotes a younger employee who feels that an ecosystem approach to management is better for the environment and more responsive to prevailing social values? Or, what happens when an agency hires a new entry-level employee who feels that regulated trapping represents frivolous and gratuitous cruelty that cannot be justified by providing economic and sociocultural benefits to participants in trapping? What are the implications when several agency employees hold these non-traditional values?

These situations, in which younger employees, whose personal and professional values conflict with the dominant cultural values of the organization, suggest four possible outcomes, all of which have potentially negative repercussions if not proactively managed.

Retain non-traditional values and remain with the agency. Under this scenario, the employee could stay with the agency, retain non-traditional values. It is likely that the employee would become marginalized as it became evident that the personal values conflicted with the organization's values. These employees would experience alienation and dissatisfaction, which may impair the ability to make meaningful contributions at work. The lack of productive and meaningful work could undoubtedly impact the employee's morale and self-esteem, often with negative effects, which can be very disruptive to other employees.

Retain non-traditional values and leave the agency. Another option is for the employee to retain non-traditional values, but leave the agency. This option might be appealing to agency administrators, but it has at least two drawbacks. First, it poses the prospect of losing trained employees. Employee turnover can result in lack of efficiency and loss of institutional memory that are important attributes in administering agency programs. Second, in order to remain dynamic and vital, organizations require some level of value diversity that will allow adaptation to changing legislative priorities and social values. Loss of employees with different values may result in a homogenous workforce with a groupthink mentality that deprives the organization of the necessary ingredients for progressive change (Janus 1983).

Change values and adopt the values of the agency. In the majority of cases, when forming their occupational identities, employees go through an occupational socialization process at work. They have conversations with fellow employees, they attend orientation sessions, they participate in on-the-job-training and they become increasingly familiar with the reasons agencies do what they do. Over time, rather than continue in a state of cognitive dissonance, they make personal compromises (often unconsciously) or they change their values such that they become more aligned with the cultural values of the agency. However, the result can be a groupthink mentality that retards progressive change.

Retain values and work to change the values of the agency. This scenario, embodied in the example of Aldo Leopold, who worked to change the values of the entire profession, might be ideal. However, agency administrators have a right to be leery of subordinates who operate in this mode. First, it confuses policy makers and the public when an agency employee advocates positions contrary to the agency's official policy. Second, advocating changes in the agency's values and mission often risks alienating traditional constituencies that have supported the agency. However, there is one possible benefit of this scenario, which is that the agency may become more closely aligned with the broader sociocultural values of society.

These four possible scenarios may fail to capture the complexity and nuances that represent the many possible future options. They are presented to stimulate discussion because it is our view that the profession must acknowledge and begin to address the challenges posed by the changes in the workforce. These four scenarios focus on the options facing the individual employee, but it is difficult to deny that the younger age group will, by attrition if nothing else, come to dominate the conservation professions. Scenarios three and four will be the most likely possibilities, in terms of influencing the culture and mission of conservation agencies and organizations in the future. The question remains, which scenario and under what circumstances, will dominate.

Policy makers, agency administrators and interest-group leaders would be well-advised to develop proactive approaches for integrating younger professionals with different values and sociocultural backgrounds into conservation organizations. Agencies must accept that there is value diversity, but they must also work to sensitize new employees, young and old, to the culture of the organization. The best and brightest minds available will be needed to meet the challenge of advancing the cause of wildlife conservation in the future.

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The Fuel and Fire for Change

William A. Molini
Nevada Department of Wildlife (retired)
Reno

Change, like death and taxes, is one of the few certainties in life. But, is there a fire for change in our business? Certainly, there is a strong desire for some change in our collective work for conservation and management of all wildlife. Change has been a consistent and continuing part of the story of wildlife management in this country. At the risk of over-simplification of a complex process of change, I would characterize wildlife conservation and management as evolving through three periods during the 20th century.

The first was a time of enlightenment about the decimation of wildlife by the continued application of the frontier harvest ethic, including year-round hunting and market hunting. This period saw the passage of laws by several states to restrict harvest by establishing seasons and bag limits. This period, roughly, the first third of the 20th century, is the law enforcement period, when the game warden was the stalwart of wildlife management. During this time, the heads of many state game and fish agencies were titled State Game Wardens. There were many other important actions occurring at this time, most notably the establishment of national parks, the National Forest Reserves, and the National Wildlife Refuge System.

The second period, which began in the 1930s, was strongly stimulated by Leopold's book, *Game Management*, and by the passage of the Pittman-Robertson Act. It was the period of traditional game management. The main players in the state wildlife agencies were game biologists and fisheries biologists. The hey days of this period was from the 1940s to the late 1980s, but it still continues to be a dominant element of state wildlife agencies today. Law enforcement, habitat acquisition and management, and scientific fisheries management either continued or developed during this period as well.

The next period, from the late 1980s until the present, while not so easily defined, has certainly been a period of change to a more holistic approach to wildlife management. Here, the term holistic means the consideration of the whole of wildlife management and conservation, including traditional game and fisheries management, but with greater emphasis on nongame, ecosystems and landscape-scale habitat. This change has been progressing since the 1970s, but it has accelerated rapidly in the 1990s. This change has been driven, to some degree, by changing attitudes in our society, punctuated by the Endangered Species Act and the concepts of biodiversity, conservation biology and human dimensions. A prime example of this change is the successful North American Waterfowl Management Plan, with its attendant habitat joint ventures, ventures which are now moving progressively and aggressively into all-bird management.

The statutory structure, which establishes state wildlife agencies, gives the agencies the broad charge to preserve, protect, enhance and manage all of the state's wildlife for their ecological, recreational, economic, educational and aesthetic values. So, while this holistic responsibility has always been there, public emphasis and political direction for this broader mission has not, nor has the funding. The fire for change is here, but is the fuel to stoke this fire and burn the change into the fabric of our mission to preserve, protect and manage all wildlife existent?

The fuel, what about that fuel? Given the desire, the commitment and the passion of the professional wildlife people to do good things for all wildlife, the fuel for this is not the energy of the people involved, rather it is the money to do it. America's wildlife management programs have evolved to be user-funded. Since the early days, with the adoption of the Migratory Bird Hunting Stamp Act, the Pittman-Robertson Act and state hunting and fishing license fees, the state wildlife programs have been primarily funded by user fees, hence the current model of management naturally focused on game, sportfish and furbearers in order to be responsive to the users who pay the bill.

State wildlife agency leaders have worked hard for the past 30 years to find alternative funding sources to help meet the mandate of management and protection of all wildlife. This work has included such things as state income tax check-offs, wildlife license plates and even marketing and selling various wildlife-related merchandise. Many states have been successful, to some degree, in getting general state funds. But, for the most part, these alternative sources have not been sufficient to do what needs to be done for non-hunted wildlife. However, there have been a few notable successes. Missouri was the first state to get 0.08 of 1 percent of the state sales tax dedicated to the conservation of wildlife. To date, this source has produced nearly $1.5 billion for wildlife conservation purposes. Other significant sources, which came to fruition in the 1990s, include similar sales tax initiatives in Arkansas and Virginia, \$10 million per year of state lottery funds in Arizona and \$42 million per year from lottery funds in Colorado.

In 1990, the International Association of Fish and Wildlife Agencies (IAFWA) established the Teaming with Wildlife initiative to achieve funding for nongame in a fashion parallel to the Pittman-Robertson and Dingell-Johnson Acts. Through the tremendous work of many, this initiative became Title III in the Conservation and Reinvestment Act (CARA). While this goal has not yet been achieved, the CARA efforts have resulted in substantial funds for wildlife conservation and management, including \$100 million in appropriated funds in 2001 (\$50 million from the Commerce, Justice and State Department and \$50 million from Interior Department, of which \$25 million was rescinded in 2002), \$80 million of Department of the Interior appropriated funds in 2002, \$3 million in the Neotropical Migratory Bird Act, \$40 million in state competitive grants for a private landowner incentive program, and \$50 million in the North American Wetlands Conservation Act. I believe that these efforts to achieve funding for conservation and management of all wildlife are approaching critical mass. The fuel to stoke the fire of change is on its way. What does this mean for the future culture of fish and wildlife agencies? One thing is certain; it does mean change.

Agencies can expect challenges from this change. How does agency management deal with this change to ensure that its actions continue to achieve the best possible result for wildlife? While most state wildlife agencies have been in the mode of slow change for many years, when the fuel comes, it will drive the engine of change at a high speed. Nongame or wildlife diversity programs, which, heretofore, have been a rather small percentage of agency wildlife budgets and personnel (less than 10% for most) will, with this money, be elevated substantially to near parity with the traditional game, sportfish, habitat and law enforcement programs. The degree to which this growth occurs will depend on the ability of the state wildlife agencies to match funds. This will likely be the first area of conflict, as employees in the traditional programs will fear the loss of existing state dollars to be used to match these new federal dollars.

How do we best deal with this change? Agency management should carefully evaluate some predictable questions to anticipate this change. Since this new money will almost certainly elevate the standing of non-traditional stakeholders, how do agencies maintain positive and supportive relationships with traditional user groups, as well as embrace the desires of non-traditional groups? Will the increased influence of non-traditional groups result in changes in the composition of Wildlife Commissions, or other political bodies, and, if so, how will this influence agency culture? How will the turnover of major cohort groups of employees, particularly the baby boomers, influence cultural change in agencies? How can agencies evolve with this cultural change to maintain and enhance effectiveness to accomplish the statutory mission for all wildlife? As agencies explore these questions, the following basic tenets should be considered:

- Most wildlife biologists can, and often do, think in terms of holistic wildlife management, but agency organizational structures and funding sources have forced them to work with a more narrow focus.
- Consumptive-use demand (hunting-trapping), which is in decline, will remain an important part of what state wildlife agencies do, probably at least for the next 30 years or more.
- Trust is a core issue among employees, as well as between agencies and stakeholders.
- Fish and wildlife agencies, as public agencies, have always had a responsibility to all people, therefore to all wildlife interest groups. However, they traditionally have been held more accountable by the consumptive user groups who are paying the bill.

When evaluating the critical questions in concert with these basic tenets, the following recommendations are possible considerations for agency management to deal proactively and effectively with the change to more holistic wildlife conservation and management:

- Work on the tenet of trust, as agency credibility is crucial and credibility is based on trust. Probably through delivery of traditional, as well as non-traditional, programs, a solid foundation of trust has been established with constituent groups. Certainly, the strong support for CARA by most wildlife interest groups is reflective of an existing high degree of trust. Continue to solidify this trust with timely and effective program delivery.
- Instill within employees, by example, that the accomplishment of the agency's mission, in a holistic sense, is the reason for existence of the

agency. Teach employees, by example, mutual respect for one another's ideas and opinions, and that, collectively, all have an important role in mission accomplishment. Consider developing a set of guiding principles by which agency employees do their daily work. Instill that, for ultimate effectiveness, their allegiance must be to the agency and mission accomplishment.

- Teach and train employees about the collective wholeness of the mission and about the responsibility and accountability to all the people who have an interest in wildlife.
- Promote leadership development at all levels of the agency, with particular focus on those employees who, with the right mentoring, can be positioned to succeed the retiring baby boomers.
- Evaluate, with agency staff, the potential for change in governing bodies, particularly wildlife commissions, and prepare staff to best work with commissions to accomplish the agency mission.
- Demonstrate practical accomplishment in non-traditional programs as quickly as possible after the money comes. Consider staffing at the field level first, with learner program guidance, build state office staff and build detailed program guidance later.
- Evaluate agency organizational structure to avoid structures that build barriers, rather than lessen them.
- Consider developing, gradually, a field force that delivers holistic, multi-disciplinary programs. In other words, wildlife biologists can be responsible for game and nongame animals, and fisheries biologists can be responsible for sport fish and native fish.
- Focus on the people resources of the agency, not on the technical facets and differences, rather on the commonality of shared work for all wildlife.
- Talk to the people from the agencies that have been there, and learn from the experiences of Missouri, Arizona, Colorado and Arkansas.

While there are challenging times ahead during the transition from traditional to holistic wildlife conservation and management, what an exciting challenge to be able to position our agencies to do more for all wildlife and their habitats.

Old and New Cultures in Wildlife Management: Welcoming Change and Diversity

Jerry Conley
Missouri Department of Conservation
Jefferson City

Daniel Witter
Missouri Department of Conservation
Jefferson City

Richard Thom
Missouri Department of Conservation
Jefferson City

Introduction

Practically all public wildlife agencies in the United States and Canada once were characterized as strictly game agencies in both name and emphasis. However, these organizations have undergone tangible changes–in numerous cases, dramatic changes–in management diversity over the last quarter of the 20th century. This change was an evolution rather than a revolution, a slowly growing recognition among wildlife professionals of the importance, advantage and effectiveness of diversifying their wildlife programming beyond the traditional fish and game management of the first three-quarters of the 20th century, with a continuance to serve anglers and hunters. However, for many wildlife professionals and agencies, even slow change in thinking and acting has been breath-taking, perhaps threatening, and not without strong pressures from the public and mixed emotions among professionals. We fear our agencies are being too conservative and slow to recognize growth opportunities in public service and resource management.

Conservation professionals face the complex task of managing living resources by reconciling biological information, land and water resources, fiscal constraints, agency mandates, legislation, political climate, and a wide array of public sentiments toward fish and wildlife. Today's management complexity may push us to wish for a past when it seems our constituencies were few and our challenges were basic. Yet, experience shows that tomorrow holds even more change in our clienteles and management challenges. Does it really make sense to resist social, cultural and land use trends that are beyond our control?

Agencies and resource professionals must welcome these transitions from old to new. If we retreat or re-trench, society will may define the conservation services we offer as irrelevant among the wide array of competing public services that cry for funding in 21st-century America. More to the point, we risk our hope for a nation and world that is rich in healthy ecosystems filled with fish, forests and wildlife for future generations.

Experience tells that change and diversity in our profession propel progress. But, let us emphasize that we are not implying that which is old is bad, or that which is new is good. Be careful to avoid pitching the baby boomer out with the bath water, unless that boomer is not performing any longer. Our natural leaning is to reject new or risky ways in favor of the old ways that are safe and predictable. Many have worked well in the past. Let us look at principles to serve in changing times, as well as to help understand strengths and weaknesses in old and new cultures.

Principle 1: Commit or Recommit to Knowing and Supporting the Department's Vision

The Missouri Department of Conservation recently formed a program review team it calls the Legacy Committee. As members introduced themselves at the first meeting by name and number of years of service to the department, we were a bit surprised. Not everyone in this group of 27 knew each other (perhaps not totally unexpected in a conservation agency of 1,500 employees). And, all but two had been in their present positions for less than five years. There was a time when one knew all the long-employed colleagues. We pitched in to help each other and share the work. We understood each others' projects and programs. Shared labor certainly contributed to a shared understanding of the agency's mission and commitment to success.

Now we are specialists–compartmented and separated. Understand, we are proud of our conservation colleagues in Missouri. Our staff can bring the widest array of skills to bear on conservation problems. Can you believe, the department has roughly 350 occupational titles. The list includes botanists, business system managers, carpenters, computer specialists, endangered species specialists, foresters, hatchery managers, magazine editors, mechanical engineers, public involvement coordinators, urban watershed coordinators, wildlife biologists and attorneys. These dedicated and talented people have forsaken the financial advancement they could have garnered in the private sector to serve Missourians and Conservation's mission.

But, just as we build strength with diverse talent, we need to increase strength by true, not token, unity. If we do not work together in local goal-oriented teams, we will fail as an agency and a movement. One of the management changes we undertook in Missouri was to standardize geographic service regions among the department's divisions, with team-building as the objective. After a few predictable howls of, "We have never done it that way before," department staff accepted the vision and created 10 Regional Coordination Teams, integrating resource supervisors from many disciplines, from biologists to engineers. Staff so embraced the idea that they went far beyond initial proposals to create multi-disciplinary District Conservation Teams to provide a more focused public service at the county level. Our experience now shows clearly self-propelled and empowered teams can overcome the isolation of specialization.

Perhaps in no other resource occupation do we risk losing so much through specialization than in our conservation agents. Here is an illustration of how new pressures and a changing world threaten to undermine an old idea. The Missouri Conservation Agent Corps was established by I. T. Bode, the first director of the Missouri Department, as agents of conservation. See and hear the word agents, not policemen! Director Bode envisioned our protection staff enforcing the state's fish and wildlife regulations, but, just as importantly, he asked agents to be the department's heart and soul, front-line conservation contacts for the widest array of people imaginable: advisers to private landowners, conservation instructors in schools, field staff for wildlife population research and surveys, the Jacks and Jills of all conservation needs.

It appears that today's America is darker and more dangerous than half a century ago; drugs, violence and the diminishment of civility evidence a nation with a wobbly moral order. In this social environment, it is understandable that Missouri's agent corps would have majored in law enforcement and related training in recent years, reducing their efforts in those collateral services that contributed so much to building the department's reputation for public service.

We were concerned that, over time, the Missouri citizenry would no longer recognize our conservation agents as the front-liners we needed them to be. It was no small course correction when we insisted our roughly 200 conservation agents recommit themselves to a broader array of conservation services. It involved making some key personnel changes and refocusing training, time commitment and professional outlook. But, in this case, the old was much more appealing, productive and elegant than the new.

Principle 2: Expand the Funding Base by Identifying Growth Areas

Though management gurus come and go, Jack Welch's recent account as chief executive officer of General Electric (GE) offers some wonderfully practical insights that we need (Welch 2002). For example, Welch explains that his mother taught him to see it like it is. We sugar-coat reality at our future peril, which Welch's darkly humorous story of GE nuclear engineers' sugar-coating growth predictions based on anticipated sales of four new nuclear reactors a year–immediately after the Three Mile Island Nuclear Reactor disaster illustrates.

For how many years have we wrung our hands over our limited budgets? Why do we continue to limit our budgets by not correctly recognizing our potential growth areas and reorienting our departments to seize the juicy opportunities that abound? Why not stop pretending that our present, feeble efforts to evolve nature-oriented management and programming that appeal to a broad audience using our old conservation culture and funding are going to work?

We know that future conservation successes cannot continue on the backs of fishers and hunters and their permit purchases. Yet, we seem unable to come up with a plan to fix or relieve this burden on our friends. Instead, we try to move to new levels of conservation service by tightening our belts and proposing that we can shrink ourselves to success, starve ourselves to prosperity, then increase permit prices.

Look at what we have going for us! We have a great–no, an incredible–product line of fish, forest and wildlife experiences, for which people are willing to pay. We do not need more human dimensions surveys to tell us that our state and national constituencies value our nation's fish and wildlife and that they care a lot about the environment in general, though human dimensions studies may help us better tailor our services for an increasingly diverse clientele.

The Nature Conservancy has a budget of about $350 million. This one private group's budget is not much less than the federal aid fish and wildlife annual apportionment to all 50 states combined! Factor in budgets of National Wildlife Federation, National Wild Turkey Federation, Audubon Society, Ducks Unlimited, Inc., the Sierra Club and other non-government conservation organizations. And, one notes that a large part of the public is willing to pay to gain the services desired.

Are we stuck in the old culture of conservation? Let us remember our proud traditions of species restoration. But, keep in mind, while it is acceptable to walk down memory lane, we should not build a house there. We developed a following to restore species that were hunted or fished to low levels. That battle is now mostly won in the eyes of our citizens. Funding was provided for this accomplishment by hunters and anglers. Now, we need to deliver on restoration of natural communities, watersheds and ecosystems, activities that cannot be funded only by hunters and anglers. Funding for these growth areas should be based on society's understanding that the quality of life is at stake, not simply entertainment. Our agencies can compete by identifying growth areas, setting broad funding objectives and releasing talented teams of professionals that have the long-term vision and understand the department's unifying standards. Administrators need to remove the obstacles and demand that goals are reached within a reasonable time.

A recent example of this drive in the Missouri Department of Conservation is a small program called Grow Native, initiated to push native vegetation planting. As individuals and teams accepted the vision, the growth area has surged. In the 18 months since its inception, our state highway department has moved from indifference to wanting native plantings on 350,000 acres of state road and designing rest areas with interpretive centers on native fauna and flora. Our governor wants his state mansion grounds and our state fair grounds converted into native vegetation landscaping. Agricultural producers are racing to establish a new growth industry, based on seed and plant production of native vegetation. Millions of dollars will flow through our department as a result of this growth area.

Future growth demands bold plans; this is not new to many of our agencies. I am reminded of perhaps the boldest state plan for conservation's future ever written. It is especially fitting that this year, Missouri conservationists are celebrating 25 years of the state's Design for Conservation, a plan that has produced $1.4 billion tax dollars for conservation programming since its inception in 1977.

Design for Conservation first appeared publically as a special issue of the *Missouri Conservationist* magazine, the department's magazine that has been distributed free to Missourians since the early 1940s. It was an incredibly creative and innovative catalog of growth initiatives and opportunities for conservation, which led to the approval of a one-eighth percent sales tax earmarked for conservation. It funds the nation's broadest-based state conservation program.

Principle 3: Champion Leopold's Land Ethic

Since the first Earth Day in 1970 the public has grown more green. Are our agencies ahead of them? Are we leaders in the environmental movement, and are we reluctant to champion a very old idea whose time has finally arrived–that of Aldo Leopold's land ethic? Do we embrace and promote the value of healthy ecosystems for the many public services they provide? Do we teach that more fish and wildlife are benefits of conserving and restoring healthy ecosystems? That diverse forests, streams, prairies and marshes perform public services that benefit all residents of the planet, among them soil erosion control, water quality protection, carbon sequestration, plant pollination, insect and disease control, climate moderation, nutrient cycling, and many other services that are absent or diminished in more developed landscapes? Aldo Leopold wrote of these benefits more than a half century ago. The resource is more basic than fish and wildlife. The resource is the healthy, functioning ecosystem that produces fish and wildlife for the public to use and enjoy.

The old conservation culture in our agencies would tell us farming agriculture produces wildlife. Fish and wildlife agencies have an association with crop production agriculture. Wildlife managers, in particular, strongly identify with promoting wildlife. It is satisfying to plant crops and observe wildlife's use of it. Residual crops help some species survive the winter, and they also attract game species at harvest time.

Crop production produces wildlife, but the wildlife species that benefit are a fraction of the species that would otherwise be produced by more diverse plant communities. Some game species that benefit the most from crop agriculture do not need the additional support to maintain healthy populations. The majority of wildlife are not produced in the context of crop agricultural production. Are we promoting the right species?

The new culture would restore diverse plant communities that produce wildlife. Natural communities of forests, prairies, marshes and glades produce native species of wildlife in abundance. Plant community restoration or origination does not create perfectly functioning examples of natural communities, but a diversity of native wildlife will benefit by the habitat change. Game species also benefit from natural community restoration, after all, they evolved in these environments. But, the game species abundance necessary for high hunter harvest might be less predictable.

Natural community restorations produce wildlife and a more complex web of animals and plants. It is revealing that the best-selling book published by our department is *Missouri Wildflowers*, which is in its fifth edition and eighth reprinting. Diverse plant-animal associations are more likely to persist through time, particularly in the face of habitat fragmentation that characterizes our land. There remains a role for crop production to produce species of target wildlife in abundance, but wildlife managers should assess the percentage of land committed to crop agriculture. Are we missing the opportunity to grow a richer association of wildlife by not expanding natural community restorations?

Principle 4: Give New Constituencies a Chance

At a recent staff meeting, we learned that field staff were encountering a new activity on our public lands–an activity called geocaching. Most at the meeting had never heard of the term. Geocaching is a new recreational activity similar to orienteering, but instead of using a map and compass, participants use a Global Positioning System to locate coordinates at which are hidden a container filled with trinkets. Successful geocachers choose a trinket from the container and substitute something else in its place. The sport involves negotiating the terrain and conditions and provides a sense of adventure and discovery. We learned that geocachers had the audacity to be caching their loot in our conservation areas. It was debated which regulation could be used to prevent the activity. Should we cite these people for littering, since they were leaving Tupperware containers, or would it be better to cite them for conducting an unauthorized activity without a special use permit? Our team of administrators wondered why we would want to cite them at all? After all, we had tried for years, with varying success, to introduce our conservation areas to new users. Geocaching seemed to be doing that without any help from us.

It turns out that there was a website for this activity. The site included comments from participants. Analysis of these comments revealed that geocachers appreciated the public lands being used. Some comments from cachers on conservation areas: "the area was very beautiful," "love this area; it is so beautiful; I will have to come back," "I grew up 30 miles from this cache, yet had never been to this beautiful lake; an extra to this cache was a pair of bald eagles circling above," "beautiful place that I never would have known existed," "took my three-year old son to enjoy the hike," "I scared up a bunch of wildlife: squirrels, chipmunks, a skunk and a wildcat," and "all I can say is wow, what a view!" Our point: Birders, hikers, native plant enthusiasts, environmentalists, school children, nature center volunteers, stream teams, campers, canoers, residential landowners, TV viewers, radio listeners and geocachers represent growth in interest in our public service.

We have land; we have healthy, beautiful natural communities; we have knowledgeable staff. We are already positioned for these growth opportunities. Changes are able to be made to make room for these new constituencies. Make these changes quicker and make them go further than ever before. Make them effective and enjoy the chance to soar. The money and the future are waiting for those that dare to seize the opportunities.

Conclusion

We have given some principles and a few examples of how our agency has changed with positive results. We did not really choose to change at first, but necessity can be a strong incentive! We believe that, based on our experiences and observations, agencies that are satisfied with the status quo are destined to shrivel up and become irrelevant. They might be swallowed up into other agencies, or they may slowly wither as their traditional constituencies become even smaller parts of the general citizenry.

It is futile to try to do more of the same with fewer resources, trying to hold the line with periodic permit increases to offset declining revenue. The alternative is to identify growth opportunity areas, to set challenging goals for financial and program growth, to find different sources for growth funding, and to evaluate, modify, and even eliminate programs and activities that are outdated drags on our resources. And we are not talking about giving up on our traditional constituencies. We are talking about growing and redefining our missions to enlarge the tent and maintain our strong influence on resource conservation.

We know the public supports conservation and environmental protection and loves wildlife, native plants and the outdoors. Our agencies have a proud heritage and many accomplishments, which were responses to the problems and issues of the times. We have heard that leaders are people–or agencies–that have the ability to find a parade and to get in front of it. Our agencies have been leading a parade for decades, but when we look behind us today, we find that the ranks have thinned and the band is weak. Big, new crowds are gathering and forming, and rousing marching music is playing somewhere nearby. Our success will depend on leading our little band to the front of that new column.

Special Session Three.
Amending the Endangered Species Act: Is ESA Threatened or Endangered?

Chair
Paul Hansen
Izaak Walton League of America
Gaithersburg, Maryland

Cochair
James Tate, Jr.
US Department of the Interior
Washington, DC

Opening Remarks

Paul Hansen
Izaak Walton League of America
Gaithersburg, Maryland

It is truly an honor and undoubtedly one of the highlights of my career to be a moderator for such an extraordinary audience of natural resource professionals and to be the chair for such a distinguished panel of experts on this difficult and seemingly intractable issue.

The situation that our nation has before it today is that the reauthorization of the Endangered Species Act (ESA), the most important law governing the welfare of threatened and endangered species, has been stuck in gridlock for over a decade.

This stalemate hurts all Americans who have an interest in the welfare of not only these species, but other species that have suffered from the enormous diversion of resources, resulting from administrative battles and legal wrangling over the ESA. Supporters of the existing law have been able to fend off efforts to weaken it, while critics of the law have been unable to enact reforms, even reforms that have widespread appeal. Many would regard these reforms as reasonable. To those of us in the crossfire of the war over the ESA, it seems that some groups prefer a good law to the welfare of the animals. On the other hand, there are some who want no law at all.

I think it is obvious to mostly everyone in this room that we have an opportunity to make the law more effective for the welfare of the wildlife species at risk. Within the next three hours, we might have a defining moment. There is, in this room, the talent, expertise, experience, knowledge and wisdom to initiate a national dialogue that could lead to breaking the stalemate, ending the gridlock and moving forward with a sensible and effective vision for an ESA. The act must protect these unique and extraordinary animals, but it cannot succeed unless it is as accepted by the people who own the land, who are most dramatically effected and who will be doing much of the work. In this way, I believe we will have the best chance to promote these species. It may, in fact, be our only chance.

In the next three hours, we need to set aside some strongly held opinions, listen well and ask what about the other's opinion we like or can live with. My charge to the panel and all: let us work together to craft a new vision for moving the ESA forward–out of the morass and political posture into a functional and pragmatic approach to protecting the wildlife that we love. With that, I'm pleased to introduce my colleague, Jim Tate, panel co-chair.

Local Innovation and Shared Responsibilities Will Unlock the Act

Greg Schildwachter
Idaho Governor's Office of Species Conservation
Boise

Amend As We Do, Not As We Say

To update and modernize the Endangered Species Act (ESA) is among the highest national legislative priorities of Governor Kempthorne, and it is a goal shared by many western governors. Having attempted to amend the act in his last term in the Senate, the governor is aware of how difficult this issue is. Apparently, we cannot amend the act by talking, so the governor is trying to amend the act by doing. Now working at the state level, the Governor is doing what it takes to make the ESA work for people and wildlife. This approach requires force of will and creative use of the current law. When it produces good ideas, those ideas should become amendments to the ESA, to change standard operating procedure. With better conservation fieldwork, we can write better law.

Amendments can work only with strong partnership between state and federal government. The Western Governors' Association, for years, has sought ESA reform that makes the states full partners. To form this partnership, the states must do their part, and the law must provide for a significant state role.

Governor Kempthorne's species conservation program is an example of the state side of the partnership. We are using the few parts of the current ESA that accommodate our work. To innovate, the governor proposes the concept of pilot authority as a way to explore possibilities before amending the ESA. Some ideas may leave us mired in litigation, and we would drop those ideas. Others will move us forward, so we would consider keeping them. This is the process of innovation and it will help to create the amendments needed.

Idaho Is Already a Partner in the ESA

In Idaho, we work hard to make do with the ESA, so we can make it better. By concentrating efforts, we have assembled an advanced ESA program. Our work is a good picture of a state's role with a partnership-oriented ESA. The arrangements we have made for conserving salmon, wolves and our lesser-known species could apply to other species in other states.

Office of Species Conservation

Governor Kempthorne has organized a staff specifically to concentrate on and coordinate all ESA business in Idaho. The Office of Species Conservation (OSC) is housed in the Executive Office of the Governor, much like the President's Council on Environmental Quality is housed in the Executive Office of the President. The OSC's job is to develop state policy for listed, and soon-to-be listed, species and to engage landowners and others in species conservation.

We are a staff of six that has been able to stay small, using coordination to avoid duplication. Government is already staffed and skilled to do the work of species conservation; it needs only a system to organize those efforts within agencies. For example, our many fish habitat issues are supported both by the expertise in the Idaho Department of Fish and Game and the Idaho Department of Environmental Quality, which administers our federal Clean Water Act program. We keep things organized and provide some additional funding so the existing talents and resources of government can do the on-the-ground work effectively. With this organizational structure, we have been able to act regionally, statewide and locally.

Salmon and Other Coldwater Fish

Fish conservation is a good example of how we operate at multiple levels because the demesne of the salmon reaches to the Pacific Ocean and salmon is important in Idaho. The governor is a partner in the Four Governors' Recommendations on Salmon Recovery, Sub-basin Planning, in Idaho, with the Northwest Power Planning Council and local conservation agreements, such as the Lemhi Agreement.

Four governors recommendations on salmon recovery. The Governor partnered with his colleagues in Montana, Oregon and Washington to offer this complement to regional federal policies. Federal policy is represented by something called the All-H strategy–addressing habitat, hydropower, hatcheries and harvest–and the actions listed in the *2000 Biological Opinion on the Federal Columbia River Power System.* The Four Governors'

Recommendations describe what our four states can contribute, in addition to what individual states contribute. It specifically identifies direct actions to be done immediately. The strategy is an immediate alternative to the continuing debate about the fate of the Snake River dams. The governors said: "Regardless of the ultimate fate of the dams, the region must be prepared in the near term to recover salmon and meet its larger fish and wildlife restoration obligations by acting now in areas of agreement without resort to breaching the four dams on the lower Snake River." The goal of the recommendations is to ensure that humans are the fifth H in the recovery approach in addition to habitat, hydropower, hatcheries and harvest. By doing this, the Governor believes we can attain the goal of a sustainable and harvestable population of salmon.

States and local planning entities (counties, cities, collaborative groups or other planners) will contribute expertise in exchange for the authority and funding to carry out conservation work. Partners, governors and other state decision makers freely offer accountability for the use of all authority and funding they receive. This partnership is a better way to make the necessary decisions. Flow augmentation, property rights, Idaho water law, and voluntary land and water improvement, through willing buyers and sellers, all require careful local understanding and tailored solutions. Flow augmentation–adding to river flows to improve fish passage for adults and juveniles–is a clear enough idea, but it needs more technical support in order to gain the partnership of state water law authorities. Any manipulation of water, redirection to other uses, must be accomplished under the terms of Idaho law, which differs from water law in neighboring states. In some cases, we have found ways to enable transactions for water between willing buyers (e.g., US Bureau of Reclamation) and willing sellers (e.g., landowners), but this would not have been possible without a mechanism for local innovation and shared responsibility. Some habitat commitments, such as setting and meeting water quality targets, are already delegated to states through state primacy under the federal Clean Water Act.

Sub-basin planning. This is a process developed by the Northwest Power Planning Council, which helps oversee the biggest engine driving salmon conservation in the region, the funding from the Bonneville Power Administration. These funds–between $150 and $200 million per year–are disbursed to projects in Idaho, Montana, Oregon and Washington. To be more specific about where, when and why these dollars are invested, the Northwest Power Planning Council organized plans for the watersheds in the Columbia River basin that the council calls sub-basins. The people living and working in each sub-basin summarize, assess and plan for projects that will advance salmon conservation most cost-effectively.

Most of the sub-basins in Idaho fall entirely within Idaho. We have been able–perhaps we are the only ones able–to assemble the many players in each sub-basin who are interested in salmon conservation and who have applied for funds from the Bonneville Power Administration. With this in-state coalition, we negotiate priorities for gathering information and taking action. It is a role uniquely suited to state government, which has the staff expertise and the policy-making authority to organize the work at this level.

The Lemhi Agreement. Still closer to the ground, the governor and the attorney general brokered an agreement among local irrigators on Idaho's Lemhi River and the National Marine Fisheries Service, the US Fish and Wildlife Service and others to begin long-term conservation. The agreement began with work from the people in the organizations mentioned. The legislators from the area extended these results by carrying a change in Idaho water law through the 2001 session, thereby enabling landowners to lease unused water, such that the water goes into a water bank and is shepherded downstream to the Salmon River without being diverted by junior water right holders.

This agreement turned a contentious standoff into a conservation project. During recent drought years, when the Lemhi River and others occasionally were running dry, raising concerns about salmon passage, spawning and rearing, the most obvious outcome would have been an enforcement action against irrigators and the potential for protracted litigation, pitting the ESA against state water law. In fact, some private groups attempted to push the standoff toward crisis by filing lawsuits against their neighbors to this effect. Instead, the agreement assures, by contractual commitments, a solution to the water flow problem and continued habitat improvements. This worked because of the flexibility found in both state water law and the ESA. The flexibility in the ESA, however, may prove to be in our imaginations, unless these agreements stand up to litigation.

Wolves

Wolf management in Idaho is also part of a regional issue. Regarding wolf management, Governor Kempthorne's partners are Governors Martz, of Montana, and Geringer, of Wyoming. These governors and their predecessors have kept a Memorandum of Agreement (MOA) up to date since 1997, committing the three states to working together for a regional solution. Part of wolf management is specific to Idaho under terms of the ESA, Section 10(j) rule defining a nonessential, experimental population reintroduced in 1995 (50 CFR 17.84(i)).

Using the same principle of partnership among the three states and within Idaho itself, Governor Kempthorne began gathering the many pieces of the wolf issue in autumn 2001. Until that time, Idaho's wolf program was scripted by the legislature. In October 2001, upon the announcement that the northern Rocky Mountains supported at least 30 breeding pairs and a larger number of packs, comprising more than 500 individual wolves, the governor directed his OSC to build a regional partnership between Idaho, Wyoming and Montana to organize the effort to remove the wolf from the list of threatened species.

The most active partners in the group include, of course, the recovery program of the US Fish and Wildlife Service, the two neighboring state wildlife programs, the Nez Perce Tribe of Idaho and a number of interest groups interested in livestock and wildlife. The challenges include navigating the de-listing paperwork, negotiating terms for long-term state management of wolves and working a management program between now and whenever we accomplish de-listing.

This partnership is now represented by the aforementioned MOA, a draft MOA between Idaho and the Nez Perce Tribe, and a budget request for wolf management in Idaho, brokered by the OSC, among the Idaho Cattleman's Association, Nez Perce Tribe and a number of environmental and other business groups. Our approach takes up an old offer from the Fish and Wildlife Service in 1995 to run the wolf management program through state government. We hope to gain more authority to manage wolves, starting immediately and culminating with a de-listing that returns all management authority to Idaho.

Sage Grouse

Many factors of the wolf issue also pertain to sage grouse conservation, which is on the opposite end of the listing process. As concern develops for sage grouse, or any other species, America's program for species conservation ought to respond. Doing so, especially with a game species such as sage grouse, ought to involve the game managers in state government.

Idaho has organized interested parties who manage sage grouse habitat. Each working group is preparing conservation projects. Congress has provided some funding. If a petition to list sage grouse appears as we continue with our state program, we will confront the now familiar question of how state efforts can be recognized by the Secretary of Interior in a status review and what effect those efforts can have on the outcome of the listing decision.

Principles of our Program

These efforts are grounded in a few simple principles: (1) engage people in the problem, and they will help to find a solution, (2) bring people to formal agreement, and they will know where they stand, and (3) solve problems according to the intent of the law, and it will be easier to amend the letter of law.

Pilot Authorities for More Partnership

In building our end of a state-federal partnership in Idaho, we have found passages in the ESA that offer small openings through which the ESA could more clearly recognize the role of the state. To facilitate this partnership, we suggest not amending these parts of the ESA, but authorizing pilot projects to fulfill the intent of these sections. Authority for pilot projects could be granted by new regulations with certain provisions or performance requirements. If the new ideas fail to improve our current difficulties, the pilot authority could revert to the status quo without an act of Congress. Only by proving the innovations through practice would we consider making them law. To do so, Governor Kempthorne suggests developing the details together. Such is the work that this panel and this audience should engage. It probably means developing federal legislation. It may mean redirecting some federal funding. It could mean progress toward updating the ESA. It most definitely means hard work. The governor asks that you to consider it.

We suggest considering pilot authorities based on five passages of ESA language found in sections 4, 6 and 10. These are the passages that focus most directly on our state-federal partnership; there are others, such as Section 7, that we could advance in a discussion on improving the ESA aspects of federal land management.

Section 4: Determination of Endangered Species and Threatened Species

Three of the five openings for partnership are found in Section 4 (16 USC 1533); they refer to best available data, efforts of the states and critical habitat designation.

The phrase, "solely on the basis of the best scientific and commercial data available...after conducting a review of the status of the species," glosses over significant difficulties in conservation biology. Sometimes the best data available are actually anecdotes, and–with or without data–a review of species status always involves significant interpretation and judgment. To manage these uncertainties, we should open this process to wide professional involvement. With a pilot authority, the secretary could solicit proposals for conducting status reviews for selected species in better ways.

Regarding efforts of states, Section 4 charges the secretary with, "taking into account those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation." This may be the clearest example of where a pilot authority would be helpful. Unlike Section 6, which pertains to species already listed and which specifically indicates how the secretary is to evaluate a state program, Section 4 does not elaborate. As a result, attempts to preclude a listing on the merits of a state program have been denied by the courts for lack of explicit grounds for the secretary to take into account efforts of a state. Also as a result, states have no incentive to address species of concern because, ultimately, the federal government must take over. With a pilot authority to defer to a state program under named circumstances, we could experiment with the draft policy for Evaluating Conservation Efforts (65 Fed. Reg. 37102–37108, June 13, 2000) and other ideas.

Later in Section 4, the secretary is required to designate critical habitat concurrently with a listing decision with some exceptions. Litigation on this point has commandeered the entire listing program. With a pilot authority, those who advocate moving critical habitat designation into recovery planning could try it. We could judge the idea in terms of conservation instead of jurisprudence.

Section 6: Cooperation with States

Section 6 (16 USC 1535) itself is the fourth area we propose for pilot authority. Many Section 6 programs comprise a number of specific projects consistent with a recovery program. We read Section 6 to allow a state to include even more ambitious partnerships, even as far as taking responsibility for an entire recovery program within its boundaries. Experimenting with such an idea may be possible under the existing statute, and it would certainly be appropriate as a pilot authority if necessary.

Section 10: Exceptions

Last in our list of five areas for innovation is Section 10 (16 USC 1539). Permits for incidental take and enhancement of survival described in Section 10 appear much easier to obtain in the statute than in the voluminous regulations, policies and handbooks that have been added. As a result, these permits are daunting to the small landowners with whom we work. Based on our experience with individual small landowners who cannot afford the required expertise, we suggest a pilot authority to explore some options. In general, we seek ways to include many adjoining small landowners in order to learn what occurs in a large area of habitat instead of focusing on separate plans for each small landholding. We recognize that because Section 10 permits are federal actions, we would require pilot authority for both the ESA and the National Environmental Policy Act (NEPA). This is good because NEPA experts already have been considering pilot authorities under that law and that innovation would add to the benefits of pilot authorities under the ESA.

Conclusion

The Governor suggests that we face up to the key issue here: to amend the ESA we must make amends among ourselves. Trusting relationships are necessary; without them, we cannot succeed. Trust is not a guarantee, but it is the beginning. We lack the trust to amend the ESA, but perhaps we have the trust to explore options with pilot authorities.

The Secretary of Interior has been promoting cooperation, and we offer our ideas in support of that approach. Governor Kempthorne invites the others on this panel and in the audience to join the discussion of a new beginning in the effort for a newer, better ESA, based on the abilities of states, local governments and landowners to be full partners in achieving the goals of the ESA.

Species Restoration: A Vision for the Endangered Species Act in Its Fourth Decade

Jamie Rappaport Clark
National Wildlife Federation
Reston, Virginia

The Importance of the ESA

Congress' enactment of the Endangered Species Act (ESA) nearly 30 years ago was a watershed moment in our nation's history. At no other time has a government made such a clear and unambiguous commitment on behalf of its people to the stewardship of our natural world. Congress took this step not simply because of the aesthetic pleasure of living in a world rich in fish, wildlife and plants, but because of the "ecological, educational, historical, recreational, and scientific value [of species conservation] to the Nation and its people" (ESA 2(a)(3)). The ESA is a striking moral commitment to future generations that we will not to rob them of the blessings of nature that our ancestors and we have enjoyed.

I write today to set forth the vision of the National Wildlife Federation about how we, as a society, can fulfill the ESA's stewardship commitment in the coming decade. As we debate our policy options, I suggest that we keep the focus on addressing four fundamental challenges:

- making decisions based on sound science,
- broadening participation in decision making,
- promoting accountability for recovery and
- securing adequate funding.

Successes and Failures

The implementation of the ESA over the past 30 years has been a story of both successes and failures. On the success side of the ledger, we have a long list of species that were once plummeting toward extinction that are now on more secure footing. Just three decades ago, most of the whooping cranes, condors, red wolves and black-footed ferrets in this nation existed only in laboratories, being fed by hand to keep them alive. Within the lower 48 states, the gray wolf had been wiped out of existence in all but a small portion of the Upper Midwest, and grizzly bears had retreated to remnant populations in remote areas of protected national parks. Our government made no serious effort to protect, or even to identify, most of the less charismatic species in decline.

Today, populations of forty percent of species protected by the ESA are stable or expanding. Viewed over time, that picture improves. The longer a species receives protection, the better its chances are of rebounding. Of species protected the longest, nearly sixty percent are holding their own or improving.

Much of these improvements have occurred with little fanfare. Wildlife agency staff often provide technical advice to avoid or minimize harm to imperiled species, and most public agencies and private landowners are receptive. Sometimes a project proposal comes forward with which it is difficult to address the needs of wildlife and the ESA's clear protection mandate makes controversy unavoidable. Fortunately, the ESA has provided a mechanism for getting these controversies resolved with both species conservation and economic development needs taken into account.

Simply put, imperiled wildlife are far better off today than they would have been without the ESA. The law has helped to impress on the public mind the plight of wildlife and the need to take action, and it has demanded accountability.

At the same time, the ESA has seen some significant failures. The ESA has not been reauthorized since 1988, due to the failure of key leaders from business, government and the environmental community to agree upon a common set of approaches. Perhaps reflecting this lack of consensus, Congress has repeatedly failed to provide adequate funding to implement the ESA, resulting in missed conservation opportunities and endless litigation over missed deadlines. Agencies are faced with reacting to listings of individual species rather than taking proactive steps to conserve entire natural communities. Despite thirty years of the ESA, many species and habitats across the United States remain at risk.

The ESA itself cannot ensure that the nation's biodiversity is conserved for future generations. Actions to conserve our precious natural resources must be integrated into every facet of our lives. But, the ESA can do more than integrate.

It is time for another visionary act along the lines of what Congress did in 1973. We must update the ESA to squarely meet the significant challenges that we face today.

The Four Most Significant Challenges

The ESA has not been reauthorized since 1988. Since that time, we have learned quite a lot about what it takes to achieve our conservation goals. Here are the four most significant challenges that we face.

Making Decisions Based on Sound Science

First, we must ensure that all policy decisions rest on sound science. This might sound obvious, yet there perhaps is no greater potential barrier to successful ESA implementation than the temptation to take scientific shortcuts.

For example, we have learned that restoring a species often requires going beyond species-specific measures and addressing larger systemic problems. Yet oftentimes, we debate how to conserve a species in decline without seriously addressing the evident suffering of the entire natural system. The situation in the Klamath Basin is a case in point. The heated debate over certain species-management issues obscures the larger problem that must be dealt with–an arid ecosystem seriously overtaxed by a government irrigation program, resulting in reduced flows, pollution and overheated water that is harmful to fish.

Sometimes an action taken to benefit one imperiled species will harm another. For example, restoring the flow of water across the Everglades, although generally beneficial to imperiled species, will harm the endangered snail kite if care is not taken. To ensure that ESA decisions are based on sound science, we must develop solutions that both conserve individual species and improve the functioning of natural communities.

We have learned that habitat protection is essential, but the emerging science tells us protection is not enough by itself to achieve our conservation goals. Many of the most pressing problems facing species are ones that can only be solved through active management of habitats and restoration of species. For example, invasive species are responsible for the decline of more fish, wildlife and plants in the United States than any other cause, save one, habitat destruction. Purple loosestrife, first brought to the United States from England in the early 1800s, is choking wetlands across the country at the rate of one million additional acres per year, rendering these habitats inhospitable to native plants and wildlife. To reverse the tide of invasive species and to tackle the host of additional problems facing our degraded ecosystems, we need to build an ESA that emphasizes protection, active management and restoration.

To ensure that ESA implementation rests on sound science, we also must build a rigorous adaptive management regime into adopted wildlife management strategies. Adaptive management, which includes both monitoring the performance of management strategies and altering those strategies to incorporate new information and changed circumstances, is a costly proposition. Therefore, some people may balk at giving it a greater role in the ESA. However, the cost of the alternative–proceeding with wildlife management strategies that are demonstrable failures–is far greater.

Grappling with what science tells us also means facing the challenge of global climate change. The need to reduce our greenhouse gas emissions to minimize future climate change is clear, though outside the scope of the ESA. The ESA must recognize that some climate change is already occurring, and additional change is inevitable. We, therefore, must take preventive measures to ensure that species are not lost due to altered vegetative zones, altered temperature and extreme weather conditions. At a minimum, corridors must be maintained and restored for movement of wildlife and seeds.

Science also tells us that we must provide greater incentives to private landowners to conserve species on their lands. A substantial percentage of the habitats of imperiled species are found on private lands, and many of those habitats must be actively managed. For example, many United States species evolved as part of fire-dependent natural communities, and they will only thrive if steps are taken to mimic the fire regime in their disturbed habitats. Many private landowners have no listed species on their property or own property where listed species are hanging on by a thread. Many can be convinced to manage the land in a way that would make restoration possible if the proper incentives are given.

The US Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) play an essential role in ensuring that ESA implementation decisions are based on sound science. Scientific expertise on the needs of imperiled species can be found in many places, and there have been various suggestions of ways to delegate ESA decisions to other agencies. It makes good sense for FWS and NMFS to rely on states, tribes, other federal agencies, private industry, universities, zoos, aquariums and non-governmental organizations for both data and analysis. However, someone needs to serve as the ultimate arbiter of the scientific questions that arise. Given their vast expertise in this role, the FWS and the NMFS should continue to serve this crucial function.

Broadening Participation in Decision Making

A significant challenge in the coming decade is ensuring the ESA has participants from the diverse array of people and organizations with ideas and expertise to share.

States and tribes have long played a central role in managing wildlife within their boundaries, including imperiled wildlife. Although the ESA accepts leadership from federal wildlife agencies on a number of significant decisions affecting listed species, states and tribes have often taken the lead in implementing ESA recovery plans and other management strategies. As the ESA becomes more focused on active management and restoration, the role of states, tribes and others must expand.

Local governments have always been vested with the authority to make determinations about appropriate land uses within their boundaries. Unfortunately, development authorized by local governments is one of the leading threats to the survival of many species, and many local governments have not even begun to address this problem. On the other hand, some local governments, such as Pima County, Arizona, have become national leaders on wildlife conservation because of their efforts on habitat conservation planning. In a few months, the NWF will release a report on Green Infrastructure, highlighting efforts in the nation's 15 fastest-growing metropolitan areas to plan for, protect and restore a network of habitat and open space. The ESA must be updated to encourage more local governments to incorporate such wildlife conservation into their land use planning work.

To ensure that ESA decisions are scientifically sound and politically viable, it is also essential to provide opportunities for input from scientists and the broader public. Many ESA decisions require difficult balance of scientific, social and economic issues, and address the concerns of a host of federal, state, regional and local jurisdictions. We must use our creativity to find new ways to secure meaningful participation from the wide array of interested groups and individuals, while making decisions in a timely manner.

Promoting Accountability for Recovery

Under the ESA, federal agencies have been held accountable to Congress, the courts and public opinion for failure to adhere to a deadline or for pursuing an action that will likely jeopardize the existence of a listed species. But, there has been little accountability when federal agencies have failed to recover species on their lands.

This is not because Congress assigned no responsibilities for recovery. Congress required federal agencies, whose activities affect listed species, to use "all methods and procedures which are necessary" to recover those species and to consult with the FWS or the NMFS about such conservation measures (ESA 7(a)(1)). Yet, federal agencies have not come close to fulfilling these conservation duties. It is time for the agencies charged with implementing our federal laws to take their responsibility for conserving threatened and endangered species seriously.

Ensuring Adequate Funding

Conserving imperiled species is impossible, if the funding needed for ESA implementation and other conservation measures is not available. By failing to provide adequate funding for species protection, management and restoration, Congress postpones the day of reckoning and enlarges the cost to society for failing to conserve its natural resources. On the other hand, Congress can be successful by meeting each of the challenges I have discussed today, if it decides to invest in the ESA and other species conservation programs.

A New Endangered Species Restoration Policy

With these challenges in mind, what kind of ESA do we need to accomplish the national goal of species protection and restoration? Each of the challenges is quite daunting and will only be met if we produce consensus around our specific objectives and the strategies for tackling them. How do we produce such consensus solutions? Highlights of the National Wildlife

Federation's recommended strategies to tackle the top wildlife conservation challenges are outlined below.

Changes Needed to Ensure that Decisions Are Based on Sound Science

Science tells us that true conservation can only be achieved if we give significant attention to the need for species restoration. Two requirements of the ESA that explicitly address the need for restoration efforts beyond mere protection of existing occupied habitat are the provisions for recovery planning and critical habitat designations. Unfortunately, neither of these provisions has been very effective in promoting restoration.

Recovery planning has suffered from a variety of problems, which will be discussed throughout the remainder of this article. A key problem is that the ESA has no deadlines for recovery plans. Recovery plans often are not prepared for years after listing and, once prepared, they are rarely updated. Thus, for most listed species today, there is no official document reflecting the best available information about the needs of the species and conditions of the habitat. This is unfortunate.

Since, recovery is the ultimate goal of the ESA, recovery plans should be the foundation from which every implementation decision springs. The ESA should require preparation of recovery plans within three years of listing and require updates to recovery plans at least every five years. The amount and type of information that is gathered for recovery plans also should be expanded. The plan should discuss all of the significant developments that have taken place in the habitat of the species, so that opportunities that have been lost and created can be identified. Recipients of ESA permits should be required to produce and deliver monitoring data to the FWS and the NMFS in a format that allows for easy insertion into the updated recovery plan.

This leads me to the subject of critical habitat designations, perhaps the most divisive issue plaguing the ESA today. Protection of habitat is essential for the survival and recovery of listed species. Most would agree that it hardly matters what else is done for species if habitat needs are not resolved. Critical habitat should be renamed recovery habitat to make it absolutely clear to everyone its crucial role when defining the recovery needs of a species. However, the current provisions requiring designation of critical habitat at the time of listing undermine the ESA's recovery goal. They place an enormous burden on the FWS and the NMFS to produce both scientific and economic analyses at a time when the data needed for such analyses has not been assembled or analyzed. Recovery habitat should be designated at the same time that the recovery plan is prepared, which should be completed within three years of listing.

Similarly, when species recovery plans are updated to reflect the current situation on the landscape and updated biological information, habitat designations also should be adjusted. Like the recovery plan, designations should be reviewed and, if necessary, updated every five years to reflect the latest science.

Changes Needed to Broaden Public Participation

Changing the ESA from a law focused on habitat protection to one that is focused on protection, management and restoration will be a major task–a task that the federal government is ill-equipped to handle on its own. To accomplish this, a broad array of participants from both the public and private sectors will need to contribute.

To secure these contributions, Congress will need to expand its funding of incentive programs for private landowners, land acquisition programs for states and federal agencies, management programs for tribes and habitat conservation planning programs for state and local jurisdictions.

Congress must also revise the recovery planning process to help ensure that a broad consensus is reached on recovery strategies. Federal funding of recovery actions alone never will be enough, so the full panoply of public and private constituencies must collaborate to identify funding sources and pursue funding commitments. Independent scientists, citizens groups, private industry and other affected groups also must be brought into this process, both to ensure that recovery strategies reflect scientific and political realities and that those strategies are accepted.

Broad participation need not be promoted at the expense of sound science. The scientific members of a recovery team should meet together as a science committee charged with the discrete task of identifying what must be achieved biologically for the species to become viable and self-sustaining across its range. They also determine what population numbers must be reached and in what locations? They also determine what quantity, configuration and quality of habitats must be conserved? Only the scientific advisors on the recovery team can help the FWS and the NMFS answer these questions. Once these questions have been answered, the recovery team can answer the question of what strategies would help achieve the biological objectives, while fairly addressing social and economic concerns.

Ensuring broad participation does not come without a cost. Making sure that the right people are at the table at the right time costs both time and money. If too many meetings are scheduled, key people will drop out due to exhaustion. However, these costs can be minimized. As mentioned earlier, we must look at species conservation strategies from the perspective of the natural system. Likewise, whenever possible, we should design recovery-planning processes from this perspective. A good model for recovery planning at the ecosystem level is the Multi-Species Recovery Plan for South Florida. This plan shows that, even in places where there are numerous listed species and an enormously complex ecosystem, it can be advantageous to plan at the natural systems level.

Changes Needed to Promote Accountability for Recovery

Congress also must restructure the recovery planning process to make federal agencies more accountable to fulfilling their statutory, conservation duties. Specific objectives must be identified in the recovery plan for each listed species, which, if achieved, will lead to downlisting and delisting of the species. Binding responsibilities must then be assigned to federal agencies, and nonfederal entities must be given financial incentives to make additional voluntary commitments. Specifically, federal agencies with activities affecting listed species must be required to participate in the preparation of a recovery implementation plan in which they make specific commitments to tasks that contribute to recovery plan objectives, subject to the availability of appropriations. States and other nonfederal entities should be given opportunities to volunteer for additional assignments, perhaps conditioned on successful applications for federal grants. Federal grant programs could be modified to give preference to participants in recovery implementation plans.

Changes Needed to Secure Adequate Funding

As discussed above, many of the problems with ESA implementation have been caused or exacerbated by the chronic under-funding of wildlife conservation work at the federal, state and local levels. Some of these problems can be addressed, in the short term, by increasing appropriations for ESA implementation. However, a long-term solution to these chronic shortages can only come if we reach consensus on a reliable and permanent funding stream. Consensus on this point was almost reached in 2000 when we passed the CARA bill in the House, for which over 60 Senators expressed support, only to be thwarted by the Senate Majority Leader at that time. If we truly aspire to make protection and restoration of our natural heritage a reality in our lifetimes, then we need to make a renewed commitment to enacting CARA, or similar legislation, which provides substantial funding dedicated to wildlife conservation.

Conclusion

The ESA is truly one of our most treasured environmental laws, but it should not be seen as a museum piece, left in its original form despite rapid changes in the world around it. Like any law, this one must be reshaped to incorporate what we have learned and to address the significant challenges of the future. I believe an important task in reauthorization should be to look to reduce layers, to provide for more efficiency and to focus on programs and processes that deliver practical programs, rather than more paper.

The ESA obliges us to maintain our commitment to conserve imperiled species for the benefit of future generations, as well as our own. It has been responsible for stabilizing and restoring populations of declining species throughout the United States and has served as a model for international conservation efforts.

The Administration's Approach to the ESA: Building a Stewardship Ethic for the 21st Century

Ann R. Klee
US Department of the Interior
Washington, DC

"Bring ideas in and treat them royally for one of them may be king." – Mark Van Doren.

Put one hundred conservation biologists, lawyers, landowners, water users, regulators, and environmental activists in a room and ask them for ideas about to how to improve the Endangered Species Act, and you will get 100 different ideas. All of them have value. That is the first step.

Introduction

When President Nixon signed the Endangered Species Act (ESA) into law in 1973, it is unlikely that anyone imagined the pivotal role it would play in a wide range of land and water management decisions. There are now over 1,200 species of plants and animals listed as threatened or endangered in the United States. Certain areas of the country that historically have had a great diversity of species are now home to large numbers of listed plants and animals. California, for example, has 292 listed species, and Alabama has 125. In some areas, every major land and water management decision or action involves an endangered species issue at some point.

Over time, the ESA has evolved, so it is no longer simply about protecting imperiled species from extinction. It has become the backdrop against which we balance economic activity and recreation against the conservation of plants and animals and their habitat. In the process, it has pitted landowners and water users against species, the West versus the East. It has resulted in economic hardship and controversy in some areas. And, it has created a federal bureaucracy that often is perceived to care more about plants and animals than humans. Because of this, we have missed opportunities to develop the partnerships with states and landowners that can achieve significant benefits for species–and their habitat.

Encouraging Citizen Stewardship

We can change to create a new era of citizen-led conservation–a new environmentalism. At the Department of the Interior (Department), we are moving forward with this new environmentalism based on what the Secretary calls the Four Cs–communication, consultation and cooperation, all in the service of conservation. At the heart of the Four Cs is the belief that, for conservation to be successful, we must involve the people who live on, work on and love the land. We know from experience that most Americans, especially those who depend on the land for their livelihood, are ready and willing to step up to the challenge.

In Texas, for example, the Peregrine Fund is working with the US Fish and Wildlife Service (Service) and Texas cattlemen to reintroduce the endangered Aplomado falcon to South Texas. The southwestern grasslands of Texas provide ideal habitat for the Aplomado, which can co-exist well with cattle. Indeed, many of the prey for the Aplomado use water troughs provided for the cattle. The ranchers initially were reluctant to participate in the partnership, not because they did not want the Aplomado on their lands, but because they were concerned about the ESA and how it might affect their operations if they hosted the Aplomado. The Peregrine Fund negotiated a Safe Harbor Agreement to address their concerns, but letting this important conservation effort go forward.

The program has been a success, with broad public and landowner support. So far, 702 Aplomado falcons have been released into South Texas over 1.6 million acres of private land. There are currently at least 33 wild territorial pairs and the introduced falcons have successfully fledged more than 59 young. This is just one of thousands of examples of collaborative partnerships that have achieved real benefits for species.

To implement the Secretary's new environmentalism, the Department is committed to:

- working together with all stakeholders, including state and local governments, tribes, conservation groups, the business community and private landowners, to conserve species before they require listing,
- looking for opportunities to improve the process for dealing with species that are already on the list; we plan to build on the successful

approaches we have taken in recent years, such as Habitat Conservation Plans, Candidate Conservation Agreements and Safe Harbor Agreements, while continuing to be creative and flexible in looking for new strategies,

- providing incentives to encourage landowners and others to become partners in the effort to conserve species and habitat, and
- reaching out to those with differing viewpoints.

The Cooperative Conservation Initiative

A keystone of the Department's approach to citizen-led stewardship is the new cooperative conservation initiative–CCI. This program is a bold, new step towards the stewardship of America's national parks, public lands and wildlife. It expands the President's commitment to conservation through citizen participation, local knowledge and economic incentives. It builds on the Secretary's Four Cs agenda, and it advances the commitment of the Department to work with all Americans to restore, conserve and steward the nation's land and resources.

CCI is a new beginning for conservation and presents a new role in conservation for the federal government. After more than a century of federal leadership to establish parks, safeguard federal lands and protect wildlife, CCI looks to the American people to carry the torch of conservation into the 21st century. Its goal is simple: use government and its resources to remove barriers to citizen participation and provide the help that is needed to fulfill the promise of citizen stewardship. Through CCI, partnerships between government and individuals, groups and communities will be formed, and new opportunities will be sought to expand the role of landowners and land users in the restoration and conservation of the American landscape.

CCI is a funding program, proposed in the President's Fiscal Year 2003 budget, to steward working landscapes and stimulate conservation innovation. It earmarks $100 million in challenge grants to be awarded, competitively, by the Bureau of Land Management (BLM), the Service and the National Park Service to landowners, land-user groups, environmental organizations, communities, local and state governments, and industries for conservation projects that advance the health of the land and the well-being of the people. CCI grants will be awarded for land restoration projects, innovative conservation programs and collaborative partnerships that breach conflict to reach conservation outcomes. In each case, the goal is to spur on new ideas and foster new land-use practices that can apply across regions and serve as models for ecologically healthy and economically vibrant working landscapes. Weaving together these purposes is a common thread: the interdependence of people and nature. The following are examples.

- Gateway communities are the working part of the landscapes of national parks. The health of one is dependent on the health of the other; CCI grants will help build strong and prosperous partnerships between gateway communities and national parks to address both the needs of people and of conservation of America's most spectacular places.
- Private lands are the working landscapes where much of America's wildlife, and many of its endangered species, seek food and shelter. CCI grants, through voluntary programs, such as the FWS's Partners for Fish and Wildlife, will give landowners the tools needed to make private lands the working landscapes for wildlife.
- Public lands are where ranchers, sportspeople, recreationists and environmentalists work, hunt, play and seek solace. CCI grants will give the opportunity to do what the Malpai Borderlands Group has already done in the southwest Arizona and southeast New Mexico– build working landscapes that accommodate multiple uses but which also provide for the restoration, conservation and sustained stewardship of the BLM's 280 million acres.

CCI is a measured step toward a new stewardship ethic for America, one that is citizen-led, landscape-based and incentive-driven. It is the first step in the President's and the Secretary's agenda to make conservation a responsibility of citizens, and to make citizens the vanguard of a new environmentalism founded in community, compassion and voluntary action. Above all, it is a necessary step to restore conservation to the hands of the American people and to dedicate individual and community stewardship to the public task of caring for the nation's parks, lands and wildlife.

Continuing to Improve Landowner Incentives Programs

Ultimately, successful recovery of endangered species will depend on the protection and restoration of habitat. With more than 50 percent of listed species having at least 80 percent of their habitat on private land, we must provide incentives to landowners and work with them to conserve that habitat. Certainly, federal agencies should use their authority to conserve species, but they cannot recover listed species on federal lands alone. Stewardship on private lands is essential. We must, therefore, continue to improve established landowner incentive programs–habitat conservation plans, safe harbor agreements, and candidate conservation agreements.

The Department has used Candidate Conservation Agreements (CCAs) to work in partnership with states, local governments and private landowners to address candidate species proactively. Under a CCA, the Service works with a landowner on a plan of action to conserve the species on the property before the species is ever listed. To date, we have completed 83 of these agreements.

A good example is the Virgin Spinedace, a native fish in Utah. With Utah, we have restored and enhanced habitat, secured water to replenish its rivers, and built barriers to keep out competing non-native fish. These efforts have led to the removal of the spinedace from the candidate list. Because the state was willing to act early to address the needs of the spinedace, this species hopefully will never have to be listed. So far, the implementation of candidate conservation agreements has obviated the need to list 14 species nationwide.

Candidate Conservation Agreements with Assurances (CCAAs) build upon the success of CCAs, but go a step further to provide regulatory assurances to private landowners who implement voluntary conservation measures for proposed species, candidate species or species likely to become candidates. This means that additional conservation measures will not be required and additional land, water or resource-use restrictions will not be imposed, should the species become listed in the future. In return for the participant's proactive management, the Service also provides take authorization which allows the landowner to take individuals or modify habitat as specified in the CCAA. There have been two CCAAs permitted to date, with another 25 currently in development.

The Department is now working with other federal agencies, states, the International Association of Fish and Wildlife Agencies and various interest groups to build on the idea of CCAs to develop State Conservation Agreements (SCAs). Like CCAs, these agreements are a tool, designed to conserve species through partnerships among stakeholders. These agreements will focus on species that are in decline, but are yet not listed, proposed, or candidates for listing under the ESA. Because an SCA is flexible, it can be applied at different levels, ranging from individual species to groups of species and their habitats, or to an entire ecological system or community. It uses an inclusive process to seek conservation solutions that are beneficial to stakeholders.

For species that are already on the endangered species list, we continue to use Habitat Conservation Plans (HCPs) and Safe Harbor Agreements to develop conservation partnerships. HCPs have been the cornerstone of the effort to make the ESA work for both landowners and threatened and endangered wildlife. An HCP is an agreement that allows a landowner to take an individual member of a species, incidentally, in the course of otherwise lawful activities, as long as the landowner takes agreed-upon conservation measures to conserve the species as a whole. For example, a landowner might agree to set certain tracts or habitat permanently, maintain buffers around rivers and streams and not engage in certain activities during critical times of the year. So far, the Service has approved 378 HCPs for 32 million acres and 516 species. In fiscal year 2001 alone, 44 HCPs were approved to 8 million acres and more than 350 HCPs are currently under development. They will apply to more than 47 million additional acres and 327 species.

The San Diego Multi-Species Conservation Plan exemplifies how an HCP can help a variety of partners find an innovative solution to conserving species. Southern California is a fast-growing area with a number of threatened and endangered species. The conservation plan brought together a broad group of stakeholders, ranging from state and local officials, to developers, to environmental organizations and to private citizens. It covered more than one half million acres, protected the habitat of 85 rare plants and animals, and ensured the kind of smart growth we need in the 21st century.

One strength of the HCP process is its flexibility. Conservation plans vary enormously, in size, scope and the activities they address–from half-acre lots to millions of acres, from forestry and agricultural activities to beach development, and from a single species to hundreds of species.

Another key is creativity. The ESA's regulations establish basic biological standards for HCPs, but otherwise allow creativity on the part of the applicants. As a result, the HCP program has produced remarkable innovation. This administration will continue to support innovation.

No Surprises Policy

In many agreements we make with landowners, we include a No Surprises Policy. This means that a deal is a deal. When a landowner enters into an agreement with the government, the landowner can be assured that the government will not come back in the future to require more than is stated in the agreement. It gives landowners who want to develop their land the one thing they really want–certainty. This administration will continue to support and defend the No Surprises Policy.

Safe Harbor Agreements

We will also continue to use and improve Safe Harbor Agreements. These agreements encourage landowners to improve the habitat of threatened and endangered species on their property. Landowners agree to improve habitat for an endangered species in return for assurances from the Service that their voluntary actions will not lead to additional land-use restrictions if more of the species are attracted to the land. We have entered into more than 14 Safe Harbor agreements that cover 130 landowners and several million acres, and we have another 30 agreements pending.

Financial Incentives

Financial incentives also play an important role when promoting citizen stewardship and conservation. This administration is committed to providing grants and other financial incentives to states and private landowners. In fiscal year 2002, for example, we will distribute more than $100 million to states and private landowners under a variety of grants, including Conservation Grants ($7.5 million), HCP Land Acquisition Grants ($61 million), Recovery Land Acquisition Grants ($17 million) and HCP Planning Grants ($7 million).

The Bush administration's fiscal year 2002 budget also includes funding for two new programs: a $40 million Landowner Incentive Program and a $10 million Private Stewardship Grants Program. The Landowner Incentive Program will allow the Fish and Wildlife Service to match grants to the states, the District of Columbia, the territories and the tribes to establish or supplement their own Landowner Incentive Programs. Eligibility criteria and other aspects of program administration will be developed by the Service in consultation with the states.

Under the Private Stewardship Grants Program, individuals and groups engaged in local, private and voluntary conservation efforts are eligible to apply for a grant to help fund projects that benefit federally listed, proposed, candidate or other at-risk species. A diverse panel of representatives from the state and federal government, conservation organizations, agriculture and development interests, and the science community will assess the applications to make recommendations to the Secretary of the Interior, who will award the grants.

Conclusion

With new environmentalism, we will continue to find consensus and common ground. As the next generation becomes involved, we will have healthier land, watched over by self-motivated citizen-stewards. We will spend more time tending the land and less time jousting with sound bites and hyperbole.

General Patton once said, "Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity." If we challenge the American people, we will create a new generation of citizen-conservationists, people who know the land, love the land and care for the land in the greatest tradition of our nation. Working together, we will get the job done.

Heretical Thoughts: Ending the Stalemate over the Endangered Species Act

William Robert Irvin
World Wildlife Fund[1]
Washington, DC

The Stalemate Over Endangered Species Act Reauthorization

In 1988, when the Endangered Species Act (ESA) was reauthorized, Ronald Reagan was President, George Bush was telling America to read his lips as he campaigned to succeed Reagan, CDs outsold vinyl records for the first time, the federal debt stood at $2.6 trillion and the Grammy for Song of the Year went to Bobby McFerrin for *Don't Worry, Be Happy* (Infoplease.com 2002). That year, the ESA was reauthorized through 1992, with every expectation that it would continue to be regularly reauthorized, as it had been in 1976, 1977, 1978, 1979, 1980 and 1982 (Committee on Environment and Public Works 1982). Since 1988, however, a seemingly intractable stalemate has developed over the ESA. ESA supporters have repeatedly fended off efforts to weaken the law, while ESA critics have consistently called for its reform. Each side has stymied the other's efforts, but neither has had the political muscle to work its will. Consequently, Congress has failed to reauthorize the law, relying instead on annual appropriation measures to fund ESA implementation.

While ESA reauthorization has been stalled, conservation of threatened and endangered species and the ecosystems upon which they depend have suffered. The number of US species listed under the ESA has grown, from 753, in 1992, to 1,255, in 2002 (Susan Jewell, personal communication 2002). The North American Commission for Environmental Cooperation recently reported that the US, Canada and Mexico are facing a widespread crisis due to declining biological diversity (North American Commission for Environmental Cooperation 2001).

Also, while ESA reauthorization has been stalled, efforts to make the law more workable for the regulated community have faltered. While a number of administrative reforms, such as the No Surprises Policy, Safe Harbor Agreements and Candidate Conservation Agreements, were adopted during the Clinton administration, efforts to write those reforms into law and to further simplify compliance for the regulated community have made only limited progress (Sullins 2001).

Meanwhile, US Fish and Wildlife Service (FWS) efforts to conserve endangered species have been hampered by inadequate funding and by persistent litigation brought by environmentalists and the regulated community alike. In the absence of reauthorization, Congress has been unwilling to provide the significantly greater funding that is needed to effectively implement the ESA. Also, without reauthorization, Congress has failed to tackle the changes to the ESA that will be necessary to make it more effective at conserving species and their habitats and more workable for the regulated community. Consequently, both environmentalists and the regulated community have turned increasingly to the courts for relief. Suits have been brought challenging everything from the FWS's failure to designate critical habitat or list species within statutory deadlines to the constitutionality of ESA protection for red wolves, Delhi Sands flower-loving flies and fairy shrimp. While some of the litigation has been well-founded, the continual need to defend itself in court has hindered the FWS's ability to devote staff and resources to species conservation, and it has delayed efforts to simplify ESA compliance for the regulated community.

Thus, the continued stalemate over ESA reauthorization benefits neither efforts to conserve endangered species conservation or simplify ESA compliance. After a decade of deadlock, it is time to try a new approach. This paper proposes such an approach, along with some substantive proposals for making the ESA more effective at conserving species and less onerous to landowners and business. Some will undoubtedly view these ideas as heresy because they will see in them either a weakening of the ESA or an expansion of federal regulatory authority over large expanses of habitat. However, unless we are willing to break with orthodoxy and think some heretical thoughts, the ESA stalemate will continue to the detriment of both species conservation and citizen compliance.

Breaking the Stalemate

The first step to breaking the stalemate is for both sides to engage in a serious dialogue to develop a consensus on a viable set of measures to be incorporated in ESA reauthorization legislation. As noted previously, both sides can block the other's efforts but neither can secure their own legislation. Compromise is needed , as more than a decade of failure to reauthorize the ESA demonstrates. Absent such compromise and consensus, Congress will not move forward with ESA reauthorization, endangered species conservation will continue to suffer and the regulated community will continue to face uncertainty regarding the extent of its obligations under the ESA.

During the course of the ESA stalemate, there have been a number of informal efforts to bring elements of the environmental and regulated communities together. For example, from 1995 to 1997, a group of moderate environmental and business groups, informally known as the Endangered Species Act Working Group, worked with Representative Jim Saxton, of New Jersey, and others to craft compromise ESA reauthorization legislation (Irvin 1996). The effort was useful in educating participants about the concerns and needs of both the environmental and regulated communities, and it influenced the drafting of ESA reauthorization legislation in the House of Representatives and the Senate. However, broad support for such legislation never materialized, participants in the effort were criticized by colleagues in their own communities and, ultimately, the effort failed. Nevertheless, a more formal approach to finding common ground, one with official standing and a clear mandate to provide recommendations to Congress and the President, could end the stalemate over ESA reauthorization.

A National Commission on Endangered Species Conservation Reform

To end the stalemate over ESA reauthorization, a broad-based national commission on endangered species conservation reform should be created. The commission should be charged with identifying the scope of the biodiversity conservation challenge in the United States and developing consensus proposals for amending the ESA to enhance endangered species conservation to make it more workable for the regulated community, with a commitment from key congressional leaders and the Administration to include the proposals in legislation and work for its enactment. Membership should consist of representatives from the regulated community, environmental community, academia, state fish and wildlife agencies, tribes, and federal agencies. The President should appoint members of the commission, upon recommendation from the leadership of the key congressional committees charged with ESA oversight. The commission should be chaired by a leader of national stature with credibility in both the environmental and regulated communities, have a professional staff and be given the resources to complete its work in one year.

The establishment of such a commission has ample precedent. In the 1960s, the United States Public Land Law Review Commission helped lay the groundwork for cooperative fish and wildlife management on public lands (Bean 1997). Similarly, the Stratton Commission reviewed management of the nation's oceans, leading to the creation of the National Oceanic and Atmospheric Administration (US Department of Commerce 1998). In the 1980s, the semi-official National Wetlands Policy Forum produced the No Net Loss of Wetlands Policy that has guided federal and state wetlands conservation efforts in the years since (The Conservation Foundation 1988).

In order for a national commission on endangered species conservation reform to succeed, participants must agree to check their preconceptions at the door. Environmentalists should acknowledge the positive measures that many landowners and businesses have adopted to conserve wildlife, while also recognizing that the regulated community needs greater certainty about the scope of its obligations under the ESA. Similarly, the regulated community should recognize, as Congress did when it enacted the ESA in 1973, that economic growth and development, untempered by adequate concern and conservation, threatens the extinction of species and, to address this threat, landowners, business and industry must do their part to conserve both species and the ecosystems upon which they depend. For their part, state, federal and tribal agencies should put aside jurisdictional rivalries and consider how best to integrate their efforts to promote endangered species conservation and simplify compliance for the regulated community.

In carrying out its work, the commission should focus on two major issues: enhancing endangered species conservation and simplifying ESA compliance.

Enhancing Endangered Species Conservation

Critics of the ESA like to point to the fact that only a few species have been taken off the endangered species list as evidence that the law has failed (Mann and Plummer 1995). Supporters of the ESA respond that recovering species to the point where they can be delisted is a long, arduous task and the success of the law should be measured by the fact that species have been saved from extinction, even if their status remains precarious (Irvin 1993). Both sides have a point. Endangered species are undoubtedly better off than they would be without the ESA, but are certainly not doing as well as they could be. Thus, a central question that the commission should address is how to enhance endangered species conservation.

One way would be to refocus the ESA and other federal and state environmental laws on conservation of large ecosystems, rather than just individual species. Groups, such as World Wildlife Fund and The Nature Conservancy, have recognized the need to address biodiversity conservation on a much larger scale through identification of globally significant, yet threatened, ecoregions (Wilson 2002). Ecoregions are large areas of relatively uniform climate that harbor a characteristic set of species and ecological communities (World Wildlife Fund 2000). This approach should be used in the ESA.

Rather than focusing on listing and recovery of single species, as is generally done now, the FWS and, in the case of marine species, the National Marine Fisheries Service (NMFS), should concentrate their efforts on conservation of threatened ecoregions. Priority in budgets and staffing should be given to the conservation of ecoregions and the species within those ecoregions, which will provide the greatest conservation benefit for the ecoregion over a long period. In carrying out ecoregional conservation, FWS, NMFS and other federal and state agencies should identify those areas of abundant biodiversity which are under the greatest threat. Within those ecoregions, keystone, indicator and umbrella species should be identified and targeted for conservation, in order to protect the overall health of the ecoregion. This will mean that, in some cases, the FWS or NMFS will not address threats to individual species or particular remnant habitats, in order to concentrate their conservation efforts at the ecoregional scale. It will also mean, however, that greater effort by federal land-management agencies, states, tribes, conservation organizations and private landowners to conserve large swaths of habitat and corridors to connect them will be needed. In the long run, effective conservation measures at the ecoregional scale should result in less regulation, as habitat is conserved and managed for a suite of species, rather than imposing a multitude of confusing, and sometimes conflicting, conservation requirements for individual species.

To carry out ecoregional conservation, FWS and NMFS should emphasize cooperative efforts with other federal agencies, state and tribal fish and wildlife agencies, private landowners, businesses, and conservation groups. Rather than relying solely on the hammer of the ESA, it might be more appropriate to use methods, such as forest planning under the National Forest Management Act or farm subsidies under the Farm Bill, to promote ecoregional biodiversity conservation. This will require significant increases in endangered species conservation funding and, in some cases, shifting endangered species conservation funding from one agency or department to another, where it can be used better. Moreover, current requirements and deadlines under the ESA may need to be modified in order to give FWS and NMFS flexibility to focus their resources on multi-species conservation efforts within an ecoregion.

Making the ESA proactive, rather than reactive, could also enhance endangered species conservation. Currently, the ESA's protections only apply when a species has been listed as threatened or endangered. Thus, the ESA operates as an emergency room when preventive medicine is needed. Greater emphasis within the ESA and other federal and state conservation programs should be placed on conserving species before they have declined to the point where listing is necessary. This will require much greater cooperation between the FWS and state and tribal fish and wildlife agencies, which have the lead in managing species that have not been federally listed. The FWS could play a critical role in coordinating conservation of such species across ecoregions, where several state, tribal and federal agencies may have jurisdiction. State and tribal fish and wildlife agencies should receive greater federal funding for their preventive conservation efforts.

With the disappearance of the federal budget surplus to tax cuts and war expenditures, securing greater funding for endangered species conservation will be difficult politically. Nevertheless, it is clear that, despite some increases in endangered species conservation funding in recent years, more money is needed if biodiversity is to be conserved. The commission should calculate how much money will be needed to effectively conserve endangered species and their habitats and to make recommendations about how to provide the necessary funding, including shifting funding from traditional ESA implementation to new approaches. For example, it may be more effective to provide greater funding for habitat conservation on private lands than to spend money on designation of critical habitat. Or, it could be more effective to provide funding to the principal land management agencies–US Forest Service, the Bureau of Land Management, the Department of Defense, states and private landowners–

for habitat conservation at an ecoregional scale than to spend more money on listing additional species. The commission should pay particular attention to identifying a dedicated source of funding for endangered species conservation, such as a percentage of receipts from offshore oil and gas leasing, proceeds from a federal endangered species stamp, or a federal real estate transaction fee.

Simplifying ESA Compliance

While most Americans believe that protecting endangered species is a worthy goal, it is difficult to find anyone within the regulated community who is enthusiastic about complying with the requirements of the ESA; at best, there is grudging acceptance. Landowners worry that the law unfairly restricts use of their property, while business and industry complain that the ESA needlessly complicates the regulatory environment in which they must operate (Desiderio 1993). At the same time, landowners and businesses often have adopted wildlife conservation and land stewardship measures on their land and in their operations (Wildlife Habitat Council 2001). Thus, tapping into this stewardship ethic could enhance endangered species conservation. As the experience with recent ESA regulatory innovations, such as Safe Harbor Agreements and Candidate Conservation Agreements demonstrates, there is a great willingness within the regulated community to do good things for wildlife, including endangered species, provided that the process is simple and the rules are clear.

In addition to codifying existing administrative reforms, such as Safe Harbor and CandidateConservation Agreements, there are other measures that would simplify ESA compliance without sacrificing endangered species conservation. For example, under the ESA currently, there are two distinct paths for a private party to obtain a permit for an activity that may incidentally take a listed species. If the activity is one that requires a federal permit or federal funding, an incidental take statement can be obtained through Section 7 of the ESA. Alternatively, if no federal permit or funding is involved, an incidental take permit may be secured through Section 10 of the ESA (National Association of Home Builders 1996). The standards for obtaining the two are slightly different and regulatory deadlines for decision-making differ significantly. Moreover, the burden of obtaining the incidental take statement is on the federal agency involved under Section 7, while the private party seeking an incidental take permit has the burden under Section 10. Although there may be some advantage to pursuing one avenue over the other, depending on the circumstances, in general it is confusing, irrational and arbitrary to have two parallel paths with different standards and costs to achieve the same end. The commission should examine the permit process with an eye toward consolidating and streamlining it, while maintaining its purpose of conserving species.

Another area of confusion for the regulated community is critical habitat. Section 4 of the ESA requires the designation of critical habitat at the time a species is listed and, under Section 7, federal agencies are required to ensure that activities they authorize, fund or carry out do not adversely modify or destroy critical habitat (National Association of Home Builders 1996). Thus, in practice, critical habitat may affect private landowners if they must secure a federal permit for an activity on their land. However, the mere suggestion that one's property may be within an area designated as critical habitat raises the specter, no matter how unfounded, that activity on the property will be restricted. This can translate into a reduced willingness on the part of lenders to finance proposed activities on the property and depress property values. Moreover, while suits to force FWS to designate critical habitat have become something of a cottage industry for certain segments of the environmental community, there is little evidence that the designation of critical habitat has resulted in significantly greater conservation benefits for listed species beyond those afforded by the listings themselves. Indeed, the cost to FWS in staff time and resources spent in defending itself against such suits detracts from its ability to implement other conservation measures (General Accounting Office 2002). Accordingly, the commission should examine the utility of critical habitat for endangered species conservation and consider whether it should be eliminated or simply made part of the recovery planning process, rather than an independent statutory requirement.

Perhaps the most common refrain heard from the regulated community is the plea for regulatory certainty. Business is willing to undertake endangered species conservation measures and to incorporate their costs, within reason, into the cost of doing business. In order to do so, however, they need to know what those costs are likely to be, with some assurance. The difficulty comes when business undertakes endangered species conservation measures, incorporates their costs into their plans and financing, only to learn down the road that, with the listing of a new species, additional costs will be incurred beyond those planned for. And, while uncertainty and risk are a part of any business undertaking, minimizing it is always desirable. The No Surprises Policy developed in the Clinton Administration was an effort to address this concern. While that policy came under attack by some environmentalists for failing to adequately account for uncertainties in ascertaining the future needs of endangered species, the basic premise of the policy is sound. Once a member of the regulated community makes a commitment to undertake endangered species conservation measures, based on the best available science, they should not be required to undertake additional measures later. The burden should be on FWS to get it right the first time and, if additional conservation needs are subsequently discovered, to identify alternative conservation strategies that will not impose additional burdens on those who already undertook the previously required conservation measures. The commission should look at how best to incorporate into the ESA the No Surprises Policy and other methods of providing the regulated community with greater certainty in order to gain their cooperation in endangered species conservation.

Conclusion

The stalemate over ESA reauthorization will continue until both supporters and critics of the ESA are willing to set aside their orthodoxy to engage in a meaningful dialogue. Neither Congress nor the Administration is likely to make ESA reauthorization a priority absent some indication that a consensus can be reached. Creation of a national commission on endangered species conservation reform, to bring the parties together, address how to enhance endangered species conservation and simplify ESA compliance for the regulated community could end the stalemate and finally result in a long overdue reauthorization of the ESA.

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Endnotes

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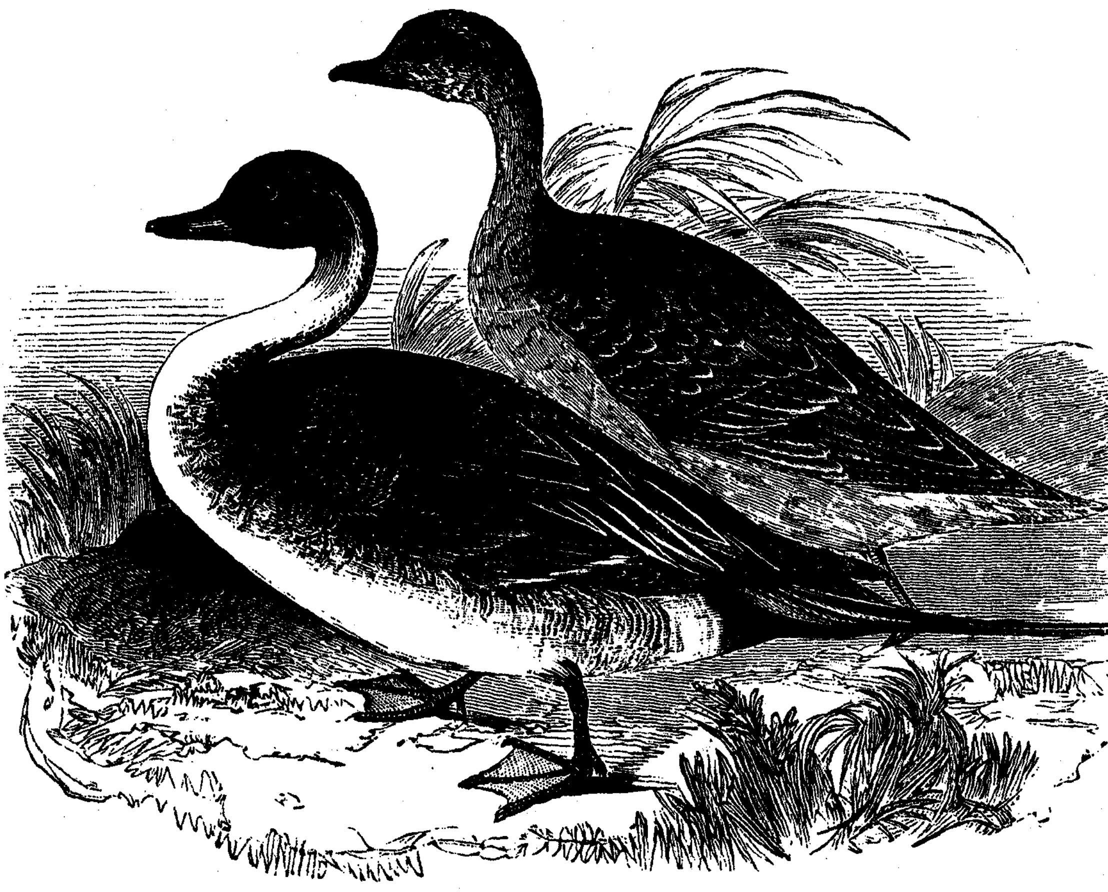

Special Session Four.
Game Ranching: Boon or Bane?

Chair
Bruce Morrison
Nebraska Game and Parks Commission
Lincoln

Co-chair
Ronald Regan
Vermont Fish and Wildlife Department
Waterbury

Opening Remarks

Bruce Morrison
Nebraska Game and Parks Commission
Lincoln

The title of today's session is *Game Ranching: Boon or Bane*? What do we mean by game ranching? For today's discussions, we will look at the raising of traditional wildlife species, both native and exotic, behind high-wire fences for economic return. Many years ago, this was considered a Texas problem and most state wildlife agencies did not pay much attention to the growing trend of fencing large acreages to hold wildlife captive. It was contrary to the traditional view of game management and many thought that it was just a passing fad. Today, there are thousands of captive wildlife operations with tens of thousands of wild animals held captive behind high-wire fencing. What began as a hobby by a few landowners has grown into a multi-million dollar industry that, at times, has negative impacts on native wildlife management. The introduction of new, exotic species into native habitat, the fencing of migration corridors and the introduction of new or previously controlled diseases present management challenges to wildlife biologists that were not there in the past. The economic downturn experienced by the traditional livestock industry at the close of the 20th century has driven more and more landowners to investigate and invest in nontraditional ranching practices. Being more comfortable with state agriculture agencies, these operators have led the drive to have the captive wildlife industry regulated by agriculture departments rather then the wildlife agency. This new use of wildlife is viewed by some as the right of private landowners and a method to save the family farm or ranch. Others view it as a way to make more money from the land, rather than by raising crops or traditional livestock. Still, others view it as a direct challenge to the North American model of wildlife management and a return to the days of market hunting, behind high-wire this time. Instances of illegal transfer of animals from one state to another, the capture and holding of the state's native wildlife and genetic manipulation to produce trophy animals by a few have given a bad reputation to the industry in the eyes of many. The unwillingness of state wildlife agencies to work with captive producers and state agricultural agencies has also given our profession a tarnished image in the eyes of many producers and their organizations. Today, we will look at this industry from many views, including the state, the producer and the federal government's. We will see how this industry has spread and what impacts it may have on wildlife management in North America. After today's session, I hope that we, as wildlife management professionals, can work with each other, with captive wildlife producers, with the sporting public and with agriculture agencies, to work through our differences to develop regulations to control the threats of this industry to native species, while at the same time acknowledging that we can agree to disagree on some of the concerns voiced. Only when we reach the point where we can work with each other, not against each other, can the concerns of each interest group be addressed in a manner that benefits wildlife resources and the citizens of our country that have charged us with managing that resource.

Farming Captive Cervids: A Review of Social, Economic and Ecological Opportunities and Risks in Michigan and North America

Thomas G. Coon
Department of Fisheries and Wildlife, Michigan State University
East Lansing

Henry Campa, III
Department of Fisheries and Wildlife, Michigan State University
East Lansing

Alexandra B. Felix
Department of Fisheries and Wildlife, Michigan State University
East Lansing

R. Ben Peyton
Department of Fisheries and Wildlife, Michigan State University
East Lansing

Scott R. Winterstein
Department of Fisheries and Wildlife, Michigan State University
East Lansing

Frank Lupi
Department of Agricultural Economics, Michigan State University
East Lansing

Mary Schulz
Department of Agricultural Economics, Michigan State University
East Lansing

James Sikarskie
College of Veterinary Medicine, Michigan State University
East Lansing

Introduction

Husbandry and sale of captive deer and elk have grown in Michigan and throughout North America over the past 30 years. Prior to 2000, the captive cervid industry in Michigan was regulated, in part, by the Michigan Department of Natural Resources (MDNR) and, in part, by the Michigan Department of Agriculture (MDA). Proponents of this industry anticipate that it is likely to grow dramatically in Michigan if the regulatory process is not prohibitive. In response to industry requests to modify the regulatory process, the MDNR and the MDA commissioned a study in 1999 to gather information on what is known about the captive cervid industry in Michigan, and beyond, and to identify issues that may interfere with further development of the industry or may affect the free-ranging herd of white-tailed deer (*Odocoileus virginianus*), elk (*Cervus* spp.) or other wildlife species in Michigan. Our paper summarizes an extensive report (Coon et al. 2000) that was used as a resource in a series of dialogues among stakeholders (private and public) interested in the industry. These dialogues led to legislated changes in the regulation and status of the captive cervid industry in Michigan (MDNR 2000). We review what is known about the economic, social, ecosystem and health management issues associated with the captive cervid industry and identify key information needs for effective management of the industry and wildlife resources.

Background

Raising wild animals in captivity poses challenges and opportunities similar to those encountered when raising domesticated species, but also generates concerns with those opportunities. For example, the white-tailed deer herd in Michigan is estimated at 2 million prior to hunting seasons. The elk herd is smaller (less than 1,500 head) and is restricted to the northern region of lower Michigan. It is difficult to establish a value for this public resource. In economic terms, the elk and deer herds generate at least $407 million each year in hunting trip and equipment expenditures (US Department of the Interior 1998). The herds generate additional but unquantified revenues in wildlife viewing and feeding activities, and as non-market values associated with wildlife encounters.

The captive cervid industry in Michigan is diverse and promises opportunities for development. Two native and at least four non-native species are grown by Michigan farmers. Operations range from small pens on farms to game ranches. Deer and elk are grown to produce products ranging from venison to trophy antlers to velvet antlers to mature bulls for trophy hunting. With a Michigan captive wildlife permit, the property owner determines when animals can be taken, under what conditions and with what methods.

Because captive cervid farming and ranching involved species that are also free-ranging in Michigan, two state agencies have been involved in regulating this industry. In addition to issuing permits to keep captive elk, moose (*Alces alces*) and white-tailed deer, the MDNR also regulated the type and height of fencing that must be used on captive cervid operations, and it required detailed record-keeping of losses, sales or acquisitions of animals in captive herds. Owners were required to report their transactions monthly to the MDNR. The MDNR also had the authority to enforce all regulations regarding captive cervids through the Law Enforcement Division. The MDA was involved in regulating other aspects of the captive cervid industry, particularly with regard to animal health management.

Status of the Captive Cervid Industry in Michigan, 1999

Michigan Agricultural Statistics Service Data

The Michigan Agricultural Statistics Service (MASS) conducted a survey of Michigan captive deer and elk operations in 1998 (MASS 1998). The MASS report estimated that there were 16,800 captive deer and 2,000 captive elk in Michigan in 1998. The total inventory value of the captive herds was estimated to be $29.4 million dollars ($18.4 million for deer and $11 million for elk). No data were available to quantify cash receipts associated with Michigan's captive deer and elk operations. In comparison, the MASS estimated the state cattle (dairy and beef) herd to be 1.1 million head in 1998 (MASS 1998), with an inventory value of $748 million, cash receipts value of $732 million for milk production and a cattle and calf marketing value of $218 million.

Data on the Number of Operations, Locations and Opportunities for Recreation, in Michigan

As of May 1999, there were 448 permitted enclosures with white-tailed deer only, 79 with elk only, and 103 with white-tailed deer and elk combined, in Michigan. The number of captive deer and elk in Michigan has grown 50 percent and 100 percent, respectively, from 1994 to 1998, with numbers reaching about 21,000 and 2,600 in 1998. The number of permits listing elk in 1998 was more than four times larger than it was in 1992. The number of permits listing white-tailed deer in 1998 was 50 percent larger than it was in 1992. The 1997 DNR inventory was 13 and 18 percent greater than the MASS (1998) elk and deer inventories, respectively.

Most of the enclosures were relatively small; 76 percent are less than or equal to 20 acres (8 ha). Seventeen percent (107) of all white-tailed deer or elk enclosures were greater than or equal to 40 acres (16 ha), and 90 percent are less than 150 acres (61 ha). Most of the captive white-tailed deer were on larger farms; about two-thirds of them were on farms greater than or equal to 40 acres (16 ha), and about one-third of the deer were on farms less than 550 acres (223 ha). Moreover, 10 percent of the captive white-tailed deer were in enclosures greater than 1,000 acres (405 ha). Most of the elk were on smaller farms; about 60 percent were in enclosures smaller than 40 acres (16 ha), and about 90 percent were in enclosures less than or equal to 400 acres (162 ha).

Some of the permitted operations offer opportunities to hunt for pay within enclosures, but no direct data identifying such operations are available. Nevertheless, nearly 20 percent of the captive white-tailed deer and elk permit holders operate on greater than 40 acres (16 ha), and it is likely that some of these also offer hunting within enclosures as part of their business.

Interstate Sales of Captive Cervids in Michigan

The number of elk and white-tailed deer sold from Michigan between 1997 and 1999 (520 elk, 416 deer) was more than twice the number imported over the same period (238 elk, 109 deer). These data were obtained from the MDA records of Official Interstate Health Certificates, which are required for interstate transport of live captive cervids. Missouri (39 %) and Wisconsin (15 %) figured prominently as points of origin for elk imported into Michigan over this period. White-tailed deer imports originated primarily from Wisconsin and Ohio (23 % each) and Minnesota (21 %). In addition, a small share of the elk (3.4 %) and white-tailed deer (4.6 %) imports were from Canada.

Potential for Continued Growth of the Captive Cervid Industry

Our analysis suggests that the short-run viability of the industry depends on continued support of prices and markets for breeding stock, and the long-run viability of the industry depends on adequate development of markets for end products. Other alternative agricultural enterprises have failed because markets did not adequately develop their products. For example, breeding stock for emus (*Dromiceius novaehollandiae*) and ostriches (*Struthio camelus*) once were valued highly. When markets failed to develop, the value of breeding stock dropped. Alternatively, bison (*Bison bison*) enterprises seem to have found a niche in the market for their products and remain viable. If the captive cervid industry can follow the bison example—and its product diversity and recognition suggest that it may—it has the potential for substantial economic growth.

Ecosystem Issues

Adjacent ecosystems may be affected by the presence of captive animals or the facilities themselves, especially if facilities are relatively large or enclose unique vegetation types used by free-ranging wildlife. Although any livestock facility may affect ecosystems, the differences between captive cervid operations and other livestock operations are that most captive cervid facilities, by definition in Michigan, contain animals that are the same as free-ranging species, and captive cervid operators are required to use fencing that may restrict the movement of publicly owned wildlife. In contrast, domestic livestock operations typically use fencing that is passable for most wildlife species.

Issues and Concerns Associated with Captive Cervid Animals

The four primary issues associated with captive cervids that have potential implications on natural ecosystems are direct ecological interactions, potentials for escapes, movement of escaped animals into unwanted areas and illegal taking. The direct ecological interactions of captive cervids pose concerns to wildlife managers (Feldhamer and Armstrong 1993) because cervids can cause impacts: (1) at the ecosystem level (e.g., altering successional trajectories of habitat types or forest characteristics through herbivory [Schmitz and Sinclair 1997] that may impact habitat suitability for other wildlife species [Raymer 1996]), (2) at the species level (e.g., competition with native species, disease transmission) and (3) at the genetic level (e.g., hybridization [Harrington 1985]).

Succession and wildlife habitat quality may be impaired by cervid herbivory within large facilities, primarily those that allow hunting within enclosures. Schmitz and Sinclair (1997) discussed that, in the absence of deer, northern hardwood forests undergo a successional trajectory from grass-herbaceous vegetation to shade intolerant vegetation to. Conditions created by shade tolerant species promote the growth and development of other shade tolerant species. However, browsing facilitates the maintenance of shade intolerant species. In this example, cervids have the potential to change the composition, structure and development of forests. Such changes were documented by Tilghman (1987) who investigated the effects of white-tailed deer densities in enclosures on forest characteristics, and Healy and Lyons (1987), who investigated deer herbivory-forest dynamics on a 50-year-old unfenced wildlife area.

Changes in forest characteristics, caused by captive cervids or those that become locally abundant due to fencing, has several implications for wildlife conservation (e.g., Anderson and Loucks 1979, Frelich and Lorimer 1985). Decreased conifer regeneration may reduce amounts of winter cover, resulting in higher mortality of wildlife, or it may increase browsing, damaging critical vegetation types or endangered plants. Also, if deer traditionally browsed an area that becomes unavailable due to high fences, they would have to seek alternate habitat.

Lastly, the wildlife community (e.g., breeding birds) may also be affected by browsing altering forest structure and composition. DeCalista (1994) found that ungulate browsing, within enclosures negatively affected songbird populations. The richness of midstory canopy-nesting songbirds decreased 27 percent and abundance decreased 37 percent between the 3.7 and 24.9 deer per square kilometer deer density treatments. Furthermore, if habitat changes have altered conditions for breeding birds, other taxa, such as herpetofauna, could also be affected.

If captive animals escape and become naturalized, they may represent risks to wild animals and compete for resources. These risks were discussed by agencies in Montana and Idaho in a review of elk farming practices (Utah US Division of Wildlife Resources 1996). Feldhamer and Armstrong (1993) stated that, because free-ranging exotics may outcompete native species for habitat, maintaining them is not in the best interest of wildlife agencies facing declines in wildlife habitat and budgets. For example, Davidson et al. (1987) investigated the health of sambar deer (*Cervus unicolor*) in relation to sympatric, native white-tailed deer in Florida, and they concluded that the condition of sambar deer appeared to be better than that of white-tails, due to differences in food use, nutritional ecology and susceptibility to parasitism and disease. Feldhamer and Armstrong (1993) found that Sika deer have a competitive advantage over white-tailed deer, based on their greater contribution to the harvest in Dorchester County, Maryland. The competitive advantage of Sika deer (*Cervus nippon*) may be explained by its digestive anatomy, feeding behavior (Hofmann 1985) and nutritional needs.

Hybridization can occur if captive animals escape and mate with wild animals or if wild individuals enter captive facilities and mate. If captive white-tailed deer or elk escape to areas where there are free-ranging species, it would be difficult to distinguish between captive (private property) and wild animals (public property), therefore the implications and effects of hybridization incidents are not fully known (Stubblefield et al. 1986). We could not find documented cases of either genetic improvement or loss of fitness of wild cervids due to hybridization. However, biologists from several state and provincial agencies (e.g., Colorado, Oregon, Utah, Washington, Wyoming, Ontario) expressed concern regarding the risk to the genetic integrity of native wildlife as a result of hybridization between wild and captive animals (e.g., Ontario Federation of Anglers and Hunters 1991, Utah US Division of Wildlife Resources 1996).

Stubblefield et al. (1986) reported that hybrids contribute little, if any, to a herd's productivity. Upon studying mule deer and white-tailed deer hybrids in Texas, Derr (1991) suggested that the genetic structure of local populations may be altered by hybridization, but, overall, it does not pose a challenge to the genetic integrity of the parent species in Texas. The effects of hybridization between escapees and free-ranging wildlife depend on the frequency of escapes, the size of the free-ranging population and the amount of genetic difference between escaped animals and the native free-ranging species. For example, Michigan's free-ranging elk population (less than 1,500 animals) may be more sensitive to the effects of hybridization than the white-tailed deer population.

Massey (1986) stated that escapes from captive facilities are rarely documented and data are limited. This may be because: (1) escapes are rare, (2) owners may be unaware of escapes, (3) the number of escapees may be considered minimal by the owner, (4) owners may be unwilling to report escapes or (5) it is difficult to determine if an escape was accidental or intentional (US Congress, Office of Technology Assessment 1993). Lanka et al. (1990) reported that 12 out of 16 US states or Canadian provinces surveyed had documented escapes of game animals. If escapes occur more or less frequently than is documented, the effects of escaped, cervids on free-ranging wildlife, whether genetic, ecological or disease-related, also may be greater or lower than is currently documented (Miller and Thorne 1993). Cervid owners, however, observe that escaped animals generally remain close to fences and attempt to re-enter with the captive herd (L. Renecker, personal communication 1999).

The causes of captive cervid escapes are primarily attributable to poor fence maintenance, inadequate height, environmental factors (e.g., floods, storm-damaged fences), vandalism, animals destroying fences, animals crawling under fences, snow creating bridges and poor construction (Lanka et al. 1990, Bryant et al. 1993). While Wheaton et al. (1993) emphasized that fencing standards exist to minimize cervid escapes, Lanka et al. (1990) and Kahn (1993) concluded that escapes will occur in the cervid industry. Kahn (1993) reported that during the 1980s, the Colorado Division of Wildlife documented five populations of exotic wildlife occurring in the wild; all escaped from private facilities. As a result, stricter fencing regulations were enacted in 1989 and went into effect in 1990. Even so, Kahn (1993) cited the Colorado Division of Wildlife documented 33 cases of captive wildlife escaping or being released from captivity since 1988, and half involved captive cervids. Over 75 percent of the escapes occurred despite the stricter fencing regulations.

An additional issue associated with the captive cervid industry is illegal taking. As stated by the Ontario Federation of Anglers and Hunters (1991:40): "Game farming and ranching has been argued to provide poachers with the golden opportunity to market illegal animals and parts through the convenience of a legal market—a means of increasing reward while reducing risks." Bunnage and Church (1991) commented that illegal taking might occur for selling meat, breeding stock and selling velvet antlers. These authors stated that, in Alberta, it would be difficult to illegally harvest wild animals for such products, since captive animals must have registration tags that are read by inspectors before slaughter; live game farm animals must have tamper proof tags; removed velvet antlers must be tagged. Little information exists to document the existence or frequency of illegal harvest that occurs in association with captive cervid operations. By its nature, poaching is difficult to document (Canadian Wildlife Federation 1992), however agencies have reported cases of wild cervids being taken into captive herds illegally in Colorado, Idaho and Oregon (Utah US

Division of Wildlife Resources 1996). To address these risks in Canada, the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act was developed (Twiss et al. 1996). Regulations that require thorough documentation and verification of animal acquisition and use genetic and biochemical monitoring can help offset any benefits that may tempt growers to illegally take wild animals (Renecker and Kozak 1987).

Issues and Concerns Associated with the Existence of Facilities

Because the area within high fences—10 feet (3 m)—is unavailable to free-ranging cervids (i.e., habitat loss), these animals may be forced into a more crowded habitat (Canadian Wildlife Federation 1992) or it may alter migration routes (e.g., migrating antelope) (Shellenbarger 1999). For example, Nielson et al. (1997) documented that a partial enclosure of 790 (319) fenced acres (ha) with five openings of 33- to 164-feet (10-50 m) wide reduced overall male deer migration and delayed migration in some males. If high fences can impede migration or access to seasonal yards, deer may utilize areas where they otherwise would not occur. Ultimately, the number, size and geographic distribution of facilities relative to migration patterns and seasonally important vegetation types will determine the degree to which high fences impact free-ranging wildlife by restricting movement or decreasing the amount of functional habitat. Due to the scarce data available, however, documentation of the effects that high fences have on habitat use and migration patterns of free-ranging wildlife is difficult to substantiate. Nonetheless, the fact that six state wildlife agencies (California, Minnesota, Texas, Utah, Wyoming and Michigan) have expressed concerns regarding the potential for negative ecological effects of high-fenced enclosures indicates that more information is needed to determine their effects on wildlife (Shellenbarger 1999).

Health Management Issues

Properly managed wild and captive cervid populations are relatively healthy and disease-free. They are, however, susceptible to infections and diseases that may threaten other wildlife or livestock (Davidson et al. 1987, Miller and Thorne 1993). Implications of disease prevalence or transmission in captive cervids are important, since some diseases are difficult to diagnose and control (e.g., bovine tuberculosis [BTB]) in white-tailed deer in Michigan) in wildlife species. As with domestic livestock, many diseases arise in captive cervids because of the stress associated with crowding within facilities, during capture and shipping, and from exposure to new pathogens (Hunter 1996). Because interactions between captive or escaped cervids and free-ranging cervids offer the greatest potential avenue for disease transmission, it is important to minimize contact between captive and free-ranging cervids (Miller and Thorne 1993).

Disease Transmission via Captive Animals

The potential of density-dependent disease transmission is greater among animals in captivity than in free-ranging wildlife because animals are often held at higher than natural densities and, thus, are frequently in direct contact (Hunter 1996, Twiss et al. 1996). Diseases that may be transmitted between captive and wild cervid populations (Lanka et al. 1992, Wheaton et al. 1993) in either direction include anaplasmosis (*Anaplasma marginale*), brucellosis (*Brucella abortus*), chronic wasting disease (*Spongiform encephalopathy*), epizootic hemorrhagic disease or blue tongue (hemorrhagic disease of deer), giant liver fluke (*Fascioloides magna*), Johne's disease (*Mycobacterium paratuberculosis*), malignant catarrhal fever (MCF), meningeal worm (*Parelaphostrongylus tenius*), and BTB.

Tests for detecting some diseases in captive species are unreliable (Hunter 1996) and regulations for disease testing have failed to prevent shipment of diseased animals, since sometimes diseased animals are certified as disease-free (Lanka et al. 1992). For example, cervids brought into New Zealand game farms introduced muscle worm (*Elasphostrongylus cervi*) and nasal bot fly (*Cephenemyia phobifer*) into the country (Massey 1987) and cattle introduced BTB and brucellosis. A BTB infection was imported to Colorado game ranches in elk from Nebraska that had tested negative for the disease (Miller and Thorne 1993). In this case, the caudal fold test was used, which is now considered unreliable in cervids. If the cervical skin test had been used, perhaps this disease transmission could have been prevented.

Animals that show no sign of disease when tested may develop clinical diseases after stress following capture, transport, handling, socialization, climatic change and nutritional change (DeNicola and Swihart 1997, Waas et al. 1997, Aiello and Mays 1998). These stresses make farmed animals more susceptible to diseases such as MCF. White-tailed deer are particularly susceptible to MCF

(Fritz et al. 1992) and may contract it from exposure to infected but asymptomatic domestic sheep or exotic antelope (Alcelaphanae—wildebeest, *Connochaetes* spp.). There is no evidence of MCF being transmitted to white-tailed deer from other deer.

Quarantine period is also a cause of concern for transmitting diseases. The quarantine period may not be sufficient to identify infected animals before shipment due to the incubation periods of some diseases (e.g., that of chronic wasting disease is 22 months) (Canadian Wildlife Federation 1992). In Michigan, for example, the Animal Industry Act of 1987 (MDA 1995) requires a negative test for brucellosis 30 days before importation, yet *Brucella* organisms can survive for three to four months (Currier 1995).

Disease Transmission via Free-Ranging Wildlife

Free-ranging wildlife may also transmit diseases to captive animals if they share the same environment (Haigh and Hudson 1993). For example, white-tailed deer in eastern North America carry meningeal worm without having clinical signs. However, the worm can be fatal to species such as caribou (*Rangifer* spp.), moose and bighorn sheep (*Obis canadensis*). If the parasite is transmitted into a captive herd by an infected deer, a slug or a snail, meningeal worms could spread and cause infection or fatality. Also, in northeastern lower Michigan, where BTB exists in free-ranging white-tailed deer, captive white-tailed deer may be at higher risk than cattle for contracting BTB from wild deer, due to social contact at fences or potential ingress and egress (US Department of Agriculture 1996).

Miscellaneous Transmission Routes

Small wild mammal populations may also contribute to disease transmission between captive and free-ranging populations. In New Zealand, the brush-tailed possum (*Trichosurus vulpecula*) is a reservoir for BTB (Bruning-Fann et al. 2001). In Montana, a coyote (*Canis latrans*) caught near a BTB-infected deer farm tested positive for BTB (Rhyan 1995). Coyote, raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), red fox (*Vulpes fulva*) and bear (*Ursus americanus*) in northeast Michigan have tested positive for BTB (Bruning-Fann et al. 2001). Although the cause of infection is not known, these cases show that the disease can be transmitted between species. No evidence exists to indicate that these non-cervid species may serve as vectors of BTB, but this possibility must be evaluated. Although domesticated livestock can contract diseases through invertebrates and infected wildlife, diseases are more easily and accurately diagnosed and treated in cattle and swine than in cervids. Subsequently, the possibility of disease establishment in cervids due to the difficulty of diagnosis, the possibility of latent infections and the unreliability of tests may complicate disease eradication strategies.

Disease Control

The industry has invested in new techniques to address the need for increasing the reliability of disease testing (S. Wolcott and L. Renecker, personal communications 1999). For example, the North American Elk Breeders Association (NAEBA) has pursued better disease prevention, diagnosis and treatment as a policy. The cervical skin test used for detecting BTB in elk was developed after the disease was found in domestic elk herds in 1991. The NAEBA advocated for establishing a BTB program for elk with the US Department of Agriculture and was successful in 1994. Efforts led to identifying and quarantining infected elk herds in the US. These herds were depopulated or went through a test-and-slaughter program until they were tuberculosis-free. Surveillance continues and the prevalence of BTB in captive cervids is now less than in cattle. Also, the cattle turberculosis program was altered to more closely resemble protocols used in the captive cervid program (S. Wolcott, personal communication 1999).

Social Issues

Game farming and ranching provide numerous benefits (e.g., local economy, food) and are expected to provide others yet proved (e.g., health benefits). Also, this industry may provide another alternative economic activity to rural landowners, either in place of traditional agricultural practices or in place of non-agricultural development. The industry also poses a number of potential costs or risks that raise social issues. This paradox is not unique to game farming or ranching, but many of these issues are unique because of the wild nature of the species involved—white-tailed deer and elk—which also exist as a common property resource. Although the rearing and marketing of these cervids is an agricultural activity, the process and potential consequences are inextricably linked to their wild counterparts, the wildlife management system and the ecosystem upon which wildlife species depend. The social issues identified here include: (1) the potential for game farming and ranching to impede the effective administration of wildlife conservation methods (Schneider 1990, Canadian Wildlife Federation 1992, Geist 1994, Posewitz 1994), (2) the recreational shooting opportunities on game ranches, which could reduce public acceptance of recreational hunting and its role in wildlife management (Wrage 1997, Peyton 1998) and (3) the wild nature of these captives, which raises humane issues of animal welfare beyond those associated with traditional domesticated livestock production (Haigh and Hudson 1993, Wass et al. 1997). These risks and their associated issues suggest a need to carefully consider regulations for the captive cervid industry. Indeed, the captive cervid industry in Michigan has supported legislation to require disease testing and to establish guidelines for raising animals humanely.

Information Needs for Effective Management of Captive Cervidae

Our review has identified several topics of informational needs that may assist policy and decision makers as they develop policies, regulations and laws concerning the captive cervid industry. These topics include effective regulation, monitoring, enforcement, health management, permit processing and fence design.

The numerous regulations and policies among states suggests that there would be benefits to developing an analysis of the differences in captive cervid agriculture regulations between states and how regulatory systems are financed. For example, an informal review conducted by the North American Deer Farmers Association, in 1997 (unpublished), found that, in six states, captive cervid agriculture was regulated by the state wildlife agency. State agriculture departments had jurisdiction over captive Cervidae in 20 states and both agencies had regulatory responsibilities in 21 states. Jurisdiction was not determined for the remaining states. In 16 states, laws did not restrict which species of Cervidae could be raised, but restrictions varied for other states. This informal survey suggests that most state regulations are not consistent or comprehensive, in spite of the developments in captive cervid enterprises.

Data regarding the number and value of captive cervids raised and marketed in Michigan were collected only one year by the MASS for the MDA, in response to the current BTB crisis in cattle and wild and captive Cervidae in the state. Given the importance of BTB and the potential risks identified in this review, these data should be regularly collected. Michigan regulations require that captive cervid owners report the sale or purchase and transport of any white-tailed deer or elk, along with testing for brucellosis and BTB. Record keeping and monitoring would help minimize the risks of disease transmission and provide information that would be needed if a disease outbreak would occur.

The disease transmission risks to agriculture and wildlife posed by captive cervids are still poorly understood. If the industry is to prosper, operators need access to better diagnostic tests, enrollment in better health management programs and expertise with health management issues for captive cervids. Specifically, research is needed to develop more reliable diagnostic tests and treatments for captive cervid diseases to identify the best management practices to enhance captive cervid health. Further information is also needed on the magnitude and cost of risks associated with disease transmission at all levels—the industry, health of publicly-owned wild populations, individual captive herds and human health (Lanka et al. 1992, Miller and Thorne 1993).

Applications for permits to establish cervid operations should be reviewed through an approval process. Yet, a number of potential issues and problems have been identified, suggesting that not all proposed permits should be approved. For example, while fencing may be designed to contain all cervids, it may inhibit the movements of wildlife, impact the property values of adjacent landowners or not be the appropriate size to accommodate recreational shooting. These land use impacts should be considered in the process of managing captive cervids and conserving our wildlife resources.

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Why Game Ranching and the North American System of Wildlife Conservation are Incompatible

Valerius Geist
University of Calgary
Alberta

The opening ceremony of the 2002 Winter Olympic Games, in Salt Lake City, had wildlife as prominent theme. It was a spectacle of motion and form, dreamy and eerie in gripping beauty. It was an expression of North America's love for its wildlife, which has returned to abundance through the hard work and sacrifice of three generations of North Americans, continent-wide, irrespective of nationality. The ceremony's wildlife theme had its roots in a fundamental policy of North American wildlife conservation. That primary policy states that wildlife is a public resource, a public good, a ward of the sovereign, which is another way of saying that it is the business of every citizen.

The commercial ranching of wildlife for its trophies, antlers, meat and byproducts, referred to in North America as the alternative livestock industry, conflicts with the fundamental policies of wildlife conservation as practiced on this continent (Geist 1988, 1995, 2000; Geist et al. 2001). Game-farming is based on private ownership of wildlife, which leads to conflicts arising from differences in interests governing private versus public ownership. As discussed below, private and public stocks of wildlife are fundamentally incompatible, particularly once the private ownership of wildlife is widespread (Klein 1980). However, the public ownership of wildlife is not the only policy game-ranching conflicts with.

The second fundamental conservation policy is a prohibition on commerce in dead wildlife, a policy derived from the hard lessons learned from the continental decimation of wildlife at the turn of the 19th to the 20th century. Yet, game farming exists explicitly to sell dead wildlife. It must traffic in its parts, and must create demand for dead wildlife where there had been none.

The third policy allocates to citizens, by law, public wildlife which is surplus to conservation requirements. Every citizen in North America has access to wildlife, access which is regulated by elected representatives at federal, state and provincial levels. In principle and with few exceptions, wildlife is allocated in an egalitarian fashion, favoring neither social status, nor land ownership. The rich and the poor, the elite and the commoner, the mighty and the meek have the same limitations by laws in wildlife consumption. Game ranches, however, allocate wildlife for consumption by the marketplace via the parts or the shooters market. One only gets wildlife if one can pay for it.

The fourth policy allows the killing of wildlife even by licensed hunters only for cause (food, fur or protection of life and property). Thus, it prohibits the frivolous, pleasure-killing of wildlife and expects a modicum of honorable conduct from the hunter during the hunt. In a recent decision a judge in Montana affirmed that the state has an interest in the heritage of hunting. Game ranchers sell large antlered deer, after these animals have outlived their usefulness, to those interested in killing them in confined spaces on shooter ranches. It is difficult to visualize how the pleasure-killing of tame, aging, privately-raised, big-game animals, be they ex-residents of game farms or of zoological gardens, is compatible with this policy or with our hunting heritage.

The fifth policy identifies wildlife as an international resource to be managed cooperatively by sovereign states. The goal here is the maintenance of natural, productive wildlife populations as a national trust. That is, we not only restore wildlife and continental bio-diversity cooperatively, but we express a general interest in our neighbors treatment of wildlife. We do so implicitly aiming to keep wildlife natural and wild. Game ranching, however, has an interest in marketable wildlife, thus an interest in the genetic manipulation of privately held stocks to maximize profitable variation–irrespective of conservation interests of their own state, let alone a neighboring state. In other words, game ranching requires the genetic pollution of its wildlife in order to generate more marketable wildlife products, or monstrosities for sale as trophies. Residents of game farms notoriously escape and mingle with public wildlife, genetically polluting it. Genetic pollution is destruction of wildlife and what we value in it fundamentally. Moreover, game ranches spread genetic pollution and multiply it very rapidly. Degradation of public wildlife is inescapable.

The sixth policy is that the best available knowledge be used to manage the conservation of public wildlife. This means that the sovereign depends on advice from experts, scientists trained in the conservation of wildlife. This is the Roosevelt Doctrine (Leopold 1933). This policy gave rise to the North American wildlife biologist and The Wildlife Society. Private management of wildlife has historically exercised the wishes of private owners, irrespective of expert knowledge and opinion.

To be successful, an alternative livestock industry requires:

- unfettered, private ownership of wildlife,
- a legal market for wildlife parts and products, and
- the absence of public wild stocks in order
  - to enhance demand in the parts, products and shooters market,
  - to reduce the operation costs arising from disease control and the many interferences of wild stocks with farmed stocks, and
  - to minimize opportunity costs arising from public attention to the industry and the public's defense of public wildlife

This happens because game ranches, unlike conventional ranching, must exclude public wildlife from their operations, leading thus to loss and fragmentation of habitat for public wildlife. Transmission of diseases from or to game farms affects game-farming operations, increasing uncertainties, opportunity costs and the cost of doing business. The same applies in principle to the transmission of unwanted genetics, be it due to the inevitable genetic pollution of free-ranging public stocks or to the loss of genetic purity due to incursions of free-ranging public stocks onto game ranches.

What happens on the private property of game ranchers is inevitably of interest to the public, as long as public wildlife is affected by game ranches. Public wildlife thus leads to the interference with the enjoyment of private property, and the economic benefits derived therefrom. Consequently, the game ranching industry, implicitly, must strive, in the long-term, to gain control over public wildlife or eliminate it as a business factor.

Linking wildlife ownership to land ownership is one step in that direction, opening the way for the leasing of public lands and its wildlife for private exploitation. An alternative is the eradication of free-ranging stocks of wildlife and insuring that all wildlife is confined to private land. The fundamental incompatibility of private and public wildlife stocks was recognized a long time ago as holders of private wildlife fear wild stocks as carriers of diseases and parasites, as competitors for forages usable by private stocks and as attractions for predators and unwanted public attention (Klein 1980).

As noted above, a tenet of North American wildlife conservation is the prohibition of commerce in dead wildlife. This removed the incentive for commercial poaching of public wildlife and minimized the need for guardians of the public resource. The existence of markets in dead wildlife encouraged poaching, endangering wildlife and wildlife protection officers. A legal market in dead, private wildlife encourages the laundering of illegally killed public wildlife. The chances of such being detected are low. To minimize the killing of wildlife, to minimize law enforcement expenditures, it is best to foreclose markets in dead wildlife. This was an old North American policy of wildlife conservation. There are exceptions here, such as the sale of furs, fish and regional arrangements allowing some trade or barter of wildlife. Thus, the creation of a legal market in wildlife parts and products in order to encourage alternative agriculture, would spawn illegal killing of public wildlife, undercutting profits to game farms and increasing law enforcement costs to the public.

Another tenet of wildlife conservation policy bans on the frivolous killing of wildlife. A hunting license allows the killing of wildlife only if the animal will be retrieved and used for human consumption. As long as the public places some worth on wildlife, whatever the motive, there will be public opposition to killing for fun or self-aggrandizement. Killing tame wildlife under the pretense of hunting in the sanctity of private land, will still draw protests and opposition to shooting ranches. Pet shoots for elk, deer or aged zoo animals, will draw public ire, irrespective of the fact that the same is legal and uncontested for pheasants and game birds, which may be raised in captivity for shooting on private farms or for release on public land, to satisfy hunters. Of course, there are reasons other than ethics for opposing big game shooting ranches, which I shall discuss below. The important point is, if game ranchers are to make money from their privately owned wildlife, then they must be allowed to charge fees for killing, irrespective of the shooters motives and unimpeded by a watchful public's sentiments.

Akin to this impediment to game ranching is one circumscribed as hunting ethics or hunting heritage. In a democratic society in which hunting is legal and controlled by legislators, hunting assumes a ritual status that gives it legitimacy with the public. The notion of fair chase is associated with it. Killing domesticated wildlife on fenced private lands does not fall under that definition. Therefore one can expect opposition to such practices from hunters, clearly an impediment to profitable shooter ranches. The impediment to game ranchers are, thus, hunters, and this is a function of publicly-owned wildlife that is made available for harvest and allocated by law. Again, this points to an obvious long-term goal for alternative agriculture, namely the elimination of public ownership of wildlife, or the elimination of public wildlife.

Regarding public ownership of wildlife, there are several ways to weaken it:

- removal of public control over ranched wildlife by excluding it from the control of wildlife departments, placing it under agriculture departments, then making it a self-policing industry. This fosters using the might of agriculture to club wildlife interests.
- retrieval of guns from the hands of the blue collar and urban masses, thereby decreasing the demand for hunting. In Canada Bill C-68 goes a long ways towards disarming the public, depriving it of opportunity to harvest wildlife. Since wildlife conservation in North America is based on self interest, and this interest under Bill C-68 is difficult to fulfill, we can expect a precipitous drop in Canadian hunters, as well as a drop in interest of Canadian blue collar and urban residents in wildlife. Secondly, any measures that restrict the ready transfer of firearms from one jurisdiction into another for the purposes of hunting, is bound to achieve the same result. This is expected from measures enacted at border crossings to limit the general availability of fire arms.
- legitimization of the industry through appropriate advertisements, press releases and lobbying, to show it as a futuristic, environmentally friendly, clean, socially progressive, profitable, world hunger fighting organization. Also, it minimized the threats from bovine tuberculosis and denies outbreaks occurred among bison ranches, elk ranches, deer ranches. It also denies that transmissible spongiform encephalopathies (TSE), the cervid equivalent of Chronic Wasting Disease (CWD) is a concern comparable to Bovine Spongiform Encephalopathy (BSE) in Europe. It coattails the industry to the reputation of the agricultural science establishment and its corps of veterinarians that belittle diseases as a problem of game ranching. This action makes the veterinarians in government spokespersons for the industry, rather than defenders of the public good, which they are paid to be. Ever since the criticism by Beryl L. Crowe (1969) of Garret Hardin's (1968) *Tragedy of the Commons*, we have warned that social scientists have documented

that government agencies, as the public's watch dogs, will become spokespeople for the industry. It is perfectly natural for agricultural bureaucracies to defend alternative agriculture and to belittle and dismiss concerns, despite their foundation.

- depopulation of wildlife areas once they are infected with serious livestock diseases. Here, bison have played a significant role historically and continue to play it. Publicly owned bison–recklessly growing in numbers–as well, became a problem for western cattle growers in Alberta, due to the threat of tuberculosis and brucellosis infection. Bison were shipped to Wood Buffalo National Park and the remainder were destroyed, along with elk, deer and moose from the same. A coalition of federal and provincial bureaucracies tried to eradicate the diseased bison in the same park, replacing them with healthy ones, to insure TB and brucellosis free status for Canada in 1989. But, the coalition ran into severe public opposition. Currently, bison crossing from Yellowstone National Park into Montana are captured, tested for brucellosis and killed if found positive to protect Montana's brucellosis free status. In California, 25,000 deer were slaughtered once foot and mouth disease spread to them. Reintroduced elk in Ontario were eliminated when they were found to harbor liver flukes. There is an effort to eliminate CWD infected deer herds, most recently in Saskatchewan.

Knowing the history of wildlife management, it is not easy to predict its actions or policies, for we learn from history that we do not learn from history. Consequently, history repeats itself. An error foreseen is an error about to be realized, with all the consequences that it entails. I have studied the history of occidental wildlife management, and I am disturbed because history suggests that our North American model of wildlife conservation is not secure. Our system of wildlife conservation is a populist one, since those that conserve wildlife have selfish motives. Wildlife conservation done the current way rewards for the effort we have expended. It is a success for the same reason that a capitalistic market economy is so successful. Both are based on selfish motives. However, historically, these selfish motives have not prevented the governing elite from abrogating public wildlife for their very own private use and pleasure. That is, historically, the most common condition was for a small, powerful elite to own wildlife outright, denying commoners access to wildlife, disenfranchising the public. We are on the way to just that. We will need great effort to keep wildlife private and it will be a battle not for the faint of heart!

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Impacts of Game Ranching on Wildlife Management in Texas

John T. Baccus
Southwest Texas State University
San Marcos

Introduction

Whether the introduction of nonindigenous species is good or bad is in the eye of the beholder. Throughout the world, the scientific wisdom of introducing nonindigenous species has been questioned on economic and ecological grounds with the opponents of introduction citing numerous reasons why it is folly (Craighead and Dasmann 1966, Samuel and Demarais 1993). The argument for or against introducing exotic game species to Texas is pointless at this time. Texas has substantial, established populations of at least eight nonindigenous species (Mungall and Sheffield 1994).

Several factors contributed to the success of exotic game introductions in Texas. About 97 percent of the land is privately owned, resulting in a staunch sentiment of private property rights. There is a strong agricultural heritage with many large, successful ranches in the state. Many ranchers were astute, innovative businessmen willing to experiment with different breeds of livestock, therefore it was not uncharacteristic of them to try different approaches in deer management, even the introduction of exotics. There was a market for hunting exotic game especially as abundance within the native range of species diminished and hunting opportunities abroad became difficult and expensive. As populations of many large game animals declined in Asia and Africa, many ranchers became interested in using their ranches to propagate these threatened species. Exotic game ranches also offered, for the first time, opportunities for individuals other than the wealthy to hunt Asian and African species. A climate, similar to the climate on continents of origin for most exotic species, allowed the establishment and growth of populations of several species. A decline in energy and agricultural revenues forced ranchers to explore additional sources to supplement or replace loses of income. Many ranchers used revenue from trophy white-tailed deer and exotic game hunting to bridge the economic gap.

Development of Game Ranching

Modern exotic game ranching began in Texas in 1924 with the introduction of the first ungulate species: one bull and two cows of the nilgai antelope (*Boselaphus tragocamelus*), by Cesar Kleberg on the Norias Division of the King Ranch in South Texas (Mungall and Sheffield 1994). In the 1930s, Leroy Denman released exotic game on the Saint Charles Ranch, and Richard Friedrich stocked several exotic species on the Bear Creek Ranch in Kerr County, Texas. Charles Schreiner, III, of the Y. O. Ranch asserted that releases of exotic game on the Bear Creek Ranch were the most significant in promoting exotic game in Texas (Mungall and Sheffield 1994). Most likely, these early releases were surplus animals from zoos (Cameron 1992). During the 1930s, exotic game ranching was confined to a cadre of wealthy, politically-connected landowners and their associates. It seems the motivations for ranchers to introduce exotic species on their land were two-fold: aesthetics of having foreign animals and an economic status symbol (Mungall and Sheffield 1994). After the original introductions, the number of ranches with exotic species grew slowly. Initially, animals were not sold and seldom hunted, existing only for show. Ranchers gave surplus animals to other ranchers and associates as gifts (Mungall and Sheffield 1994).

On the Bear Creek Ranch, animals were confined by a high fence, possibly one of the first such fences in Texas. However, exotic animals escaped when fences were breeched during floods. A natural dispersal of these animals began a slow diffusion onto adjoining ranches. These animals became the nucleus for free-ranging exotics in the Edwards Plateau. During the developmental stage of exotic game ranching in Texas, the number of ranches with exotics grew from 2 to 37 by the early 1950s (Jackson 1964).

From the 1930s until the 1950s, hunting in Texas was primarily for white-tailed deer (*Odocoileus virginianus*), especially in the Edwards Plateau and South Texas. Subsistence hunting was the primary goal of white-tailed deer hunters in Texas until after World War II. Populations existed below carrying capacity principally because of periodic screwworm infestations. Trophy bucks probably subsisted, but there was little concern by hunters regarding age, sex or size, especially in South Texas (Brothers and Ray 1975). Most large ranches had a few quality bucks.

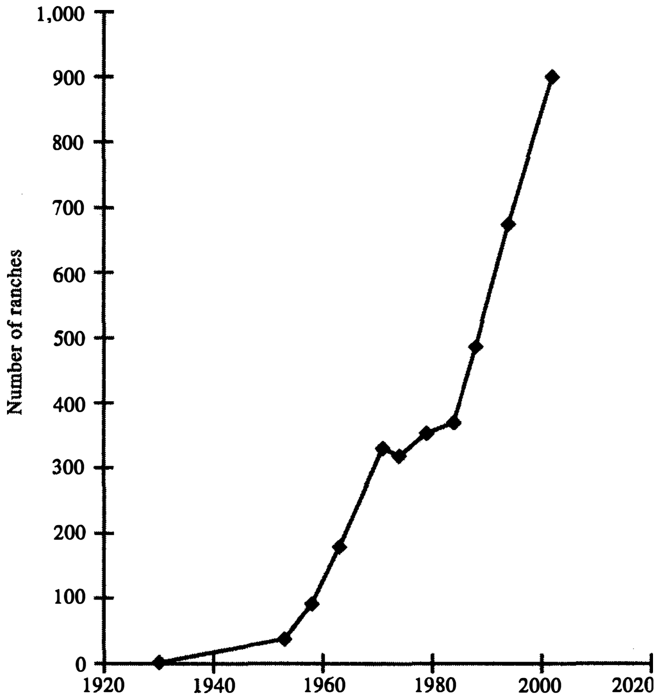
Following World War II, major changes occurred in game management in Texas. Texas landowners became more interested in the deer herd because of a relatively new and unique system of leasing land for hunting (Brothers and Ray 1975). Hunters became interested in trophy white-tailed bucks, and the value of a lease depended on the abundance of quality deer. Ranchers began to protect the female segment of the herd, but many hunters wanted only trophy bucks (Brothers and Ray 1975). During this time, there was a revolution in land use, especially exploration for energy sources and agricultural management for higher productivity. By the late 1950s, hunters could reach much of the country that had been inaccessible and hunting pressure on the deer herd increased, causing diminished abundance (Brothers and Ray 1975).

The number of exotic game ranches increased substantially in the 1950s with the advent of hunting and commercial sale of exotic stock. The desire of hunters to harvest trophy bucks also influenced exotic game ranching. Many ranchers with white-tailed deer only constructed high fences for managing trophy white-tailed deer and introduced exotic game species. As a result, several ranches began duel management for exotics and white-tailed deer. As an example, part of Friedrich's Bear Creek Ranch was sold to Eddie Rickenbacher in 1951; his son, David, supported the ranch by offering exotic trophy hunts to paying clients (Mungall and Sheffield 1994). Later, David Rickenbacher influenced the Y. O. Ranch to offer exotic game, in addition to their white-tailed deer hunting program.

The commercial success of exotic game ranches in the early 1950s caused ranchers to view exotics more for their economic worth than their aesthetic value. Landowner and hunter interests in exotic game developed rapidly. Exotic game appealed to ranchers as a substitute for depleted populations of native big game, as a way to increase the variety of game for hunting and as a method to increase production and income from rangelands using animals with varied food habits. Since hunting regulations of the state game agency did not apply to exotics, they were hunted at the prerogative of the landowner. This new capital venture of exotic game ranching caused a 60-percent increase in the number of exotic game ranches, from 36 to 90 between 1953 and 1958. This trend continued (Figure 1), and, by the early 1970s, 330 exotic game ranches existed in the state (Mungall and Sheffield 1994).

Several changes occurred in exotic game ranching in Texas during the 1960s. The Edwards Plateau Ecological Region, especially Kerr County and adjoining counties, became the center of exotic game ranching. Many ranches jointly managed for trophy white-tailed deer and exotic game. The proliferation

Figure 1. Increase in the number of exotic game ranches, 1920 to 2002



of ranches with high fences complemented the increase in exotic game ranches. Several exotic species involved in earlier releases showed unexpected hardiness when adapting to the environment. The antlers and horns of males of several species began to reach trophy size. Wildlife management on these ranches was unique and involved livestock, trophy white-tailed deer and trophy exotic species. Most ranchers realized additional income from this management system and were probably not aware of any interspecific ecological incompatibilities among these three ungulate entities.

As a result of the hardiness of several exotic species, some wealthy and influential ranchers began to import and experiment with raising super exotics (elands, kudus, oryx and other large antelopes). The motivation for stocking super exotic species was the same as in the first introduction of exotic: aesthetics and status. The super exotics were not intended initially for hunting or income production, but to add variety to existing herds of common exotics, such as axis deer (*Axis axis*), sika deer (*Cervus nippon*), fallow deer (*Dama dama*), blackbuck antelope (*Antilope cervicapra*) and several sheep species.

As market demand increased for hunting exotic game, fees charged for hunting increased, especially for trophy bucks. As a result, hunting pressure on exotic species was mainly on the male segment. Thus, herds of the most exotic species were skewed toward an abundance of females. Also the market demand for brood stock and stockers influenced the development of commercial enterprises of raising and selling exotic game.

The expansion of exotic game ranching and trophy white-tailed deer management paused from the late 1970s until the mid 1980s. Several factors contributed to this stagnation. The most important was the economic malaise in the United States during this period. High interest rates on bank loans and a general recession discouraged potential landowners from investing capital in ranching. Also, the large energy companies had substantial investments in leasing and purchasing ranches in the 1960s, and the volatility in the oil supply affected the money available for investments. The number of exotic game ranches in Texas declined by 3.6 percent (Harmel 1980a). Only the Edwards Plateau Ecological Region had a modest increase in exotic game ranches, with minimal increases in the Rolling Plains and Gulf Prairies and Marshes ecological regions.

The reduction in the number of exotic game ranches can also be attributed to the realization by some ranchers that the burgeoning populations of exotics on their land was detrimental to trophy white-tailed deer management and land management in general. The minimal harvest of the female segment of exotic populations on many ranches contributed directly to the overuse of range resources. On a number of sheep ranches on the Edwards Plateau, the interbreeding of Mouflon-Barbados sheep with domestic sheep changed the connotation of these hybrids to exotic, which altered their value for hunting purposes (Harmel 1975).

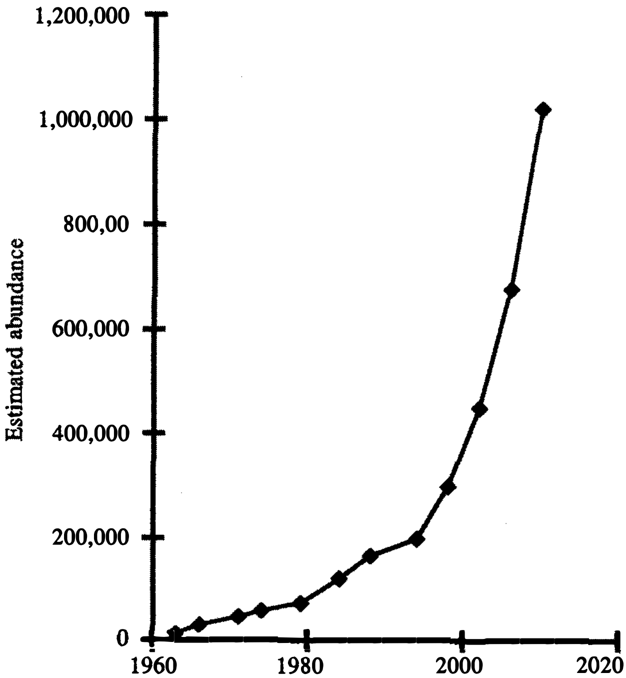
The number of exotic game ranches expanded by 24 percent, between 1984 and 1988, and 28 percent, between 1988 and 1994 (Traweek 1989, 1995). In 1984, there were 369 exotic game ranches, 486 in 1988 and 674 in 1995 (Harmel 1980a; Traweek 1985, 1989, 1994). This trend has continued unabated to the present as an exponential growth since 1980 (Figure 1), with an estimated 900 to 950 ranches in 2002. Traweek and Welch (1992) reported the average size of exotic game ranches to be 4,859 acres (1,968 ha). For 900 exotic game ranches, the total acreage would be about 4.4 million acres (1.78 million ha). A similar trend of increase has occurred in the number of ranches with high fences for managing trophy or quality white-tailed deer.

Since the mid 1980s, several factors have contributed to the expansion of game ranching in Texas. The most important was economic. Interest rates on bank loans declined and capital gain taxes decreased, making investment in ranches a more viable use of money. Since the 1980s, the education of landowners and sportspeople concerning deer management and game ranching for exotics has increased substantially. A substantial number of magazines and other periodicals addressed deer and exotic game management issues. In Texas, the Exotic Wildlife Association was an effective informant for ranchers about exotic wildlife. The Texas Wildlife Association, composed primarily of ranchers and private landowners, became active promoters of white-tailed deer and exotic game management. Texas Parks and Wildlife Department became more active in landowner assistance through a technical guidance program for landowners. The retirement of executives of corporations with money to invest led to the involvement of a new group of individuals in game ranching. These individuals were avid hunters during their working years, but their work required them to live in the metropolitan areas. Upon retiring, they sought the rural life that many had experienced during childhood. They bought smaller tracts of land than that of the traditional ranch. All or part of the tract was high fenced and stocked with exotic game. Some entered into trophy white-tailed deer management, in addition to raising exotic game. Being a private property state, many landowners perceived an intrusiveness of the government when managing their land through the Endangered Species Act. Thus, a negative attitude toward government, both federal and state, led to an attitude of wanting to be left alone by governmental agencies. Exotic game ranching was a partial solution to the problem, since the exotic game rancher did not have to conform to bag limits, seasonal rules or other hunting regulations of the state. Also during this period, several ranches began intensive deer farming using exotic species. These ranches provided venison to restaurants and the specialty food market, and they provided antler velvet to the folk medicine trade.

Population Trend

Concerns about the growing populations of exotic species in Texas resulted in an attempt in 1963 by the Texas Parks and Wildlife Department to document the status of exotic populations using a statewide survey of exotic game ranches. A population of about 14,000 animals of 13 species (Mungall and Sheffield 1994) was found. Additional surveys were conducted at about five-year intervals in 1966, 1971, 1974, 1979, 1984, 1988 and 1994. These data indicated a substantial increase in exotic populations from one survey to the next (Figure 2). Based on the estimated number of exotic animals in surveys, there was an average increase of 51 percent (S. E. = 14.78, Range 20-231) between 1963 and 1994. The last survey in 1994 showed a population of about 196,000 exotic animals, representing 71 species. The largest concentration of exotics (62 percent) occurs in the Edwards Plateau Ecological Region and 50 percent (about 40,000) of these animals are free-range. This region also has the state's largest white-tailed deer population. In the Edwards Plateau, two or more classes of livestock, plus wildlife species, graze most rangelands. This influx of free-ranging, exotic species has increased the potential for interspecific competition.

Figure 2. Increase in exotic populations, 1960 to 2002, in Texas



Personnel of the Wildlife Division have not conducted a statewide survey of exotic animals since 1994. Personal interviews with landowners, land operators and local game wardens previously provided data. Ranchers became reluctant to participate in the survey in the late 1980s. The biologists conducting surveys found many ranchers reluctant to fully disclose the information queried about their ranches in the survey document, and the data were too specious for departmental needs (Traweek, personal communication 2001). It is surmised that concerns over endangered species and other regulatory matters contributed to the lack of participation. Survey personnel reported that 51 ranches with exotics in 23 counties refused to participate in the 1994 survey. Thirty-seven (73 percent) of the ranches not participating in the survey are on the Edwards Plateau with 11 of the 37 in Kerr County, the county with the most game ranches, statewide (Traweek 1995). Many of these ranches had participated in previous surveys. With the lack of support concerning reporting information about exotic abundance and diversity, the survey to assess the status of exotic game ranches in Texas was discontinued. However, exotic game ranching continued to expand. Therefore, if one assumes the rate of increase has not changed appreciably and the abundance of animals has increased at the average rate, one can make estimate the number of exotic animals in subsequent intervals of four years. Based on this assumption, the estimated number of animals in 1998 would have been about 296,000 and 447,000 in 2002. A similar projection for 2006 would be 675,000 animals with the estimated population exceeding 1,019,000 by 2010. On lands with this estimated abundance of exotic animals, there exists a white-tailed deer population of about 4 million, a livestock population of about 14.7 million, and a feral hog population of more than 1 million.

Another important factor related to the abundance of exotic animals was the increase in free-ranging animals. The estimated population of free-ranging exotics in the 1994 survey was about 77,000 (39 percent), with 50 percent of these on the Edwards Plateau and 42 percent in the South Texas Plains. The number of free-ranging exotic animals reported in the 1994 survey was 4.5 percent greater than the 74,000 free-ranging exotic animals found in the 1988 survey.

Management Impacts and Implications

Texas has the most widespread and abundant populations of nonindigenous ungulates within the United States (Teer et al. 1993).

Historically, the Edwards Plateau was described as the most important deer range in Texas from the standpoint of land area, deer numbers, hunting pressure, deer harvested and economic return to landowners (Thomas et al. 1964). In recent years, the South Texas Plains has rivaled the Edwards Plateau as an important venue for white-tailed deer hunting because of the number of trophy deer produced on the brush-type habitat. These two regions of the state with substantial investments in white-tailed deer management by landowners and Texas Parks and Wildlife have the greatest abundance of exotic animals, not only confined on ranches with high fences but also free-ranging. Several important factors impact management for trophy white-tailed deer and exotic game species on game ranches in Texas. These are high fences, free-ranging exotics, interaction between native and exotic game species, and the Texas Parks and Wildlife's program directed toward game management.

The confinement of exotic game behind a high fence became a standard practice early in the development of exotic game ranching. A low fence was insufficient to confine animals that could easily jump a low fence, and, with substantial investment in the purchase of exotic animals, ranchers needed a high fence to restrict the movements of animals. However, the high fence also restricts the movement of native animals and possibly disrupts the dispersion of animals on a landscape, especially under condition of a small acreage. This fragmentation of habitat and distribution of animals can influence the social structure of deer herds and interaction between species. Some question the right of landowners to limit by high fences the movements and distribution of native deer that are the property of the citizens of the state. In effect, the high fence gives the impression that landowners own the native game thereby confined. Essentially, they own the exotic game contained by a high fence. The proliferation of high-fence ranches poses a philosophical question about fair chase in hunting. Several organizations (Boone and Crockett for example) do not recognize trophy animals harvested on lands with a high fence. Certainly, small acreages do limit the ability of an animal to elude a hunter. However, large ranches (if no high cross fences subdivide the land into small pastures) provide ample space for an animal to move over a substantial distance and elude a hunter.

The increasing abundance of free-ranging exotic populations is a troublesome problem for the state wildlife agency. As populations of unconfined exotic species increase, management problems will be exacerbated on an already overstocked and overgrazed rangeland. On some ranches exotic species have already displaced white-tailed deer (Butts 1979). A genuine potential for competition and displacement of white-tailed deer by free-ranging exotics has been illustrated by a unique set of enclosure experiments (Harmel 1980b, Baccus et al. 1984). The potential exists for a widespread displacement, where deer-proof fences do not confine exotic species. With the establishment of free-ranging populations, the management of exotic species presents Texas Parks and Wildlife with a unique challenge of harvesting sufficient numbers of exotic animals to control their abundance, so that the habitat and population structure of the native deer are not compromised. This can become a volatile management issue in the state. If established by data that free-ranging exotic species are causing significant harm to white-tailed deer populations, hunters will demand a swift and intensive control of exotic animals by Texas Parks and Wildlife.

In many areas of Texas, exotic ungulates have been released on private lands occupied by high-density populations of white-tailed deer (Demarais et al. 1998). Our knowledge of the patterns and processes of ecological systems suggests that a high potential exists for interspecific competition for limited resources between native deer and exotic species. The resources of any ecosystem are dynamic and limited, and the pressure placed on these resources by native species alone can be substantial. Certain exotic ungulates may have a trophic function in an ecosystem without harming native species, whereas other species have ecological similarities that make them incompatible with native species. Texas has few native ungulates in proportion to the 71 exotic species that occur. The potential for community disruption is great under these circumstances. No ecosystem can remain functional under such pressure. One has to look no further than the example of New Zealand to see the destruction, which can be caused by too many ungulates. Managing for the control of exotic species in Texas may require methods that seem radical to some. Managing for most exotic species begins the day they are released, followed by judicious cropping of all ecologically similar species (Murphy 1967, Baccus et al. 1984, Demarais et al. 1998).

The Texas Parks and Wildlife Department has initiated several programs and permits aimed at landowner assistance for managing white-tailed deer populations and habitat. Although most programs are targeted for white-tailed deer, many landowners in these programs also stock exotic game, which also benefit from habitat and population management for white-tailed deer. A brief synopsis of these programs follows.

- Managed land deer permits: Permits are issued to landowners through a Texas Parks and Wildlife-approved Wildlife management plan. Managed Lands Deer Permits allow hunters to take additional deer and hunt during an extended season.
- Landowner-assisted management plan permits (LAMPS): Permits are issued to landowners with a landowner assisted management plan. LAMPS permits allow antlerless deer to be taken in an otherwise buck-only season.
- Private lands enhancement program: The goal of the Private Lands Enhancement Program is to provide expertise to land managers in the preservation and development of wildlife habitat and the proper management of various wildlife populations using that habitat. Through this effort, the department hopes to slow or reverse the decline in quantity of wildlife habitat and improve the quality of remaining habitat.
- Texas big game awards: The purpose of the Texas Big Game Award is to preserve the hunting legacy for future generations, to promote awareness about wildlife management and the role that hunting plays in habitat conservation, to foster cooperation among stakeholders and to ensure that the state's wildlife habitat is conserved forever.
- Triple-t permit: Permits give land managers additional flexibility for managing white-tailed deer populations on properties where traditional practices do not achieve desired goals. As the name implies, the program provides guidelines for trapping white-tailed deer on private property, transporting deer to other locations and releasing the animals.
- Deer management permit: Permits allow landowners, with a property surrounded by a high fence capable of confining deer to trap deer on that property, to retain the deer for breeding purposes, and later release them on the same property.
- Scientific breeders permit: This permit is issued to a qualified person to possess white-tailed deer or mule deer for propagation, management and scientific purposes. Only white-tailed deer and mule deer that are in a healthy condition may be offered for sale, barter or exchange by a scientific breeder.

Since the first introduction of exotic game, there has been a continual increase in the abundance of exotic and native animals on the land. The ranches involved in game ranching in Texas today are many. For most ranches, these animals were a supplement to the domestic livestock that already occupied the land. The ecological literature is replete with warning about exotic animals and interactions with native species. What will be the outcome of the situation in Texas? Will we learn from past mistakes or repeat history? The intelligent use of living resources by man must be based on a thorough understanding of the total ecology of the community involved (Murphy 1967). We can only hope that, in the desire by landowners to obtain maximum yield from the land through game ranching and traditional ranching with livestock, they do not cause a decline in diversity and abundance of native wildlife.

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The Federal Role in Regulating Alternative Livestock Operations

Jose R. Diez
US Department of Agriculture
Fort Collins, Colorado

Mike Gilsdorf
US Department of Agriculture
Riverdale, Maryland

Robert Werge
US Department of Agriculture
Fort Collins, Colorado

Introduction

This paper discusses one aspect of federal regulation for alternative livestock, namely that concerned with the health status of animal agriculture. Federal responsibility for animal health programs rests with Veterinary Services (VS), a unit of the Animal and Plant Health Inspection Service (APHIS), an agency of the United States Department of Agriculture (USDA). The objective of this paper is to briefly describe three aspects of VS' policy that have a potential to impact alternative livestock as well as free ranging wildlife. These are (1) using cooperative state-federal programs to eliminate diseases in alternative livestock, (2) collaborating on health issues with a variety of federal and state agencies, and (3) reducing the risk of disease transmission between traditional or alternative livestock and free ranging wildlife.[1]

The Changing Context of Animal Disease Management

Historically, VS primarily has focused on the health of traditional domesticated livestock, such as cattle, sheep, swine and horses. Over the past several decades, this focus has broadened. This expanded focus is the result of many factors. In the context of this symposium on game farming, two of these factors are worth noting.

The first is a rapid expansion of alternative livestock farming. The American bison industry is continuing to experience rapid growth after growing from 30,000 head, in 1972, to 250,000 head, in 1997. Exotic hoofstock in Texas has grown in 30 years from 37,500 to 198,000 animals. Elk and deer farms have expanded, along with farms raising llamas, alpacas and other nonnative species (Kopral et al. 2000). Much of this growth has been fueled by the desire of small and medium scale producers to move toward higher value animals to fill new niche markets.

While some alternative livestock producers experienced classic boom and bust cycles, others have experienced steady growth and have established organizations representing their interests at local and national levels. Such organizations, like the North American Elk Breeders Association, the North American Deer Farmers Association and the National Bison Association are essential for the management of animal health programs. Cooperation by producers in the execution of disease regulations is an essential element in their success.

The growth of the alternative livestock industry is itself part of the second factor for change; the evolving role that animals play in the American economy and society. At one time, there were clear distinctions in popular culture between domestic livestock, free-ranging wildlife and household pets. Species could be neatly assigned to each category. Each category, in turn, had its own management systems that were usually reinforced by the authority of public agencies. Thus, free-ranging wildlife species were regulated by states to maximize hunter yield; livestock owners were regulated by federal and state agencies for health and marketing concerns; pet owners were regulated by health and welfare codes.

These cultural boundaries now are blurred more. The phrase, alternative livestock, is an indication of that blurred line. Another indication is the transformation of exotic free-ranging wildlife into pets. The American Pet Products Manufacturers Association notes there are 9 million pet reptiles in 3.6 million American homes (Derr 2002). There are thousands of wild mammals, including lions, wolves and primates, in private hands or collections. It is estimated there are 10,000 privately owned tigers in the United States, dwarfing the 200 or so kept by zoos (Peterson 2002).

Another change is the industrialization of livestock production, probably most advanced at this point in the poultry and swine industries. These food animals are raised in climate-controlled, mechanized surroundings that are indeed factories in every sense of the word. At the other extreme, some farms that continue to have small numbers of traditional barnyard animals have become bed and breakfast destinations so that paying urban visitors can experience the presence of these animals in their natural setting. Also building upon the motif of selling experiences rather than products, hunt farms sell the adventure of hunting animals within an enclosed private setting.

These changes produce conflicts between individuals and groups that respect animals, often particular species and the manner in which they should be managed. The title of this symposium, *Game Farms: Boon or Bane?*, assumes that the question can be answered, again utilizing values and statistics. This paper does not answer that question, but rather seeks to shed some light on the manner in which VS in APHIS attempts to address disease issues in this changing environment.

Using Cooperative State/Federal Programs to Eliminate or Control Diseases in Alternative Livestock

VS' responsibility for the health of animal agriculture includes those animals, such as elk, deer, bison, etc., that are held under ranching or farming management regimes for the purpose of commercial agricultural marketing. VS is particularly concerned with high risk diseases shared with other livestock species. For any disease control effort to be successful, however, state agencies must take a primary role and stable organizations of producers must be willing to take action.

It should be noted that federal statutory authorities for animal health issues are extremely broad and include all animals. However, federal authorities are primarily confined to regulating animals that are involved in interstate movement. State agencies generally have much broader authority to regulate practices on the farm. Thus, national animal health regulatory programs, such as for pseudorabies, brucellosis, tuberculosis, etc., are always cooperative state and federal endeavors.

In these programs, VS provides a mechanism, along with funding, for linking disease control efforts in the states to a set of federal standards. Attainment of a health status level by a state within those standards permits that state to move animals in or out of states at an equivalent level. The development of these cooperative state-federal programs, in close partnership with involved industries, is the key mechanism for federal regulation of animal health issues.

Results of cooperative programs that have dealt with alternative livestock include:

- elimination of brucellosis from most farmed bison herds in the 1960s,
- inclusion of captive Cervidae in the tuberculosis eradication program in the 1990s,
- inclusion of reindeer in the brucellosis program, as a response to the reintroduction of disease through contact of Alaskan reindeer herds with free-ranging caribou, and
- elimination of tuberculosis from farmed bison herds in the 1980s.

Currently VS, state departments of agriculture, departments of fish and game and other groups have developed a proposed cooperative program for chronic wasting disease (CWD) in farmed elk. To date, this program has received limited funding from Congress and has just passed the federal regulatory process. USDA has been able to provide indemnity for all known positive herds through emergency funding.

Collaborating on Health Issues with Other Federal and State Agencies

National animal health programs are inherently cooperative federal and state efforts. This cooperation has a long history of close, if sometimes stormy, relations. Extending these ties of collaboration on diseases to other state agencies having jurisdiction over alternative livestock or free-ranging wildlife is an essential part of VS' strategy.

In the past, such collaboration has been inhibited by a number of factors. The first, as related to alternative livestock, is the variety of state jurisdictional patterns that exist. In almost all states, farmed bison are classified as livestock and are subject to the same regulations as cattle. One exception is Hawaii where bison are classified as exotic. Work with farmed bison, subsequently, has proven to be relatively easy to accomplish.

In the case of farmed cervids (elk, deer), however, 25 State departments of agriculture have jurisdiction, 19 state departments of fish and game have jurisdiction, and six states have shared responsibility. Many state departments of agriculture have some regulations for importing cervids, but most do not continue to regulate the animals after they have entered the state. Relations between state departments of agriculture and departments of natural resources are often at odds. Producer groups may be poorly organized or in denial of disease issues. The difficulty of developing the correct collaborative linkages, one state at a time, can cause slow progress, when addressing cervid health issues.

In terms of diseases shared with free ranging animals, a second factor limiting collaboration is the lack of a consistent ideology guiding their management. A 1999 collection of articles on wildlife management highlighted deep divisions over policies, such as natural process management and management for population size, among adjacent public land agencies (Huff 1999, Porter 1999). These differences extend into disease, which can be seen as a part of the natural process and as something to be controlled. Such deep ideological differences are evident in the case of brucellosis in Yellowstone National Park over the past decade.

A third factor lies in the divergent value systems of constituent groups whose economic and political interests are involved with free ranging wildlife or traditional or alternative livestock. In some cases, these interests are very concrete. Free ranging wildlife, in terms of hunting or viewing, may represent a higher economic value to a local community than raising traditional or alternative livestock. These interests may lead to conflicting approaches for solving animal disease problems affecting animals under different management regimes.

VS has taken a number of steps to strengthen its connections for cooperative action across this ideological and jurisdictional spectrum. Participating in symposia and forums like this is one aspect of that approach. Others include:

- Ongoing collaboration with the Southeastern Cooperative Wildlife Disease Study (SCWDS) for their disease expertise on free-ranging wildlife and livestock.
- Creating closer ties to Wildlife Services, another program unit within APHIS that is currently conducting large scale wildlife rabies-control programs in several regions of the United States.
- Developing wildlife liaison positions to work with wildlife agencies on disease issues affecting both livestock and wildlife.

- Collaborating with wildlife agencies on CWD diagnosis and surveillance of free-ranging cervid populations inside and outside of the endemic area in Colorado, Wyoming and Nebraska.

Collaboration between VS and various State jurisdictions is currently most apparent in work on bovine tuberculosis in Michigan, where the disease has been found in cattle, free-ranging deer, deer on hunt farms and other free-ranging species. A joint strategy is evolving to deal with that situation involving APHIS' VS, the Michigan Department of Agriculture, the Michigan Department of Natural Resources, Michigan State University, APHIS' Wildlife Services and other agencies. While relations between these groups have, at times, been tense and conflictive, cooperation has resulted because it is clear that any solution to this disease problem will only come from a joint, coordinated effort.

Reducing the Risk of Disease Transmission between Traditional and Alternative Livestock and Free-ranging Wildlife

Through cooperation, VS policy aims to reduce the risk of disease transmission from free-ranging wildlife to animal agriculture. Several factors are currently combining to raise the significance of this approach and, at the same time, to shift the manner in which it may be implemented. One factor is the United States' success of, largely, eradicating significant diseases from its livestock, including alternative livestock populations. These include diseases, such as brucellosis, pseudorabies and tuberculosis. As livestock populations have become free of these diseases, the risk of disease transmission back to them through reservoirs in free-ranging wildlife has increased. This is apparently the case in Michigan with tuberculosis, and it is the concern that drives the controversy surrounding brucellosis in the greater Yellowstone area.

A second factor comes from an international animal trade principle–compartmentalization–which is growing in importance. A country may be considered to be free of a disease if it has been eliminated from its livestock population. But in that country, the disease may remain in a reservoir in its free ranging wildlife. In this case, the country's free status is conditional upon its taking steps to compartmentalize the disease and reduce the risk of its transmission back into livestock. The nature of those steps is not specified, only that their result should reduce or prevent the risk of reintroduction.

There is an irony in this situation, which should not be lost. Many of these diseases are in free-ranging wildlife because they were originally transmitted to them from livestock. Irony aside, the fact remains that in a rapidly changing global environment, health status across species is increasingly intertwined. Probably the most graphic example of this is the emergence of zoonotic diseases, like West Nile Virus that interacts across bird, horse and human populations in new and complex ways.

When researching diseases across species and management regimes, VS and other cooperators have carried out a number of activities that aim to understand the types of disease transmission that occur and how the incidence of transmission can be reduced. Some examples include the following:

- VS has worked with SCWDS, since 1978, to survey disease relationships between animal agriculture and free-ranging wildlife, especially regarding outbreaks of foreign animal diseases. These have included Exotic Newcastle Disease, Heartwater and African Swine Fever, and other diseases.
- APHIS' Wildlife Services and state agencies are studying the ecology of bovine tuberculosis in free-ranging wildlife species in Michigan.
- Surveillance efforts have been conducted on migratory birds, since the 1980s, for avian diseases that have the potential for transmission to poultry. That work is currently being expanded.
- Pilot projects on feral swine have been conducted, since the 1990s, in Florida, Texas, Georgia and California, with state agencies and the help of SCWDS and Wildlife Services. The focus of these projects has been on intervention strategies for pseudorabies and brucellosis.

Because transmission is a two-way street, VS is looking for additional partners in the wildlife community to study disease interactions and patterns. Emerging diseases, such as CWD, potentially have a tremendous impact upon both livestock and free-ranging wildlife populations, as well as upon those who depend upon these populations for livelihood and recreation. There is a great need to both understand and provide solutions that safeguard the health status of all.

Conclusion

This paper has presented a brief overview of three aspects of VS' role in developing regulatory programs to safeguard the health status of animals.

These programs and related activities occur in a rapidly changing environment, altering patterns of animal management, disease and cooperative activity. This paper described three aspects of VS' approach to alternative livestock and free-ranging wildlife: development of cooperative state and federal programs, collaboration with natural resource agencies, and reduction of the risk of disease transmission between free-ranging and farmed populations. These aspects lay the foundation for a broader cooperative effort to improve the health status of animals in this country.

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Endnotes

1. In this paper, free-ranging is always used in connection with wildlife to denote animals that are managed under natural conditions without the confines of a fence, usually by public entities.

Status and Management Implications of Captive Cervid Farming in the Northeast

John M. Buck
Vermont Department of Fish and Wildlife
Barre

Introduction

My vision of a ranch is a place where land and cattle combine to extend beyond the horizon, and it evokes a vision of the western landscape that, at one glance, symbolizes the rugged entrepraneaurialism that settled that land more than 150 years ago. A farm, on the other hand, causes this New England boy to think of a dairy operation on 300 acres of woods and fields that supports 75 milking Holsteins. In reality, ranching and farming only seems to be different on the outside, as they both are means of combining land management and animal raising for a profit. This is not a new concept; humans have made use of a variety of animal species for thousands of years. However, when we analyze this evolution, we find that approximately a dozen animal species have maintained their favor with humans. Some of the common mammals in western cultures are cattle, horses, dogs, sheep and goats.

Jared Diamond, in his book *Guns, Germs, and Steel*, reported that humans have spent centuries identifying and domesticating species that best lent themselves to providing work, food and protection. He postulated that it is why cattle and hogs have proliferated, and, although very edible, elephants and alligators have not. The deer family (*Cervidae*) seems to lie somewhere closer to the elephants than to the cattle. Although some Nordic cultures have made use of reindeer (*Rangerfer terrandus*) for many centuries, deer generally have never flourished as a domesticated species. This probably is due to the combination of their powerful athletic bodies and their high-strung personalities, making them difficult to approach and confine even after generations of careful breeding. However, as many traditional farms in the northeast, and elsewhere, faced the prospect of competing with real estate land values and declining milk and beef prices, alternative agricultural uses of the land become more inviting.

Although not raised as a dairy species, cervids provide a variety of products. Their uses include, meat, antler products—such as hunting trophies and aphrodisiacs—and breeding stock. Depending on the prevailing market value, these products can be very lucrative to the owner. In 1999 for example, prices for antler velvet ranged between $30 and $125 per pound. Top selling, bred elk cows ranged between $9,500 and $16,000, and, at the 1999 Colorado Select Elk sale, straws of semen sold at prices that ranged between $450 and $1,150 (Whittlesey 1999). Finally, canned hunt prices vary. A review of Internet advertisements indicated a range of prices between $2,000 and $14,500 could be expected, depending on criteria such as the payment of a harvest fee or the preferred antler development of the selected animal, such as its Boone and Crockett score. Unfortunately, given this potential for a substantial profit, ill-prepared or marginal individuals are attracted to the industry. This in turn gives rise to standardization through regulation by state and federal governments, as they are called upon to protect human safety, existing domestic livestock operations and the public wildlife resource.

Status in the Northeast

To assess the extent of cervid farming within the northeast and differences between the states and provinces, each jurisdiction was contacted through the Northeast Deer Technical Committee Network. Through e-mail correspondence, telephone conversations and scattered publications, I compiled a matrix of the extent of captive cervids and each state's level of oversight.

One interesting fact was the presence of captive deer, in one form or another, in the northeast for nearly 100 years. For example, in Rhode Island, where deer are likely to be part of someone's private estate (Suprock, personal communication 2002). In Maryland, at the turn of the 20th century, Sika deer (*Cervus nipon*) were added to the variety of the North American continent. They escaped, adapted to the surrounding landscape and have lived in the wild ever since (Hotton, personal communication 2001). Other examples can be found in nearly every other state.

Disease issues were the most readily identifiable issue among those who responded. Tuberculosis (Tb) and Foot and Mouth Disease (FMD) were pointed to quickly as having, or likely to have, an impact on the wild deer resource. Chronic Wasting Disease (CWD) was most often identified as causing the greatest impact to wild deer because of the many unknowns associated with this disease. Other diseases, such as those caused by parasites, were also of concern.

Other captive cervid issues facing wildlife professionals that are difficult to quantify include habitat loss and free movement of wild animals through restrictive high fencing and vegetation and captive hunt operations. High fencing has emerged as an issue in several northeast states, but not as prominently as in Virginia, where wildlife officials have outlined the dangers to the resource and the public's interest in that resource. Wildlife agencies have also been quick to recognize the breach of hunting ethics as captive hunts are blended with the hunting of free-ranging cervids in the public's mind. However, when qualitatively evaluated against personal preference or private property rights, the realm of ethics becomes clouded and often dismissed during regulatory deliberations, as has been Vermont's experience.

The geopolitical makeup of the northeast states and provinces is a patchwork of small, individual governments, each with sovereignty within their respective boundaries and each with a unique history of captive cervids. The result has been regulations and responsibilities that vary with each jurisdiction. However, every jurisdiction permits captive cervids to some degree. For example, Virginia, with the backing of the Cattle Ranchers Association, the United States Agriculture Department (USDA) and the fish and wildlife departments, has been able to eliminate all but two deer farms in the entire state. In contrast, New York not only permits deer farming, it permits the possession and sale of native white-tails. This is done under the auspices of The Fish and Wildlife Department (FWD) of New York, although wildlife managers take a dim view of the practice. Oversight responsibilities also differ from state to state and province to province. In Massachusetts for example, the FWD is solely responsible for importation permits and for inspection of facilities. However, there are no personnel designated for this duty, and it falls, by default, onto the deer project manager's shoulders. Connecticut does have a person specifically hired to oversee all captive cervid permits and inspections. Where Massachusetts and Vermont specify which cervids may be imported and held captive, Connecticut makes no specification.

In Vermont, captive cervids, specifically red deer (*cervis elaphus*), reindeer and fallow deer (*Dama dama*) are defined by law as domestic in the same way as cattle (*Bovis*) and sheep (*Ovis*), and regulations governing importation and captivity are under the sole jurisdiction of the USDA. But, captive species held for hunting, such as elk (*cervis elaphus*) or pheasants (*Phasianus* spp.) are defined as wildlife and are under the jurisdiction of the

FWD. Personnel from their respective departments are responsible for permit and facility inspection. This pattern of shared responsibility seems to be the most common means of regulation. In New Brunswick, yet another variation occurs. The provincial FWD oversees all aspects of game farming operations, except when human health issues (food safety) are involved. In these cases, the USDA, *Agriculture Canada*, has responsibility. Table 1 summarizes the status of deer farming in the northeast states and provinces.

Concerns

Though standardization may be achieved within a state, regional consistency, relative to issues of concern, is not when considering the small size of most northeast states and their juxtaposition on the continent. This does not include the political layer of the promise of another countries' border, adding provincial and national layers of jurisdiction. By comparison, the area of the six New England states is approximately two-thirds that of the state of Wyoming. When Wyoming is added to Colorado, Nebraska and South Dakota (the area roughly where CWD is identified) the land area is 1.5 times that of all of the 13 northeast states combined. If there is any place for the concerns of disease transmission, habitat loss and escape, the small confines of the northeast would seem to be the most problematic.

However, monitoring and regulation enforcement within each northeastern state may be made easier due to the fact that the average farm size is much smaller than that found in the Mid-west and the West. In Vermont for example, all farms have an average of 217 acres and a median size of 140 acres (US Department of Agriculture 1997). Deer farms range in size greater and smaller than this average, although statistics for such are not kept. In Nebraska by contrast, all farms average 885 acres with a median of 378 acres (US Department of Agriculture 1997). The ratio of landowners to land area would be an important factor when administering any educational or regulatory actions. Working with the fewest number of people would ensure greater compliance and greater efficacy for the greatest number of acres.

Along with the difference in farm size is the difference in human population density. As densities increase so do varieties of public opinion towards holding animals in captivity. Many studies have suggested that Americans are not opposed to using animals for work, food or educational value (Kellert 1980). However, holding animals captive for the purpose of

Table 1. The status of selected northeast state and provincial captive wildlife operations and regulations.

State	Captive cervids allowed?	First year	Maintenance	Purpose	Other captive wildlife?	Costs to deaprtment	Future interests or issues	Number of farms
CT	Yes	Cir. 1960	Department of Agriculture	Research, education, rehabilitation farming	None	Special position for animal management	Fencing large acerage for elk, nothing to prohibit hunting	Unknown
ME	Red deer, elk, fallow deer, Sika deer, white-tailed deer	Mid-1980s	Department of Agriculture, Fish and Wildlife Service (for natives)	Livestock, venson breeding, antlers exhibition, rehabilitation	Camels, bison, pheasants	Regional, biologist (wild deer only) animal welfare group	Prevention of disease	Several dozen
MD	Fallow deer, white-tailed deer, feral deer, Sika deer (since early 1900s), reindeer	Unknown	Department of Natural Resources, Department of Agriculture	Grandfathered facilities, zoos, exhibition, rehabilitation	Bison, quail, ducks, pheasants	Department of Natural Resources permit, co-ordination, police for inspection	High-fenced acerage loss, alternative agriculture	Unknown
MA	Sika deer, fallow deer, red deer, reindeer	Cir. 1955	Fish and Wildlife Service	Propogation, venison, education, zoos, exhibition	Pheasants, quail, partridge, bison, sheep, fox	Annual permit admin-istration facility inspections	Venison and breeding	20-25
NB	Fallow deer, red deer, elk, white-tailed deer	Cir. 1980	Department of Agriculture (Canada, diseases, State Fish and Wildlife Service (species and fencing regulations)	Zoos, antlers, propogation, venison, parks, game farms, rehabilitation	Pheasants, mallards	Cost to big game pro-gram, re-garding monitoring and compliance	Wildlife trade, diseases, wildlife behind fence	Unknown

Table 1. (continued)

State	Captive cervids allowed?	First year	Maintenance	Purpose	Other captive wildlife?	Costs to department	Future interests or issues	Number of farms
NH	Elk, caribou, reindeer, fallow deer, Sika deer, elk	1992	Department of Agriculture, Fish and Wildlife Service	Venison, velvet antlers, propogation, education, exhibition, hunting (grandfathered)	Quail, pheasant, chuckar, boars	Greatest amount of wildlife regulations, regular inspections	Canned hunts, possession of native deer	10-15
NY	White-tailed deer, fallow deer, elk, red deer	Unknown	Department of Agriculture, Fish and Wildlife Service	Estates, propogation, venison, research, education, rehabilitation		Special license unit, fencing standards	Illegal transport unknown facilities, disease	130
RI	exotic deer	Cir. 1956 (USDA), Cir. 1997 (FWS)	Department of Agriculture, Fish and Wildlife Service,	Estates, propogation venison, research, education, rehabilitation	Quail, pheasant, chuckar	Permitting, inspections, escapes	Disease transmission	Unknown
VT	Red deer, fallow deer, reindeer	1986	Deaprtment of Agriculture, Fish and Wildlife Service	Venison, velvet, antlers, propogation, rehabilitation exhibition	Goats, sheep, boars, game birds, hares	Staff for import permits, legislative input	Canned hunts, high fences, possession of native deer, disease prevention	50
VA	Fallow deer (permit only)	Cir. 1988	Fish and Wildlife Service	Venison, propogation	Goats, sheep, boars, game birds	Staff to monitor	High fences to possess native white-tails	2

hunting is not held in high regard by most Americans. As public opinion mounts in one direction, our state and provincial management agencies are often caught in the middle of ensuing legislative debates.

The Vermont experience. To illustrate the many contingencies a jurisdiction may face due to the presence of farmed cervids I will present those experienced by Vermont. With the exception of a remnant captive white-tail held, captive cervids were nonexistent and exotics of other species were very rare. Our current issues began in 1986 when legislation was passed permitting the transport and possession of fallow deer. This legislation was not supported by the FWD, due to the disease and escape threat to native deer (*Odocoileus virginianus*). The outcome was largely due to the promotional efforts of the agricultural community to broaden the alternative agricultural uses of marginal dairy farmland. Regulatory jurisdiction rested completely with the USDA, including health certificates, fencing standards and facility inspections. In 1990, red deer and reindeer were added to the list of domestic deer species. Both species were added over the objection of the FWD. Given the lucrative financial prospects alluded to earlier, deer farming quickly spread to 51 farms in the late 1990s (Johnson, personal communications 2002). As of 2002, even in the face of declining venison prices and drastically reduced Asian markets for antler products, the total number of farms known to the USDA remained at about 50. An accurate count is not available but the static total is due, in part, to an ongoing quarantine for Tb and a lack of a realistic means for liquidation of the remaining standing herds.

A new prospect has emerged giving Vermont deer and elk farmers hope for profit on their investment, and that is captive hunting. Currently, stringent regulations administered by the FWD permit only certain exotics to be hunted behind a fence (e.g. boars and sheep) and does not include any Cervid family members. However, legislation passed in 2000 directed the FWD to develop standards by which captive hunts, including cervids, shall be permitted. Much time and energy has been expended in the ensuing two years by FWD personnel to develop standards that will provide, first and foremost, maximum protection to native wildlife species. Currently, there exists a dichotomy in the fencing and capture standards required for captive cervids held for farming purposes, administered by the USDA, and for those cervids potentially held for hunting purposes, administered by the FWD. Proponents of the captive hunt facilities argue that it is a double standard for the state to permit red deer to enter the state under one standard but apply a different standard to convert them to shooter status. Opponents claim that the importation and fencing standards are not stringent enough, nor are the existing standards enforced (lack of staff and funding) with the regularity necessary to be affective and, therefore, the FWD is justified when setting a higher standard of protection. Meanwhile, issues, such as habitat conservation and environmental education, do not receive a proportionate amount of FWD staff time as the captive hunt issue simmers.

Future concerns for and implications of cervid farming in the Northeast

Despite the many varied histories and current conditions among the northeast states and provinces, one theme that consistently ran through the conversations with each deer management project leader was the threat of disease transmission to native cervids. This concern is especially troubling, as there is no reliable test for Tb or CWD. In fact, not only is there no live test for CWD, there is no definitely known mode of transmission from one animal to another. Information about this disease is rapidly being collected, but new cases continue to emerge. For better or worse, CWD appears to have stopped interstate transport of cervids, and disease concerns in the northeast may be on hold. Furthermore, Tb and brucelosis tests for cervids are actually borrowed from those used for domestic cattle. Their reliability, therefore, is less than that intended for cattle.

There is also a potential for free-ranging cervids to transmit disease to captive cervids. The giant liver fluke (*Fascioliodes magna*) is a natural parasite of and coexists in white-tails, yet it can be fatal to elk, fallow deer and Sika deer. Also potentially damaging is the presence of the endemic meningial worm, *Parelaphostrongylus tenuis*. It resides in eastern white-tails benignly as a natural host, yet it is fatal to other cervids, most noticeably moose (*Alces alces*), but also elk. If white-tails are regularly transported from east to west, the risk of transporting this parasite to western white-tails and other cervids is significant. The potential for conflict over native deer densities, and parasite-free cervid farms would increase as demands for abundant wild deer are made by hunters and as deer farming advocates press for broad markets. Both have the potential to proliferate the foreseeable future.

A concern in several states is that of high fences on private property designed to contain certain species, namely white-tails. Two questions arise from high fences, the first being public access to a public resource. As the wildlife movement becomes more privatized, where access is gained by a fee, what will become of the North American Wildlife Management Paradigm? The second question is what are the ecological consequences for preventing the free exchange of genetic material and for local habitat quality as deer are prevented from living on their self-selected range? There does not appear to be an easy answer, as courts have ruled in favor of both advocates for the possession of wildlife and for the public ownership and state custodian model (Chase 1998).

Another concern is the fate of the standing cervid stock in the northeast while markets for their products remain depressed. Will governments become financially liable for lost income if farmers are forced to liquidate? This has been true when disease has forced depopulation. Will some farmers be tempted to leave the gate open to rid themselves of ongoing food and health bills?

Summary

In a time when instant gratification is fueled by commercial gain and when magazines featuring big antlered bucks are placed against the backdrop of a society furthering itself from the natural world through suburbanized conversion of the landscape, the fate of the free-roaming, self-sustaining wildlife population is seriously jeopardized. What shall become of the North American wildlife management paradigm envisioned by Teddy Roosevelt and championed by such notable contemporaries as Jim Posewitz and Shane Mahoney?

History is replete with accounts of wildlife populations succumbing to commercial, human use. One only has to recount the sad history of the passenger pigeon (*Ectopistes migratorius*) to understand the effects of commercial hunting on a species. When Theodore Roosevelt was born (1858), there were about 10 Americans and 17 buffalo per square mile in the United States. When he became president 43 years later, there were about 25 Americans per square mile and only about 40 buffalo remaining in the entire country, all in what is now Yellowstone National Park (Jahn 2000).

The success of the wildlife conservation paradigm rests entirely on the principle that these resources are publicly owned and access and custodial responsibility are shared in common trust. When one considers the potential consequences to native wildlife from high fences, disease transmission and pay-per-hunt facilities, it is at the heart of the conservation movement. This tradition was based on inclusiveness and has been successful because of it (Mahoney 1998).

Respect for wildlife comes from the emersion of oneself in the life of the animal, what Roosevelt referred to as the strenuous life. Honor and fair chase were manifestations of his postulation. Can respect for wildlife and oneself be garnered by associating with wildlife held behind an enclosure? Does one's encounter become a matter of skill, animal husbandry or economic position (Posewitz 2001)?

Given the high level of financial investment, the political advocacy and the prospect for profit, it would appear that cervid ranches will remain on the northeastern landscape for some time to come. It is also likely that wildlife management agencies will continue to work to do what is necessary to protect the ecological and public interest in their respective native cervids (and all wildlife for that matter). Therefore, it would seem the best means to reconcile these management differences and to provide the most consistent regulatory framework would be to ensure states and provinces continue to maintain good working relationships with their respective advocates and to maintain good working relationships with their neighboring states and provinces.

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Closing Remarks

Ronald J. Regan
Vermont Fish and Wildlife Department
Waterbury

First, I would like to extend thanks to our presenters this morning. I think they have acquitted themselves well, in terms of presenting data, offering insightful perspectives and challenging us with both the reality and the complexity of sorting through this particular wildlife conservation issue. And, I truly believe this is a wildlife conservation issue–one that cuts to the heart of the historical, philosophical and successful presuppositions of North American wildlife management, not to mention the legitimate concerns for wildlife health, habitat availability and hunter access–all of which have been touched on by our presenters this morning.

I began my career over 20 years ago, working with white-tailed deer. Nearly 15 years ago, I had my first professional exposure to the concept of "farming cervids." Though my department and I had reservations about this practice becoming legal in Vermont, it appeared there were sufficient safeguards for us to accede to the idea, at least for the sake of alternative agriculture, if not be an advocate for it. On a personal note, I remember the graciousness of Dr. Geist helping me, over the telephone, to understand better red deer and elk taxonomic considerations as well as behavioral and anatomical distinctions.

Over the years, however, I have become increasingly uncomfortable with the possession and interstate movements of domestic or wild cervids, especially for shooting purposes, for all of the reasons articulated this day. But, I know from experience that game ranching or farming is not necessarily an easy issue to untangle or address. Property rights and fair chase considerations, for example, often create uncomfortable conversations, some of which we may not be adequately prepared to address in the public arena.

More to the point, I hope our profession has the resolve or conviction to remain fully engaged in this issue from a biological, land use, regulatory and philosophical perspective. Given the press of habitat degradation, the shrinking stewardship resources for public lands and facilities, overabundant wildlife populations, and the restoration of threatened and endangered species, some might ask, "Should we even be in involved in this issue?" Or more pragmatically put, "Should not the agricultural community take the lead on this issue?" To both, I must answer "no" and suggest that nothing less than steady leadership by state and provincial fish and wildlife agencies is mandated by the complexity and importance of this issue.

I am grateful to The Wildlife Society for sponsoring this session and to each of you for participating in it. Your participation, in fact, gives me hope that we–biologists, ecologists, policy makers and administrators–will collectively work towards solutions and safeguards that can only benefit our public wildlife resources and the ethical hunting heritage of our forefathers.

Special Session Five.
Energy and Conservation: Does Big Oil Mix with Big Game?

Chair
Fred Lindzey
University of Wyoming
Laramie

Cochair
Len Carpenter
Wildlife Management Institute
Fort Collins, Colorado

Opening Remarks

Fred Lindzey
University of Wyoming
Laramie

The impetus for this session stems from frustration felt by wildlife managers facing increasing levels of energy exploration, development and extraction activities. Wildlife biologists are seldom consulted before decisions are made to explore for or develop energy resources. Rather, they are called upon to help minimize potentially negative effects of development after decisions to proceed have been made. Entering the planning phase for developments after the decision to develop has been made often casts the biologist in an obstructionist role, an uncomfortable position exacerbated by the paucity of information available from which to construct mitigation plans. Changes resulting from energy development, undoubtedly, will influence wildlife populations, yet little is available to support inferences about the degree of population-level effects or the best way to address possible impacts. Understanding the population-level effects of disturbances, such as those realized during energy exploration and development requires more than the short-term, observational studies biologists now have to rely on.

We have taken liberty with the title of this session, *Energy Conservation: Does Big Oil Mix With Big Game?*, by including birds to illustrate that potential problems are not unique to the more visible and simply well-known wildlife species. Our intent with this session was to not repaint the perceived problems associated with developing energy resources in wildlife habitats, but to sketch a broad view of the working environment of the wildlife manager. The potential scale of energy development activities will be illustrated by the distribution of identified and probable reserves in North America. Discussion of pertinent laws and regulations will identify the legal sideboards within which federal agencies, state agencies, industries and conservation organizations must operate. Problems faced by industries as they attempt to develop energy reserves on public lands, something many of us have not heard or have chosen not to hear, will provide an insight into how industry views wildlife mitigation measures. Lastly, descriptions of mule deer, pronghorn and sage grouse populations in areas with energy development will illustrate the breadth of the difficulties faced by managers of these populations.

Overview of Hydrocarbon Production, Consumption, Reserves and Potential, at World and Local Scales

Mitchell E. Henry
US Geological Survey
Lakewood, Colorado

Debra Higley
US Geological Survey
Lakewood, Colorado

Statistics on Hydrocarbon Production, Consumption, Reserves and Resources at World and Country Scales

Oil and Gas Production, Reserves and Consumption

Hydrocarbon (oil and gas) production and consumption, along with remaining resources, are irregularly distributed across the world and within countries. Daily world hydrocarbon production, in 1999, was 72.6 million barrels of oil (mbo) and 232 billion cubic feet of gas (bcfg). Daily average production in 1999, for North America, was 14 mbo and 71.7 bcfg, and, for the United States, it was 8.1 mbo and 50.9 bcfg. North American average daily consumption for 1999 was 23.4 mbo and 71.5 bcfg. The United States produced 42 percent of the oil and 85 percent of the gas it consumed in 1999. Onshore federal lands in the United States account for 29 percent of the land area, but contribute only 5.1 percent of oil and 8.8 percent of gas produced in 1995.

As of January 1, 2000, world reserves were reported at approximately one trillion barrels of oil and about 5,200 trillion cubic feet (tcf) of gas. Most of the world's oil reserves are located in the Middle East (nearly 66 percent) and most gas reserves are in eastern Europe and the Former Soviet Union (38 percent). North America contains reserves of 55 billion barrels (bbl) of oil and 261 tcf of gas (as of January 1, 2000), or 5.5 percent of the world's oil reserves and 5 percent of the world's gas reserves. The United States contains reserves of 22 bbl of oil and 167 tcf of gas, or 2.2 percent of the world's oil and 3.2 percent of the world's gas reserves. About 26 percentage of the world total production was used by the United States.

Undiscovered Oil and Gas Resources

Estimates of undiscovered volumes of oil and gas often mirror the geographic distribution seen in the reserve numbers. Recent world totals for mean estimates of undiscovered oil and gas are 724 bbl and 5,196 tcf, respectively. The former Soviet Union, the Middle East and North Africa are estimated to contain 47 percent of the world's undiscovered oil and 57 percent of the world's undiscovered gas. Mean estimates of undiscovered North American oil and gas are 146 bbl and 682 tcf, respectively, or 20 percent and 13 percent. Mean estimates of undiscovered oil and gas in the United States are 83.6 bbl and 527 tcf. These estimates are 11.6 percent and 10 percent of the world's undiscovered oil and gas resources, respectively. Mean total estimated volumes of oil and gas in onshore federal lands are 11.1 bbl and 201 tcf, as of January 1994. The preceding numbers do not include the possible additions to known reserves from the phenomenon of field growth, which is the increase in recoverable oil and gas as a result of continued development, technologic improvements in recovery, underestimation of original reserves and other factors.

Domestic oil production generally has decreased since 1985. This decrease will result in increased reliance on imported oil, even if our future usage remains constant. Projections of increases in United States gas consumption will require a corresponding increase in United States gas production and importation. More than 2.8 million wells have been drilled across the United States, and there are more than 39,000 oil and gas fields. Although discovery of new oil and gas fields continues and new types of reservoirs are recognized, most of the large oil and gas fields in the United States have been discovered.

Oil and gas reserves and resources have been assessed at world, country, basin and state scales, and much of this information is available on the web. Data for this summary came from several sources. Historical production, consumption and reserves data for the United States' oil and gas were accessed the from United States Department of Energy's websites: *http://www.eia.doe.gov/neic/historic/hpetroleum.htm* and *http://www.eia.doe.gov/neic/historic/hngas.htm* (September 18, 2001). Historical production, consumption and reserves data for worldwide oil and gas (exclusive of the United States) were accessed from the United States Department of Energy's websites: *http://www.eia.doe.gov/emeu/international/petroleum.html* and *http://www.eia.doe.gov/emeu/international/gas.html* (September 14, 2001). Estimates of the world's undiscovered oil and gas (exclusive of the United States) were taken from United States Geological Survey World Energy Assessment Team (2000), and similar estimates for the United States were taken from Gautier and others (1996), unless otherwise noted. Included within the Gautier et al. (1996) CD-ROM are oil and gas reserve and resource estimates for formations in basins across the United States.

Oil and Gas Reserves and Resources for the Powder River Basin of Wyoming and for Wyoming

Proven oil reserves on existing fields for Wyoming was 561 mmb (Energy Information Administration 2001). This is 2.54 percent of the total United States reserves. Most future drilling for conventional oil and gas in Wyoming will be for smaller fields, or will be infill drilling within existing fields. An exception to this is unconventional gas from coal beds. Coal bed gas is a recently recognized commercial source of natural gas. The Wyoming Oil and Gas Commission reports that there are more than 18,000 active well permits for coal bed gas in the Powder River Basin of eastern Wyoming. More than 5,000 of these wells have been drilled and are currently producing gas or water. The federal government owns mineral rights for more than 50 percent of the land in the Powder River Basin. About 14 percent of coal bed gas wells are on federal lands; the majority are on state and private lands. The Wyoming Oil and Gas Conservation Commission lists cumulative production from coal bed gas wells at more than 350 Bcf and 880 mmb of water in the Powder River Basin (through December, 2001) and almost 500 Bcf for the State (Wyoming Oil and Gass Conservation 2000).

In April, 2000, the American Association of Petroleum Geologists Explorer listed estimated recoverable gas reserves and resources of 6 to 9 tcf of coal-bed methane in the Powder River Basin. The United States Geological Survey (1996) estimated the mean potential additions to reserves of gas, or resources, in the Powder River Basin at about 14 tcf. Additional information on Wyoming oil and gas reserves and resources can be found at *http://www.wims.uwyo.edu* (University of Wyoming 2000) and *http://www.wsgweb.uwyo.edu* (Wyoming Geological Survey 2000).

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Where Would You Like the Holes Drilled into Your Crucial Winter Range?

Thomas D. Lustig
National Wildlife Federation
Boulder, Colorado

Introduction

This paper addresses some of the legal shortcomings of oil and gas development on federal lands. It is unapologetically written by a wildlife advocate who has witnessed the industrialization of Wyoming's wide-open wildlife spaces over the last 20 years. Prior to unveiling these legal deficiencies, I list some statutes involved in oil and gas development, describe the current pressure to develop oil and gas on federal lands, and skim over the kinds oil and gas impacts with which wildlife must contend.

Laws Affecting Wildlife Habitat on Federal Lands Subjected to Oil and Gas Development

Beginning in 1920, oil and gas development on federal lands was governed by the Mineral Leasing Act (30 U.S.C. I 8 *I et seq.*). In 1987, Congress overhauled that law with the Federal Onshore Oil and Gas Leasing Reform Act (FOOGLRA), which primarily focused on and altered the procedures by which tracts of federal land were made available for leasing.[1] Although FOOGLRA includes provisions, which influence how the environment is to be treated when the federal government leases and then authorizes development to extract oil and gas on federal lands, other laws have a more direct impact on the protection of wildlife habitat in the face of oil and gas development. These federal statutes include:

- Forest and Rangeland Resources Planning Act of 1974 (16 U.S.C. § 1600 *et seq.*), which governs planning for and the use of National Forest System Lands,
- Federal Land Policy and Management Act (43 U.S. C. § 1701 *et seq.*), which governs planning for the use of lands managed by the Bureau of Land Management.,

- National Environmental Policy Act (42 U.S.C. § 4321 *et seq.)*, which requires preparation of environmental analyses in order to evaluate alternatives and the environmental impacts of proposed actions,
- Endangered Species Act (16 U.S.C. § *1531 et seq.)*, which protects wildlife species–and sometimes their habitat–designated by the US Fish and Wildlife Service,
- Wilderness Act (16 U. S.C. § I 1 *31 et seq.)*, which removes lands that Congress has designated as wilderness from oil and gas leasing, but honors leases existing at the time of the area's designation,
- Federal Water Pollution Control Act (33 U.S. C. § *1251 et seq.*) and Safe Drinking Water Act (42 U.S.C. § 300f *et seq.),* which regulate the disposal including reinjection–of water produced from coalbed methane wells, and
- Clean Air Act (42 U.S.C. § 7401 *et seq.*), which governs emissions from diesel generators and compressors, as well as fugitive dust from operations.

In addition to these across-the-board statutes, which inhabit the legal interface between oil and gas development and wildlife habitat, the particular laws which establish special management areas on federal land, such as national wildlife refuges and national monuments, often speak directly to whether those lands are open to oil and gas development.

For example, when Congress created the Arctic National Wildlife Refuge (ANWR), in the Alaska National Interest Lands Conservation Act of 1980, it provided that, "production of oil and gas from the Arctic National Wildlife Refuge is prohibited and no leasing or other development leading to production of oil and gas from the range shall be undertaken until authorized by an Act of Congress" (West 2002). Oil and gas leasing on other national wildlife refuges is governed by regulations of the Bureau of Land Management (BLM), which generally preclude oil and gas leasing and development on refuges.[2]

As for national monuments, the recent monuments created by President Clinton with executive orders pursuant to the Antiquities Act of 1906 (16 U.S. C. § 43 1) typically withdrew the land from oil and gas leasing, although where there were existing leases, the portion of the executive order dealing with oil and gas development was more complex. For example, Presidential Proclamation number 7398 (January 17, 2001), establishing the Upper

Missouri River Breaks National Monument, provided: "All Federal lands and interests in lands within the boundaries of this monument are hereby appropriated and withdrawn from all forms of entry, location, selection, sale, or leasing or other disposition under the public land laws, including but not limited to withdrawal from location, entry, and patent under the mining laws, and from disposition under all laws relating to mineral and geothermal leasing, other than by exchange that furthers the protective purposes of the monument. The establishment of this monument is subject to valid existing rights. The Secretary of the Interior shall manage development on existing oil and gas leases within the monument, subject to valid existing rights, so as not to create any new impacts that would interfere with the proper care and management of the objects protected by this proclamation." Perhaps concerned that the new administration might attempt to modify Clinton's presidential proclamations that withdrew the new monuments from leasing, Congress subsequently added a rider to the Interior Department's appropriations bill for fiscal year 2002, further restricting leasing on national monuments.[3]

Federal Lands in the Rocky Mountain West Face an Onslaught of Oil and Gas Development

Nearly 58,000 oil and gas wells have been drilled on federal lands administered by the US Forest Service and the BLM. Most public-land oil and gas activity is centered in Utah, Wyoming, Colorado, New Mexico and Montana, where over 90 percent of the BLM's lands are open to leasing and development.

These lands are being leased and drilled at an unprecedented pace. For example, in 2001 the Veinal BLM Field Office, in Utah, approved more than three times the average number of wells approved every year since 1990. The rapid pace of leasing and drilling is being fueled by a recent explosive interest in coalbed methane production. In Wyoming, there were only 125 wells producing coalbed methane in 1995. Today, there are 6,500 producing coalbed methane wells.

With the arrival of coalbed methane, extensive leasing and drilling projects developed. In Wyoming's Powder River Basin, the BLM contemplates an additional 51,000 wells in northeast Wyoming and up to 80,000 wells in the Powder River Basin, straddling the Wyoming-Montana border. In the Atlantic

Rim area of south central Wyoming, the BLM is considering another 4,000 coalbed methane wells. If these coalbed methane developments come to pass, they will more than double the number of wells on federal lands.

What Are the Consequences to Wildlife of Oil and Gas Development

The most significant impacts on wildlife of oil and gas development typically involve fragmentation of habitat. The disturbance to habitat is particularly severe when the development occurs in crucial winter range for large ungulates or in close proximity to a sage grouse lek or raptor nest. The BLM often tries to mitigate these impacts by seasonally restricting the development, for example, by limiting activity on the lease during certain times to avoid interference with use of crucial winter range or spring strutting grounds. Whether these seasonal restrictions are sufficiently far-reaching is an issue addressed later.

A newer, and as yet not well understood, problem for wildlife is the substantial amount of water produced from coalbed methane wells; the coal seam must first be relieved of its water in order to free the trapped gas. The quality of this produced water can often be low, and its disposal is a problem; placing it on the land may result in increased salinity and sodicity, and discharges into surface waterways can lower existing water quality, with effects to both wildlife and irrigators. The BLM proposes to dispose of some produced water by reinjecting it into other groundwater aquifers, which raises questions about the permeability of those aquifers and whether this may affect wells, springs or distant surface waters. A recent Denver Post editorial (2002) summarized some of the produced water problems: "The lax existing rules let energy companies destroy wildlife habitat, fishing streams and livestock grazing by pouring millions of gallons of salty or arseniclaced water onto the ground or into fresh-water ecosystems and by letting methane infiltrate wells used for human or animal consumption." But, aside from the problem of produced water, the primary threat to wildlife is still habitat fragmentation. Several studies have looked at the consequences to wildlife of road building that accompany development, such as logging or oil and gas production.[4] But, because a picture is worth 1,000 words, I refer you to photo 1, which shows drill pads and connecting access roads and utility rights-of-way on the BLM's managed land in the upper Green River Basin, in western Wyoming. Imagine

Photo 1. Drill pads on Bureau of Land Management land, Green River Basin, Wyoming.

almost 80,000 coalbed methane wells, in the Powder River Basin, and about 4,000 wells amongst the crucial winter range, on Wyoming's Atlantic Rim. Oil and gas development at this scale on the BLM's lands that harbor important wildlife habitat will cause serious wildlife impacts.

The BLM's Legal Maneuvering, Decreases Protection of Wildlife Habitat Impacted by Oil and Gas Development

In the face of increasing proposals to develop oil and gas in the Rocky Mountains and despite serious consequences to wildlife from that development, the BLM continues to inappropriately, but legally, manipulate the process used to lease and develop oil and gas on federal lands. There are four tactics used by the agency that impair protection for wildlife.

BLM Issues Oil and Gas Leases Before Site-specific Environmental Analysis is Done

Although the BLM superficially examines whether or not federal lands should be leased when it prepares land-use plans, the examination is only generic. For example, when preparing the 1990 Medicine Bow-Divide Resource Management Plan, which covers about 4 million acres of BLM managed public land surface and 5 million acres of federal mineral estate in southeast Wyoming, the BLM analysis of oil and gas leasing considered four alternatives–all opened 5 million acres to oil and gas development. The only difference in the alternatives was in the level of stipulations attached to the leases.[5] The BLM's analysis of its decision to lease for oil and gas in the resource management plan contained no site-specific evaluation of the impacts of issuing particular leases. Once the BLM completed its land use plan, it leased parcels without further environmental analysis and without site-specific evaluation of whether a particular lease parcel should preclude all surface-disturbing activity because of wildlife use or other sensitive environmental features of those federal lands.

Issuing these oil and gas leases without an environmental analysis of the lease parcel to determine if there are wildlife or other environmental attributes that warrant precluding surface disturbance on the lease lets the horse out of the barn before closing the gate. Once the lease has been issued, the BLM is prevented from imposing new conditions on the lease holder, despite subsequent environmental and wildlife studies, which may show that the standard stipulations the BLM has attached to the lease are insufficient to protect wildlife and other environmental resources on the parcel.

The BLM admitted this problem in a recent environmental analysis, concerning a proposal to authorize coalbed methane drilling. The leases had been already been sold before 1995 near crucial big game winter range in south central Wyoming and had been sold without the BLM's detailed environmental analysis of the lease parcel. The BLM acknowledged that, "[n]one of the stipulations [included to protect wildlife and other environmental resources], however, would empower the Secretary of the Interior to deny all drilling activity because of environmental concerns." This was the case, the BLM explained, because its "authority to implement a 'No Action' alternative is limited because the public lands have already been leased."[6]

This policy of leasing before one looks is used by the BLM to save time and money. The agency and some courts ask why the BLM should carefully examine the environmental consequences of leasing a particular parcel of federal land when it is uncertain if the lease will ever be developed. Instead, the BLM waits until the drilling request for the already leased lands is submitted.

Unfortunately, postponing the site-specific environmental analysis until after the lease has been issued and the lessee wants to begin drilling does not work. Any needed environmental or wildlife restrictions over and above standard stipulations which were attached to the lease can no longer be added at this late stage. The BLM already sold the rights to develop and, in so doing, limited the environmental restrictions that can be placed on the lease developer.

BLM Piecemeals its Environmental and Wildlife Analyses

The BLM authorizes development portions of a large oil and gas field before it has completed the required environmental analysis of the impacts of developing the whole field. In doing so the agency allows substantial development, making a subsequent decision to deny drilling authorization for the entire field extremely unlikely. It is like telling a teenager, who just received a driver's license, it is acceptable to drive to the mall, but to call upon arrival to ascertain it is acceptable to drive home.

This kind of oil and gas piecemealing is underway on the Atlantic Rim, in south central Wyoming, where the BLM is studying the environmental impacts of drilling up to 3,880 coalbed methane wells. Unfortunately, while this project-wide environmental evaluation is underway, the BLM and the lease holder created nine pods where they are evaluating (and so far authorizing) drilling up to 200 interim wells within those pods–wells that will be approved, drilled and possibly producing before the agency finishes its evaluation of the entire project of which the wells are a part.

The BLM asserts that jumping the gun on its overall evaluation by drilling in pods within the larger project area is warranted for two reasons: (1) because data from the interim wells will guide its project-wide decision and (2) out of fairness to the leaseholder, who otherwise would have to await completion of the full-field analysis before starting to drill. If the BLM had actually evaluated the environmental consequences of the oil and gas development before it sold the lease, this would not have been a problem).

But, for wildlife and the environment, this piecemealing of drilling authorizations nibbles away at wildlife habitat before the agency can make an educated and legally informed decision about where habitat and environmental incursions should be allowed. It will do the Atlantic Rim's wildlife little good if the BLM authorizes drilling 200 wells in the nine interim pods, if a year later the agency–after finally completing its full project evaluation–concludes that some of the pods should not have been drilled because important big game migratory routes will be blocked. Jumping the gun on drilling is, of course, exacerbated by the fact that BLM already issues the leases–and the development rights that go along with the lease–before doing any environmental studies. Both the uninformed lease issuance and piecemealing of drilling authorizations violate the National Environmental Policy Act.

Stipulations to Protect Wildlife do not Carry Over into Production

The BLM and the US Forest Service try to avoid environmental and wildlife impacts as a result of oil and gas development by attaching stipulations to the issued leases. When the lease holder ultimately develops the parcel, the BLM may require compliance with the stipulation or waive the stipulation if circumstances no longer require its imposition. For example, if there is a stipulation that prevents surface activity during certain times because of a nearby raptor nest and the nest is abandoned, the BLM may waive compliance with that stipulation. Hopefully the raptor will receive notification and not move back in.

A common stipulation designed to benefit wildlife is a timed or seasonal stipulation. It precludes certain activities during times of the year when wildlife would be particularly disadvantaged. For example, in the Atlantic Rim Coalbed Methane Project, where the BLM is allowing interim development before it has completed its overall evaluation, construction activities are limited within big game crucial winter range from November 15 to April 30. For sage grouse, lek protection during the breeding, egg-laying and incubation period (March 1-June 30) is provided by restricting construction activities within a two-mile radius of active sage grouse leks.[7]

The problem with these stipulations is that the stipulations apply only during exploration and development. They do not apply during production. During the production phase, the BLM acknowledges that traffic to producing wells will be required about every other day. If there are hundreds or thousands of wells, roads will have to be plowed and there will be frequent traffic year-round. The seasonal stipulations, which were designed to protect wildlife during critical times of the year, have vanished, since they apply only during exploration and development.

This shortcoming results from issuing leases before the BLM does its legally-required environmental homework. When the BLM sells the lease because it does not know whether there is crucial winter range, raptor nests or important sage grouse habitat, it attaches stipulations it believes may be appropriate. Unfortunately, they expire if the project goes into production. This is another consequence of the BLM leasing before it looks.

Oil and Gas Development is Approved before Being Evaluated in Land-use Plans

The Federal Land Policy and Management Act requires the BLM to prepare land use plans governing activities on BLM-managed federal lands, including oil and gas leasing and development. The statute specifically requires that, "[t]he Secretary shall manage the public lands under principles of multiple use and sustained yield, in accordance with the land use plans developed by him under section 1712 of this title" (43 U.S.C. § 1732(a)). After the BLM finishes a resource management plan, "[a]ll future resource management authorizations and actions...shall conform to the approved plan." 43 C.F.R. § 1610.5-3(a). Conformity means, "that a resource management action shall be specifically provided for in the plan, or if not specifically mentioned, shall be clearly consistent with the terms, conditions, and decisions of the approved plan or plan amendment" (43 C.F.R.§ 1601.0-5(b)).

Unfortunately, the BLM has failed to live up to this requirement in two ways. First, it allows development of coalbed methane, even though the land-use plans neither contemplate nor discuss the impacts of coalbed methane production. Since coalbed methane production is a new enterprise, the BLM land use plans of the late 1980s and early 1990s do not discuss this type of oil and gas development or deal with its unique environmental impacts, such as the need to dispose of substantial water that has been removed from the coal seam to liberate methane gas. While the BLM, in Wyoming, currently is scrambling to amend its land-use plans to consider this type of oil and gas development, until this is complete, the Interior Board of Lands Appeals has halted some lease sales on grounds that leasing for coalbed methane is not consistent with the provisions of the governing land-use plan.

Second, the BLM has prepared management direction for oil and gas development without including that direction in its land-use plans or, for that matter, in any document on which the public has an opportunity to review and comment. For example, prior to a decision on the 3,880 coalbed methane wells proposed for the Atlantic Rim, in south central Wyoming, the BLM developed an interim drilling policy governing how up to 200 interim wells could be drilled on the Atlantic Rim while the BLM was contemplating the 3,880 well proposal. This interim drilling policy was never discussed in BLM's land-use plan (now being amended), never provided to the public for comment and never evaluated for alternatives or impacts pursuant to the National Environmental Policy Act. Yet, the interim drilling policy was relied upon by the BLM as the only method under which the 200 interim wells could be leased.[8] Setting rules governing oil and gas development where the public is excluded from the development of those rules is hardly consistent with the numerous laws protecting federal lands.

Conclusion

Admittedly, my grousing about the BLM's oil and gas leasing and development tactics is not shared by the agency, the solicitor, the Department of Justice or some courts. Nonetheless, there is no dispute that federal lands, in places like Wyoming, are overrun with oil and gas development, which will have serious consequences for wildlife.

One remedy is the BLM doing more than approve leases and drilling permits with only part-time stipulations. The agency must evaluate impacts to the environment before giving away development rights, and it must utilize its statutory authority to protect sensitive areas from the onslaught of energy development.

Endnotes

1. A quick summary of some of the changes brought by the 1987 legislation can be found in Maxwell, R., P. Martin and B. Kramer. 2002. Oil and gas cases and materials, seventh edition. Pages 1,012-1,020. Foundation Press. New York, New York. 1,125 pp.
2. "No offers for oil and gas leases covering wildlife refuge lands shall be accepted and no leases covering such lands shall be issued except as provided in § 3100.2 [covering drainage of oil and gas] of this title. There shall be no drilling or prospecting under any lease heretofore or hereafter issued on lands within a wildlife refuge except with the consent and approval of the Secretary with the concurrence of the Fish and Wildlife Service as to the time, place and nature of such operations in order to give complete protection to wildlife populations and wildlife habitat on the areas leased, and all such operations shall be conducted in accordance with the stipulations of the Bureau on a form approved by the Director." 43 C.F.R. § 3101.5-1 (b).
3. "No funds provided in this Act may be expended to conduct preleasing, leasing and related

activities under either the Mineral Leasing Act...or the Outer Continental Shelf Lands Act...within the boundaries of a National Monument established pursuant to the Act of June 8, 1906 (16 U.S.C. 431 et seq.) as such boundary existed on January 20, 2001, except where such activities are allowed under the Presidential proclamation establishing such monument." Pub. L. 107-63, 115 Stat. 414, 471 (2001).

4. A study conducted in North Dakota found that mule deer avoided areas within 300 feet of well sites for feeding and bedding, resulting in a 28 percent reduction in secure bedding areas. Although the population had over 7 years to habituate to oil development activities, avoidance of roads and facilities continued and was determined to be long term and chronic. In addition, in areas subject to oil and gas development, the fawn to doe ratio dropped dramatically. Jensen, W.F. 1991. Internal memo. North Dakota Fish and Game Department. As a general rule, one mile of road per square mile reduces the habitat effectiveness for elk of the area by 50 percent, two miles of road reduces the effectiveness to 25 percent. Lyon, J.S. 1984. Field tests of elk and timber coordination guidelines. USDA Forest Service Intermountain Forest and Range Experiment Station. Ogden, Utah. Research Paper INT325.
5. Medicine Bow-Divide Resource Areas-Resource Management Plan, Draft Environmental Impact Statement. 1987. Pages 51-54.
6. Environmental Assessment for the Atlantic Rim Coalbed Methane Project, Sun Dog Pod, Carbon County, Wyoming. September 2001. Rawlins Field Office, Bureau of Land Management, Wyoming (hereinafter "Sun Dog Pod EA"). Pages 2-26.
7. Sun Dog Pod EA at 2-23.
8. The Proposed Action was developed around measures provided in the Interim Drilling Policy Conditions and Criteria Under Which Development Activities May Occur Concurrent with EIS Preparation for the Atlantic Rim Coalbed Methane Project. Only alternatives addressing allowable actions specified in the IDP are considered in this analysis. As a result, no other alternatives, other than the No Action Alternative, were considered in this analysis. Decision Record and Finding of No Significant Impact for the Atlantic Rim Coalbed Methane Project, Sun Dog Pod, Carbon County, Wyoming. December 21, 2001. App. A, at 2 § 2.3.

Developing Oil and Gas while Protecting Wildlife on Public Lands

Dru Bower
Petroleum Association of Wyoming
Casper

Thank you for the opportunity to speak to you today. As the Vice President of the Petroleum Association of Wyoming (PAW), I specialize in public land issues. PAW is the largest and oldest trade association in Wyoming, the members of which account for over ninety percent of the natural gas and over seventy percent of the crude oil produced in the state. The oil and gas industry is deeply involved with the issue of wildlife and wildlife habitat protection.

In all honesty, I am not a biologist, an attorney, nor do I have a Ph.D. in any field. I am just a small-town farm girl, born and raised in Wyoming and have a passion for all that my state has to offer, which includes both an abundance of wildlife and significant reserves of natural resources, including oil, gas, coal, trona, uranium, bentonite and many other minerals. These minerals all overlap, in some way, with wildlife and wildlife habitat.

In order to address the theme of this conference, *Energy and Conservation: Does Big Oil Mix with Big Game?*, we must have a better understanding of the demographics of Wyoming. The 2000 census reported that there are approximately 494,000 people living in the state, which covers 62,664,960 acres, accounting for 26.8 acres per person. There is a tremendous amount of open space. The largest city is Cheyenne, with a population of 50,000 people. There are no major airports (only commuter airports), and there are two interstate highways crossing the state (east to west and north to south). The point of mentioning this is to show that Wyoming is unique and that natural resource development is needed for the survival of its citizens in order to maintain a reasonable tax base and revenue stream for the state to operate.

The mineral industry provides a solid job base for residents and generates a significant portion of the state's revenue, which supports the education of our children and other programs that could not otherwise support themselves. Many, if not the majority, of PAW members hunt, fish, recreate outdoors and have a personal, vested interest in the conservation of wildlife and wildlife habitat. Often, people express concern over whether or not oil and gas development is compatible with the conservation of wildlife and wildlife habitat, particularly those who are not familiar with the regulatory process for conducting business on public lands. In this presentation, I will describe the processes that govern oil and gas activity on public lands, and I will dispel the misconception that oil and gas development is allowed unfettered access.

Access to public lands is critical to the development of oil and gas resources in the western United States. Public lands make up a significant portion of our western states and, in Wyoming alone, approximately 49 percent of the surface estate and 66 percent of the mineral estate is managed by federal agencies, such as the United States Forest Service (USFS) and the Bureau of Land Management (BLM). For those that have not had the opportunity to conduct business in states that are primarily composed of federal land, the USFS and the BLM are the land managers that make decisions regarding all aspects of resource and habitat management. The Wyoming Game and Fish Department (G&F) manages the animals. The G&F receives no state tax money for their operating budget. Most of the department's revenue, about 70 percent, is generated by sales from hunting and fishing licenses, conservation stamps, and application fees. Approximately 20 percent is received from federal aid and the remaining 10 percent comes from other sources and interest generated from certain accounts. With that money, the G&F is responsible for the management of 600 species that are in Wyoming, while only approximately 70 are game animals, which generates the funding base. As a resident of Wyoming working in the mineral industry, I prefer that the responsibility for management of animals lie with the state agency and not the federal agency, the United States Fish and Wildlife Service (FWS). Our common goal is to manage wildlife for sustainable populations and prevent the impairment of any species to the greatest extent possible. We must focus on a balance between oil and gas development and wildlife protection.

To achieve this balance, the G&F needs additional funds to study and monitor species of concern and a portion of those funds can be derived from industry. The mineral industry can only provide funding or support additional studies if production and development is taking place at a rate that is economically feasible. In the past few years, the BLM, the G&F and PAW entered into a cooperative effort to employ a project biologist in southwest Wyoming who is charged with the responsibility of monitoring the effectiveness of certain mitigation measures that are imposed on the industry, which are specifically related to sage grouse, big game crucial winter range and seasonal closures. The purpose of this effort is to gather data that will determine the effectiveness of the mitigation and expand the protection measure, if necessary, or eliminate the protection measure, if it proves to be unnecessary. The cooperative effort is driven by an advisory committee, which is made up of members from each of the participating partners. Results from the study will be available in the near future. This project has been beneficial in developing better partnerships between the different parties and encourages communication and understanding from different points of view.

Many people believe that industry has a free ride when it comes to development on public land. This could not be farther from the truth. It is appropriate to take some time now to explain the basic process necessary for oil and gas exploration and production, the National Environmental Policy Act (NEPA) that drives the land management process, and determine if wildlife and oil and gas development can co-exist.

Understanding Oil and Gas Development

What do most people know about oil and gas development? What does oil and gas development look like? Many people picture oil derricks and pump jacks lined up like dominoes such as in early photographs of Texas oil fields. This could not be further from reality. Let me describe a typical oil and gas project.

For simplification purposes, we will use a one square mile section of land (640 acres) as an example. The average spacing of wells in a productive gas or oil deposit would be 80 acres. That means there is one well every 80 acres, or eight wells per square mile. A typical well pad for wells up to 10,000 feet deep is approximately 2.5 acres. That means that the total disturbance for the eight well pads will be 20 acres.

To access these wells, approximately 2.1 miles of service road per square mile are needed. Service roads are typically constructed with a surface width of 18 feet, resulting in a total of 4.5 acres of surface disturbance related to roads. Pipelines would be laid in the road, not adding to the disturbance. So, of the eight wells, there is a required 24.5 acres of land disturbed, which will last the life of the well, estimated at 20 years, after which, the land will be reclaimed.

The typical well, of up to 10,000 feet, takes approximately four weeks to drill. If only one drill rig is used, the total duration of drilling-related human activity is 32 weeks for eight wells. Following completion of the wells, daily human activity would consist of one person in one pick-up truck, which will check each well once per day, spending approximately 30 minutes at each location.

In summary the physical disturbance from this scenario consists of 24.5 acres out of the 640-acre area. The human disturbance consists of a one-time, 32 week drilling period, then 20 years of a one-vehicle trip per day, per eight wells. When put in this perspective, surface disturbance and human disturbance is minimal compared to year-round activities such as hunting, wildlife watching and four-wheeling.

The NEPA Process

The public permit process demonstrates that the oil and gas industry does not have a free ride. Many have heard of two acts of Congress: the Federal Land Policy and Management Act (FLPMA), of 1976, and the National Environmental Policy Act (NEPA), of 1969. These acts are the driving laws that guide land management decisions for federal agencies.

FLPMA provides the framework through which the agencies, with public involvement, develop plans that provide for the long-term management of specific blocks of public lands. NEPA is the process through which the agencies, with public involvement, analyze the impact of industry's proposed actions to determine if modifications to the proposed action are necessary to mitigate the impact to the environment. These modifications occur in the form of restrictive stipulations and conditions of approval on oil and gas leases and operating permits. These stipulations can be for the purpose of protecting anything, including wildlife, wildlife habitat, air quality and water quality.

Regarding FLPMA, Congress instructed the Secretary of the Interior to, "maintain on a continuing basis an inventory of all public lands and their resources and other values...with public involvement...develop, maintain, and, when appropriate, revise the land use plans."[1] The "goals and objectives established by law as guidelines for public land use planning and that management be on the basis of multiple use and sustained yield unless otherwise specified by law."[2] Congress recognized that the, "principal or major uses includes, and is limited to, domestic livestock grazing, fish and wildlife development and utilization, mineral exploration and production, rights-of-way, outdoor recreation, and timber production."[1] FLMPA addresses the protection of the environment in other places. While mineral development may not be preeminent in the definition above, it is a principal use because Congress had an overriding concern that, "public lands be managed in a manner, which recognized the Nation's need for domestic sources of minerals, food, timber and fiber."[3]

The purpose of NEPA is, "recognizing the profound impact of man's activity on the interrelations of all components of the natural environment." Further into the purpose clause, the act declares, that "it is the policy of the Federal Government, in cooperation with State and local governments and other concerned public and private organizations...to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of Americans."[4] It is important to note that NEPA does not mandate a particular result, nor does it require an agency to adopt the least damaging alternative. It is through this process that the land management agency must provide sufficient evidence and analysis of impacts on the quality of the human effects. The cumulative effects of a proposed action, such as oil and gas development, take into account the effects on wildlife and wildlife habitat.

Explaining the permit process may convince many that industry does not have a free ride when developing on federal lands. Should the Resource Management Plan (the land-use bible in the west) determine an area to be suitable for leasing, the land management agency then holds public lease sales. The lease is automatically subject to standard lease terms at a minimum. Based on the Resource Management Plan (RMP), the lease may have additional stipulations that spell out development restrictions, such as seasonal closures. The operator knows and understands these stipulations.

Once the lease has been let, it becomes a contractual agreement between the federal government and the lessee. While this agreement gives the exclusive right to develop, it does not give the lessee the green light to develop. The lessee is then subject to conducting a project level Environmental Assessment (EA) or to providing an Environmental Impact Statement (EIS) before exploration or development can occur. Each project level EA or EIS is subject to additional mitigation requirements before approval. Once the record of decision for the project is in effect, each individual Application for Permit to Drill (APD) may be subject to additional conditions of approval for the site-specific analysis. An APD must be submitted for every well that is considered for development. If the desired mitigation is not a requirement in the existing RMP, the project EA or EIS, the land management agency may also request that the operator voluntarily accept so-called applicant committed measures, which become conditions of approval. With the many layers of the permit process, it is evident that industry does not have a free ride. The delay in development and waiting for the NEPA process to be completed costs the operator time and money, particularly if the price of oil or gas is high. The cost of all additional protection measures is borne by the operator and is a consideration for the applicant when determining the project's economics and feasibility.

Further, in order to conduct development activity, industry is required to do the following: post a bond guaranteeing final reclamation before any activity can take place, conduct an archeological survey, conduct a paleontological survey, avoid sensitive soils, avoid slopes in excess of 25 percent, stop all construction activity for five months each year to protect big game on crucial winter range, avoid raptor nests within a 1-mile radius of the nest, avoid sage-grouse leks and nesting areas within a 2-mile radius of the lek, avoid riparian habitat, and avoid historical and cultural resources with a protection area. With all of these restrictions, the operator only may have a small window of opportunity during the year to exercise the valid, existing right and only may be allowed to access a fraction of the lease. Also, with reclamation standards in place, industry often creates better, more productive habitat than was originally present before disturbance occurred.

In addition, the land managing agency must seek consultation or participation from other entities before a record of decision can be issued for a particular project. Consultations may include the Fish and Wildlife Service (for the Endangered Species Act and the Migratory Bird and Treaty Act), the Environmental Protection Agency, the State Department of Environmental Quality, the Wyoming Oil and Gas Conservation Commission, the State Historic and Preservation Office, the State Game and Fish Department, the county government (for zoning issues), and private landowners (for surface access issues).

Without the agreement from the operator to implement any or all of these protection measures, the land manager may deny some, or all, of the project resulting in fewer than eight wells per square mile. The BLM and the G&F have no process to monitor the effectiveness of the mitigation measure over time, for example the BLM often implements an oil and gas stipulation when there is a perceived threat to a resource value, even though there is a lack of science or data to support the restriction. The protection of wintering big game animals is applied from November 15 through April 30 each year in specified areas. In the absence of good data, neither the BLM nor the operator really know if the closure protects the wintering animals or if it should be a month longer or shorter. The philosophy among agencies is that bad data is better than no data, and the result is the best guess mitigation measure, which becomes the threshold that the agencies use. It rarely is reduced, but often is increased. Agencies should be required to monitor its mitigation measures and qualify or quantify its effectiveness. Proper scientific monitoring should become the basis for adjustments to the mitigation measures. The agencies should be responsible for funding this monitoring program and additional appropriations for human resources may be necessary to avoid unfairly placing the burden on industry.

Access to public lands has become difficult over the past few years. Access to public lands has become more time consuming and expensive than the actual cost of production. While some would argue that gaining access to public lands is too easy, others may argue that access is difficult, expensive and almost impossible to obtain. Some may use the process as a strategic tool to prevent exploration and development in lieu of preservation and, in that case, oil and gas development will gravitate to adjacent private and state trust lands, which may not have the same degree of environmental restrictions.

Throughout the NEPA process, there is ample opportunity for the interested public to comment on any portion of the proposed project. The process was designed to receive and analyze public input and to assist the federal land manager to develop land management decisions. This process has evolved into a process where the person who speaks the loudest and with the most numbers influences the outcome. Unfortunately, this process has taken the agencies away from basing decisions on sound science, but has caused them to make political decisions instead. Wildlife knows no boundaries between public and private lands, hence the term wildlife, and it cannot be managed like livestock to avoid overgrazing. It is unfair to institute unnecessary and unwarranted restrictions on industry because the land management agency can control industry activity, but not wildlife migration. Public land decisions should not be a distorted popularity contest; it must be based on scientific data or the credibility of agencies will be damaged, ineffective and eventually eliminated.

Can Wildlife Co-exist with Oil and Gas Exploration and Development?

It is not a matter of the ability to co-exist; it is a matter of the desire to co-exist. The answer is—we must. If the economy and the environment are healthy, there is more money to spend protecting the environment, including wildlife and wildlife habitat. Over time, industry has improved technology, which has afforded the following opportunities: more cost effective development; greater protection for the environment; less surface disturbance; and more revenue for federal, state and county governments.

A perfect example of improved technology is the ability to develop and market coalbed methane production, of which Wyoming has a generous amount of coal in the state. Just 10 years ago, coalbed methane was being vented into the atmosphere, which is not good for the consumer or the environment. Coalbed methane development, particularly in the northeastern portion of Wyoming, has created beneficial uses for wildlife with the water produced from the coal seams. In time, technology will improve, and, with that improvement, our ability to extract various energy resources will minimize our impact to the environment.

The oil and gas industry is obligated to supply citizens of this country with resources that are needed for survival. As discussed earlier, public land is essential to oil and gas exploration and production in Wyoming. Mineral resources are where they are. No one can move them to areas where there is no interaction with other resources. The reason that industry develops oil and gas at the rate it is developed is because the consumer is demanding the resource. Natural resource development is the lifeline for Wyoming and its residents. There has been development for over 100 years, yet there are groups that believe Wyoming is pristine and needs to be protected or withdrawn from availability to oil and gas leasing. That leads many people of the state to believe that they have done an exceptional job balancing the protection of the environment with economic stability. Industry has adapted its activities to be sensitive to the needs of wildlife and wildlife habitat, however we must remain vigilant to identify and discourage unnecessary layers of restrictions that do not improve the protection and quality of the human environment. A wealthy environment is a healthy environment, and oil and gas development must continue in Wyoming in order to achieve this balance. Therefore, unequivocally, yes, wildlife and oil and gas development can co-exist, as they have successfully co-existed for decades in Wyoming.

1. Federal Land Policy and Management Act or 1976. Public Law 94-579. 94 *in* Congress. Section 201(a).
2. ibid. Section 102(a)(7)(12).
3. ibid. Section 103(1).
4. National Environmtnal Policy Act of 1966, as amended. Section 101 [42 USC 8 4331].

Oil and Gas Development in Western North America: Effects on Sagebrush Steppe Avifauna with Particular Emphasis on Sage Grouse

Clait E. Braun
Colorado Division of Wildlife
Fort Collins

Olin O. Oedekoven
Wyoming Game and Fish Department
Gillette

Cameron L. Aldridge
University of Alberta
Edmonton

Sagebrush (*Artemisia* spp.) steppe was once a dominant feature of the landscape in western North America, covering at least 243 million acres (60 million ha) (Beetle1960, Vale 1975) in 16 states and three provinces. Most of this vast expanse has been altered by human activity. Estimates of complete loss of sagebrush-dominated areas exceed 50 percent (Schneegas 1967, Braun et al. 1976, Braun 1998). The remaining sagebrush steppe has been markedly altered through treatments to benefit livestock grazing, including livestock grazing as a treatment, fragmentation (roads, power lines and other structures, pipelines, reservoirs, fences, etc.) and degradation (Braun 1998). More recently, urban expansion, as well as development of housing scattered through large tracts has impacted wildlife use of sagebrush habitats (Braun 1998).

While the sagebrush steppe is seasonally host to a large number of avian species (Braun et al 1976, Paige and Ritter 1999), only five species (Gunnison and northern sage-grouse [*Centrocercus minimus, C. urophasianus*], sage thrasher [*Oreoscoptes montanus*], sage sparrow [*Amphispiza belli*] and Brewer's sparrow [*Spizella breweri*]) are truly sagebrush obligates (Braun et al. 1976). However, at the grassland or shrub steppe interfaces with sagebrush-dominated areas, other species, such as Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*), mountain plover (*Charadrius montanus*) and burrowing owl (*Athene cunicularia*) were locally abundant. All of these species are now known or thought to be declining in distribution and abundance.

Oil and gas developments and their attendant structures, including power lines, roads and collection stations, are not recent additions to western North America, since some activity dates to the late 1800s. Exploration and development activity tends to be cyclical, depending on apparent needs, extraction costs and cost per barrel or cubic foot. In the 1970s and early 1980s, the interest was in development of oil shale. In the early and mid-1980s, the emphasis was in the Rocky Mountain Overthrust Belt. Today, interest in oil and gas development is everywhere in the West, where reserves are thought to be present. Nowhere is this more apparent than in development of coalbed methane, especially in the area near Gillette, Wyoming. Because of the rapid expansion and development of oil and gas reserves, this paper examines what is known about the effects of energy exploitation on sagebrush steppe dependent avian species and logical expectations during and after exploration, facility development and extraction. Case history examples are provided from Alberta, Colorado and Wyoming.

What Is Known

A relatively large body of literature exists for game species, such as sage-grouse (Connelly et al. 2000) and Columbian sharp-tailed grouse (Giesen and Connelly 1993). Reasonable information is available for passerine species breeding in sagebrush steppe and the presence of sagebrush (Feist 1968; Best 1972; Schroeder and Sturges 1975; Reynolds and Rich 1978; Rich 1978, 1980; Reynolds 1981; Peterson and Best 1985a, 1985b, 1987) and patch size (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981, 1985; Wiens et al. 1987; Knick and Rotenberry 1995; Aldridge and Brigham 2002) are important for all sagebrush obligates. Relatively little is known about the effects of habitat alteration on other species, such as burrowing owls and mountain plover, which seasonally occupy the interface of sagebrush steppe and grasslands. It is known that burrowing owls are negatively impacted by plowing, reseeding and other disturbances in breeding areas (Rich 1986, Haug et al. 1993). Plowing native habitats to reseed with taller grasses also has negative effects for mountain plovers, and restrictions have been placed on oil and gas exploration in key breeding areas in Colorado, Montana and Wyoming (Knopf 1996).

Review of the available information suggests that habitat alteration that removes live sagebrush and reduces patch size has negative effects for all sagebrush obligates, specifically sage-grouse, sage sparrow, sage thrasher and Brewer's sparrow. Plowing of native habitats is also negative for burrowing owls and mountain plovers. Columbian sharp-tailed grouse (and other subspecies) are less impacted, as they can positively respond to some altered habitats, providing that native shrub habitats remain available. Thus, sharp-tailed grouse have the best potential to maintain their distribution and abundance with changes in habitat use and disturbance.

Oil and Gas Developments and Sage-grouse

Alberta

Sage-grouse were historically abundant across southeastern Alberta, occupying as much as 18,920 square miles (49,000 km^2) in the early 1900s (Aldridge 2000). However, the current distribution of sage-grouse has been reduced to approximately1,544 square miles (4,000 km^2), less than 10 percent of their historic range. Sage-grouse population data exist for the currently occupied area, however lek counts only began in 1968 and were conducted sporadically prior to the 1990s. Thus, direct comparisons and cause-and-effect studies are not possible, but the available data are compelling.

Records of oil and gas developments are incomplete and difficult to obtain, but the earliest records suggest that exploration for gas began as early as 1940. The oil boom of the mid-1980s resulted in intensive oil extraction activities in southern Alberta. Over this time, the number of male sage-grouse displaying at lek sites decreased from as many as 524 males to as few as 300 (Aldridge 2000). Similar correlations were seen in the early 1990s, with a resurgence of development activity in the heart of sage-grouse habitat (Manyberries Oil Field). The number of male sage-grouse in Alberta fell to the lowest known level, with only 70 males in 1994 (Aldridge 2000). Direct disturbances (development of road or well sites) within approximately 220 yards (200 m) of three different lek complexes were noted between 1983 and 1985. None of these leks has been active since the disturbance. At that same time, drilling activities occurred within view of a fourth lek complex and the two lek satellites were reduced to one smaller lek. This site has since been reclaimed, but the numbers have never recovered. Two additional known lek sites were directly disturbed at some unknown time in the past; one is now a reclaimed well site and the second was seeded to tame grass; the latter, most likely, is also a reclaimed well site. Neither of these leks have been active for at least 10 years.

To date, approximately 1,500 wells have been drilled within the current range of sage-grouse, in Alberta. It is estimated that 575 wells are still producing. Thus, there are approximately eight well sites per square mile (one active and two inactive well sites/km²) within sage-grouse habitat. Connecting each of these well sites is a series of roads and trails, as well as power lines and pipelines that are interlaced with compressor stations and gas camps. These structures and linear features result in direct habitat loss and fragment remaining suitable habitat. The effect of daily vehicular traffic along these road networks can also impact breeding activities or directly reduce survival.

There are relatively few limitations placed on spacing and density of well sites in Alberta. Each company is restricted to drilling 16 well sites per section of land, but each is allowed 16 wells per zone in which they are drilling. Thus the total number of wells potentially could exceed 16 per section. Recommendations and guidelines are made by the Alberta Department of Fish and Wildlife to reduce the impact of such intensive drilling, particularly in important sage-grouse habitats. However, there is no current legislation that commits Alberta Public Lands or the Alberta Energy Utility Board to these recommendations. Under the Alberta Provincial Wildlife Act, an individual cannot willfully destroy the nest or den site of an endangered species; sage-grouse are listed as endangered in Alberta and Canada. This provincial legislation offers little or no protection for sage-grouse breeding and nesting habitat, and, currently, there is no federal legislation in place.

Over the last three decades, the Alberta sage-grouse population has declined by at least 66 percent (Aldridge 2000). Currently, only seven of 31 historic lek complexes remain active. The future plans for oil and gas developments within the range of sage-grouse are unknown, but expansion is expected. The cumulative impacts of further activities could result in reduction of the Alberta sage-grouse population to non-viable levels.

Colorado

Sage-grouse historically occurred in at least eight counties in Colorado (Braun 1995) in which oil and gas development is common. No cause-and-effect studies have explored the impacts of oil and gas production on sage-grouse populations, although Braun (1987, 1998) generally discussed the apparent short-term impacts. Presently, active oil and gas production occurs in only four counties (Jackson, Moffat, Rio Blanco and Routt), while sage-grouse populations within areas impacted by coalbed methane (CBM) production (LaPlata and Montezuma) or that could be potentially impacted by development of oil shale (Garfield) are no longer present, due to complex factors.

Oil and gas developments preceded formal counts of sage-grouse in Colorado and date to at least the early 1920s. Counts of sage-grouse were initiated on a sporadic basis in Colorado in the late 1940s. These counts were incomplete and focused on larger, more accessible leks. Thus, data collected from the 1940s to the early 1970s are not directly comparable to those collected in the last 25 to 30 years. Therefore, it is not possible to be definite about actual impacts of oil and gas development on sage-grouse.

The most complete data set for sage-grouse and oil and gas production is from North Park, in Jackson County. Development of the McCallum Field was initiated in 1926, and it continues to be active, with 47 producing wells, 39 water injection wells, 25 abandoned (plugged) wells and six approved plans for wells in an area of approximately 8,600 acres (2,125 ha). This area has a well-developed unimproved road network, with one paved road to a processing plant, numerous pipelines and a few power lines. Sage-grouse were reported to occur in the McCallum Field in the 1940s but no data are available. During the 1973 to 2001 interval, at least 11 leks were active within or immediately adjacent to the McCallum Field. Seven of these leks were active in 2001, with a total of 181 males, which is 12.8 percent of the total males counted on 20.6 percent of the active leks in North Park. Examination of each active lek indicated that only two were within sight of an active well or power line. Most were out of sight because of topography, but there were noises associated with pumping and oil field activities inaudible to the human ear, on the lek site. Only three active leks were within the main oil field and 8 of 11 known lek sites were on the periphery. During the 1973 to 2001 interval, the number of male sage-grouse counted and active leks in this area fluctuated in synchrony with the entire sage-grouse population in North Park. Sage-grouse are also known to winter within the McCallum Field (Beck 1975) because a series of ridges are wind swept of most snow.

Locations of the known active sage-grouse leks in the McCallum Field suggest selection for sites that are removed from disturbances, such as active wells, the processing plant, the paved road and power lines. The McCallum Field is a relatively small, old, moderately developed oil production area, which demonstrates that sage-grouse continue to use areas in and near oil production facilities providing that suitable sagebrush-dominated habitats are available and that they have opportunity to select sites that are not disturbed by physical structures or paved roads. Despite the fragmented nature of the habitat (by trails, pipelines, power lines and several roads) in this area, only small areas are no longer useable by sage-grouse.

Wyoming

Oil and gas development in Wyoming dates to at least to 1883 (Salt Creek Field). Since that time, many additional oil and gas fields have been discovered and developed throughout areas occupied by sage-grouse. Presently, the focus is on development of CBM in northeastern Wyoming. CBM gas development, in northeast Wyoming, began in 1987 with a test well. Over the next 10 years, more wells were drilled and markets were developed for the gas. From 1997 to 2001, nearly 12,000 CBM wells were brought into production. Another 40,000 wells are expected to be developed within the Powder River Basin over the next 10 years, according to the Bureau of Land Management's (BLM) Draft EIS for the Powder River Basin Oil and Gas Project (2002). Nearly 80 percent of the production to date occurs on private surface lands with the remainder on state-, BLM-, and US Forest Service- (USFS) owned lands. Over half of the mineral ownership within the basin is private. CBM production involves drilling relatively shallow water wells into the coal seams to pump off the water and release the gas. The gas is then sent through a series of compressor stations and finally released into large transportation pipelines for sale. Discharge water is either impounded locally or released into area drainages. Each well has at least one unimproved road, an electrical line, a gas pipeline and a water discharge pipeline. For every six to10 wells, there is a small single-stage compressor. Larger, two-stage compressor stations are built for every three to five smaller compressor stations and there is a large facility for third-stage gas compression. All facilities have improved road access, utility lines, overhead power lines and underground pipelines. The expected production life of a CBM well is about seven years, depending upon the depth of the coal seam and the amount of gas present. With an estimated 25 trillion cubic feet of CBM within the Powder River Basin, the life of the development is expected to be 30 to 50 years. Prior to 2001, wells were drilled with 40-acre (16 ha) spacing. Currently, wells are drilled with 80-acre (32 ha) spacing, however exceptions to this rule are often granted to facilitate production. The disturbance from pipelines, power lines and roads is similar with either well-spacing criteria. Although the actual disturbed area from wells, compressors, pipelines and roads is relatively small (typically 15-20 acres [6-8 ha] per section), the overall project area is very large and mostly contiguous. Currently, the 12,000 active wells occur over an area of approximately 4,500 square miles (11,655 km^2). The total field development area is approximately 11,000 square miles (28,490 km^2), which will result in a total of over 300,000 acres (121,410 ha) in direct habitat loss. Predominate habitats within the CBM development area include sagebrush and grassland types, agricultural lands (hay and grain fields) and some mixed shrub communities. Most of the area is considered yearlong sage-grouse habitat, with over 200 known active leks. Not all of the area has been extensively searched for sage-grouse so the actual number of leks is considered to be much higher.

Impacts to sage-grouse from CBM development include direct loss of habitats from all production activities along with indirect effects from new power lines and significantly higher amounts of human activity, during both initial development and during production. Direct habitat loss to sage-grouse to date, with nearly 12,000 wells in production, includes an estimated 5,000 acres (2,024 ha). CBM activity has affected an estimated 28 percent of the known sage-grouse habitats within the project area. Development will continue to affect more sage-grouse habitats over the next 30 to 50 years, as new wells are drilled within areas that contain sage-grouse populations and their habitats. Should all of the project area be placed into production, over 50 percent of the sage-grouse range will be either directly or indirectly affected.

Sage-grouse population responses to CBM development are just beginning to be observed, as most of the current production has only occurred over the past four years and nearly 70 percent of the current production in just the past two years. Although CBM production is fairly recent, there are a few early indications of detrimental affects on sage-grouse as a result of this development.

There are 200 CBM wells within 0.25 miles (0.4 km) of 30 known sage-grouse leks. For these leks, there has been significantly fewer males per lek and the rate of growth is much lower, compared to other less disturbed leks

(Figure 1). Direct disturbance and loss of habitats are the suspected causes for these differences. Some 6,000 miles (9,656 km) of new overhead power lines have been constructed since CBM development began. Another 5,000 miles (8,046 km) of overhead power lines are expected as CBM development continues over the next 10 years. Currently, there are 40 known sage-grouse leks that have an overhead power line within 0.25 miles (0.40 km) of the lek. Sage-grouse numbers for these leks have a significantly lower growth rate than observed on leks that do not have an overhead power line so close to the breeding ground. Higher raptor predation rates because of perches are the expected cause. The proximity of CBM compressor stations to sage-grouse leks is also having a measurable negative impact on sage-grouse. Currently, there are nearly 200 CBM facilities within 1 mile (1.6 km) of a sage-grouse lek. Sage grouse numbers are consistently lower for these leks than they are for leks that do not have this disturbance. Direct habitat losses from the site itself, roads and traffic, and the associated noise are most likely the reasons behind this finding.

The cumulative impact to sage-grouse from all CBM activities is just starting to be observed (Figure 2). Currently, nearly 90 sage-grouse leks lie within the CBM development area, or about 40 percent of the known leks within

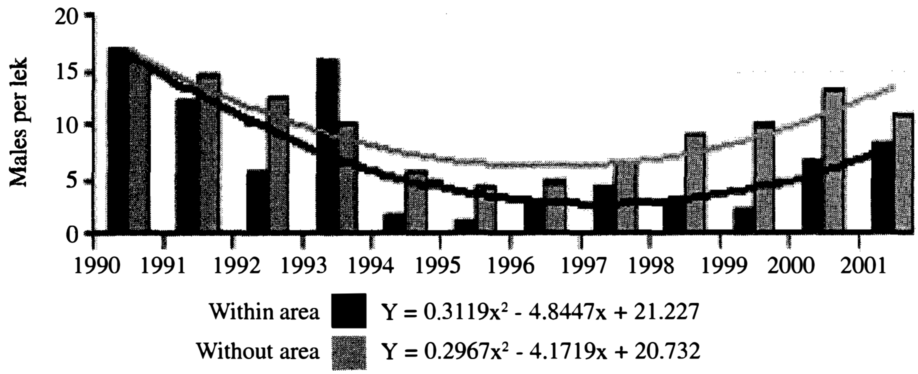

Figure 1. Sage-grouse response to CBM wells and drilling in Wyoming. Average males per lek for both leks within ¼ mile of a CBM Well (n = 30) and leks outside ¼ mile of a CBM well (n = 200). Note, since 1996 when CBM production started to significantly increase, sage grouse response in areas of gas production has been increasing at significantly lower rate that for those leks outside of this area.

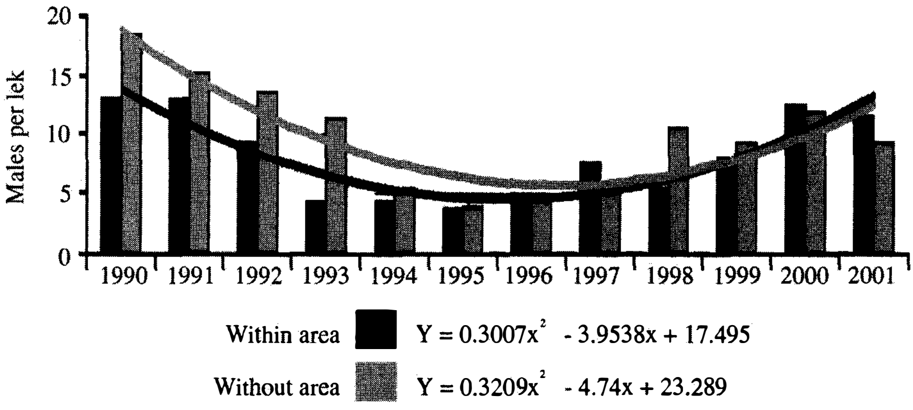

Figure 2. Sage-grouse response to the cumulative affects of CBM development in Wyoming. There are 90 sage grouse leks that have CBM development within 2 miles of the lek. Within this area, there are 3,688 wells, 168 facilities, and 872 miles of overhead power lines. The amount of direct habitat loss and displacement can only be estimated at this time. As development continues, adverse affects on sage grouse will continue.

northeast Wyoming. As development continues, another 50 to 70 lek areas will be impacted by CBM. Population monitoring most likely will reveal severe consequences to sage-grouse from this activity, however this knowledge most likely will come too late to result in any major initiatives to protect the birds or their habitats.

Mitigation of CBM impacts on sage-grouse has been minimal and usually voluntary by the operators involved because nearly 80 percent of the surface ownership is private. On federal lands, companies are required to avoid lek disturbance during the spring breeding season, reduce compressor noise near leks and place overhead power lines at least 0.5 mile (0.8 km) from any sage-grouse breeding or nesting grounds. Companies are also required to avoid sagebrush habitats when locating impoundments. All of these requirements can be waived by the federal land management agencies. There are no mitigation requirements or stipulations for sage-grouse on private land or private mineral CBM production.

Concluding Comments

The effects of oil and gas developments on sage-grouse and other sagebrush-grassland avifauna are poorly understood because of the lack of replicated, well designed studies. However, it is clear that all sagebrush-grassland dependent birds have specific habitat requirements, including shrub structure and patch size. We believe the immediate effects of development are negative and are caused by loss of habitat and disturbances associated with structures, roads and noise–especially during the breeding season. We hypothesize that the number of birds of each species will decrease with initial development, then increase to some unknown level below that prior to development. A return to pre-disturbance levels of abundance is not expected because of loss of habitat. The length of time of the expected decrease is unknown and may be species dependent, as well as dependent upon the level of activity and density of physical disturbances. Increased roads and power lines have the most potential to be negative, as does the decrease in available habitat. Increased long-term and well-funded research is needed for all bird species in areas presently and to be developed for oil and gas production, so a sound scientific basis becomes available. Cause and effect studies using an active adaptive management approach (Walters 1986), are necessary to fully understand the implications of energy developments on wildlife species. We believe it is the responsibility of the oil and gas industry to demonstrate that their activities have no negative impacts initially or eventually. We especially believe the impacts of oil and gas development have been and are negative for sage-grouse and this species, because of its requirement for large areas of sagebrush-dominated habitats, it will be placed at risk of local extirpation in intensively developed areas. Thus, we strongly recommend *Guidelines to Manage Sage Grouse Populations and their Habitats* (Connelly et al. 2000) be followed in all areas with populations of sage-grouse. This is not presently done, as agencies choose which guidelines to follow and vary their application among states, districts and resource areas, or agencies may ignore them, as is the case in both Alberta and Saskatchewan. Further, it would be desirable to have uniformity in application of habitat guidelines for all bird species among all agencies across the entire shrub-steppe region. Finally, the oil and gas industry should be expected to fully mitigate for documented decreases in useable habitat as well as in populations of specific bird species. Mitigation should also consider those impacts that can be reasonably expected, including cumulative effects. Consideration should be given to the removal of other uses of sagebrush habitats that also have cumulative effects on specific avian species as well as other wildlife.

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Potential Effects of Oil and Gas Development on Mule Deer and Pronghorn Populations in Western Wyoming

Hall Sawyer
Wyoming Cooperative Fish and Wildlife Research Unit
Laramie

Fred Lindzey
Wyoming Cooperative Fish and Wildlife Research Unit
Laramie

Doug McWhirter
Wyoming Game and Fish Department
Pinedale

Keith Andrews
US Bureau of Land Management
Pinedale, Wyoming

Introduction

Western Wyoming is home to the largest, most diverse ungulate populations in the Rocky Mountain region. Maintenance of these populations and protection of their habitats is a primary concern among public and private sectors. While urban expansion, habitat loss, disease and changes in vegetation contribute to management concerns, extensive energy development is thought to pose the most serious threat to mule deer and pronghorn populations. Southwestern Wyoming is rich with oil and gas resources and has consistently produced 10 million barrels of oil each year, with gas production increasing steadily since the early 1980s. A five-county area (Sweetwater, Carbon, Sublette, Lincoln and Uinta) produced an estimated 13.8 million barrels of oil and 885 million cubic feet of natural gas in 1998. As of 1998, there were an estimated 2,100 producing oil and gas wells in southwestern Wyoming. Between 1984 and 1998 the US Bureau of Land Management (BLM) prepared 31 National Environmental Policy Act (NEPA) documents, evaluating project proposals for oil and gas development in the area. The cumulative total of approved wells has increased from 238 in 1984 to approximately 8,500 in 1998. While the total number of new wells drilled over this period was lower than the number approved, there is a large potential for further development and much interest in new gas fields. Recently, renewed political and economic support for developing domestic energy reserves has intensified industry efforts to extract oil and gas from public lands.

In July 2000, the BLM approved the development of 700 producing well pads in the Pinedale Anticline Project Area (PAPA), and recognized that this may require as many as 900 well pads to be constructed and drilled. Additionally, 401 miles (645 km) of pipeline and 276 miles (444 km) of access roads were approved for development (USDI-BLM 2000).

Because the PAPA provides winter range for thousands of mule deer and pronghorn, development of this area may have adverse impacts on those populations. Impacts to wildlife species may be defined as the change in a population's reproduction and survival, caused by some disturbance (Anderson 1999). Determining the impacts of energy development on wildlife populations requires long-term manipulative studies, where pre-development data on survival and reproduction are available. Simply documenting a behavioral response (i.e., avoidance, acclimation, dispersal, etc.) to a disturbance does not add to our knowledge of the impact, since it cannot be linked to the survival or reproductive success of the species involved. Also, documenting a change in reproduction or survival does not add to our knowledge of the impact if the cause (i.e., weather, development, disease) of the change cannot be determined. Because of the difficulty of designing and funding a long-term, experimental study, population-level impacts of energy development on free-ranging ungulate populations generally are unknown. However, both direct and indirect impacts associated with energy development have the potential to affect ungulate population dynamics, particularly when impacts are concentrated on winter ranges, where energetic costs are great and animals occur at high densities. Direct impacts include the loss of habitat to well pads, access roads and pipelines. Indirect impacts may include changes in distribution, stress or activity, caused by increased human disturbances associated with energy development (e.g., traffic, noise, human use).

The purpose of this study was to: (1) collect pre-development movement and distribution data to assist agencies with management decisions to help minimize potential negative effects of natural gas development on big game winter ranges and migration corridors and (2) collect pre-development data to facilitate the design and implementation of a long-term study that examines the effects of natural gas development on mule deer and pronghorn populations.

Study Area

The PAPA is located in west-central Wyoming, in Sublette County, near the town of Pinedale (Figure 1). The PAPA is characterized by sagebrush, high desert vegetation and riparian areas associated with the Green and New

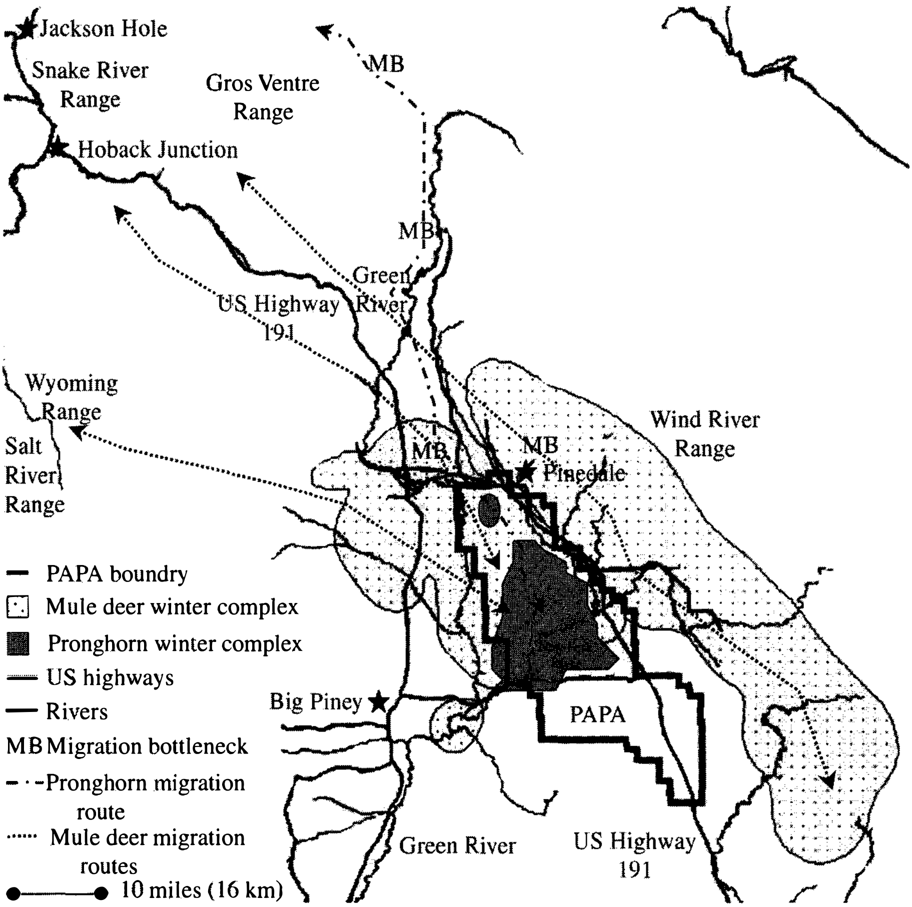

Figure 1. Location of mule deer and pronghorn winter range complexes and migrations routes, in and adjacent to the Pinedale Anticline Project Area (PAPA) in western Wyoming.

Fork Rivers. Elevations range from 6,800 to 7,800 feet (2,702-2,377 m). The 308 square-mile (798 km^2) PAPA consists primarily of federal lands (80%) and minerals (83%) administered by the BLM. All but 7.4 square miles (19.2 km^2) of federal minerals in the project area have been leased (US Department of the Interior-BLM 2000). The state of Wyoming owns 15.2 square miles (39.5 km^2) (5%), and another 46.7 square miles (120.8 km^2) (15%) are private. Aside from the rich natural gas resources, the PAPA is an important area for agriculture and wildlife. The PAPA provides winter range for 4,000 to 6,000 mule deer, winter range for 2,000 to 3,000 pronghorn (*Antilocapra americana*), elk (*Cervus elaphus*) and moose (*Alces alces*), seasonal range for 3,000 to 4,000 sage grouse (*Centrocercus urophasianus*), and seasonal range for at least 12 species of raptors (USDI-BLM 1999). The PAPA is one of two major wintering complexes used by mule deer (*Odocoileus hemionus*) in the upper Green River Basin (Sawyer and Lindzey 2001).

Methods

Helicopter net-gunning was used to capture and radio-collar adult (greater than one year) female pronghorn on summer ranges. Capture work was restricted to early morning hours (0600-1000 hrs) to avoid running pronghorn in hot (greater than 75° F, 24° C) conditions. Radio-collared pronghorn were located from fixed-wing aircraft once a week during the fall migration, October through November. Telemetry flights (Figure 1) were reduced to once a month during the winter. Pronghorn were located from the ground and air during the spring migration.

Helicopter net-gunning was also used to capture and radio-collar adult mule deer on winter ranges. Telonics (Generation I and II) radio-collars were equipped with both very high frequency (VHF) transmitters and global positioning systems (GPS). The Generation I GPS units were capable of collecting 700 locations over one year and were programmed to obtain locations every nine hours, during migration periods, and every 25 hours, during summer. The Generation II GPS units stored 2,600 locations and were programmed to collect locations every hour from January 1 to April 15. All GPS radio-collars were store-on-board units that had to be retrieved before data could be downloaded. Helicopter net-gunning was used to recapture deer and retrieve Generation I GPS collars. Generation II GPS collars were equipped with remote release mechanisms that were activated at a specified time and date. Radio-collared deer were located from fixed-wing aircraft approximately every 10 days, during spring and fall migrations, and once per month, during summer. Additionally, radio-collared deer in the PAPA were monitored with ground telemetry during the winters of 1998 to 1999 and 1999 to 2000. Monitoring began in February 1998 and ended in October 2000.

ARC-VIEW (Version 3.2) was used for spatial analysis and mapping distribution data. Winter range boundaries were delineated using a 90-percent adaptive kernel home range technique on winter locations (November 15-April 30) of deer and pronghorn. Locations obtained from GPS collars and ground monitoring were excluded from estimates of winter dispersion to avoid results biased towards individual deer with many locations. Animals were considered migratory if their summer and winter home ranges did not overlap (Brown 1992). Winter and summer fidelity was examined by comparing locations of individual pronghorn among consecutive years.

Results

Capture

We captured and radio-collared 171 adult mule deer (144 standard VHF collars, 17 GEN I GPS collars, 10 GEN II GPS collars) across winter ranges in and adjacent to the PAPA, between February 1998 and January 2001. The capture sample included 12 males and 159 females.

We captured and radio-collared 34 adult female and one yearling female pronghorn in July of 1998. The capture sample reflected the proportionate distribution of pronghorn across the summer ranges, with approximately two thirds (n = 23) of the radio-collars distributed in Grand Teton National Park (GTNP) and the other third (n = 12) in the Gros Ventre River Drainage (GVRD), near Jackson, Wyoming.

Mule Deer Seasonal Movements and Distribution

We collected 34,570 locations from 166 radio-collared deer between February 1998 and April 2001. Approximately 29,844 of these locations (86%) were obtained from the 25 GPS collars (2 others malfunctioned). The other 14 percent (4,726) of locations were collected from ground and aerial telemetry. Of 166 radio-collared deer we monitored, 96 percent (n = 159) were considered migratory. Most deer from the PAPA seasonally migrated 40 to 100 miles (64-161 km) north or northwest to summer in portions of four different mountain ranges: the Wyoming Range, Salt River Range, Snake River Range and the Gros Ventre Range.

Deer from different winter complexes often shared common transition ranges, parturition areas and summer ranges. Transition ranges generally occurred between 7,000 and 8,000 feet (2,134-2,438 m) and were characterized by abundant grass and forb communities intermixed with mountain shrub communities. Deer typically occupied these ranges for four to five months during the year, usually April, May, early June, November and December. Spring migration of mule deer progressed north as snow melted and new plant growth provided abundant, high-quality forage. Most deer (70%, n = 101) that were monitored through a complete year gave birth on mid-elevation transition ranges before moving onto high-elevation summer ranges. Summer habitats were characterized by rugged terrain and abundant forb communities that occurred between 7,000 and 10,000 feet (2,100-3,048 m).

Data collected from GPS collars indicated deer migrated at a gradual, steady pace, rather than quickly over long distances. Typical daily movements during spring and autumn migrations were one to three miles (2-5 km). Given that GPS location attempts were scheduled every nine hours, the average distance between each location was usually less than 1 mile (1.6 km). Most movement during the spring migration occurred in May, when the average distance increased to 1.1 miles (1.8 km) between GPS locations. Although most deer arrived on summer ranges by late-June, periodic movements of one to four miles (2-6 km) were not uncommon during July, August and September. Mule deer generally remained on summer range from July through October, and they occasionally remained through November. Most autumn movement occurred in November and December, after the hunting seasons and prior to heavy snow accumulation. Many deer remained on transition ranges north of the PAPA winter ranges during November, December and, occasionally, early January, when weather conditions allowed.

Mule deer densities in the PAPA were highest from January through March. Mule deer were evenly distributed across the northern half of the PAPA, when snow depths were less than six to eight inches (15-20 cm). However, as snow depth increased, mule deer generally moved off the high-elevation areas into the breaks around the perimeter of the PAPA. Mule deer demonstrated strong fidelity to their seasonal ranges, generally occupying areas zero to five miles (0-8 km) apart in consecutive seasons. All but two mule deer captured in the PAPA winter range complex returned in subsequent winters, and all but one used the same summer ranges during consecutive years.

Pronghorn Seasonal Movements and Distribution

Pronghorn seasonal ranges and migration routes were identified using 918 aerial locations obtained from 33 radio-collared pronghorn. Fieldwork conducted during spring migrations resulted in additional observations of collared and non-collared pronghorn moving between winter and summer ranges. Continuous observation of migrating radio-collared pronghorn was often possible and helped determine specific migration routes (Sawyer and Lindzey 2000a). Pronghorn generally migrated out of GTNP and the GVRD in October and November, crossing the 9,100-foot (2,774 m) hydrographic divide that separates the Gros Ventre and Green River drainages. Pronghorn then migrated southerly, 80 to 100 miles (129-161 km) down the Green River to winter ranges in and adjacent to the PAPA.

An estimated 2,000 pronghorn, including 85 percent (n = 27) of the radio-collars, occupied winter ranges within the PAPA, from November through early-April. Although several pronghorn (15%, n = 5) spent the majority of winter south of the PAPA, all migrated through the area and used it as a spring transition range, during their three-month, 100 to 150 mile (161-241 km) migration back to GTNP and the GVRD. Radio-collared pronghorn were usually distributed among 15 to 20 distinct herds. Winter (November-April) distribution of GTNP and GVRD pronghorn was similar; mixing of groups was common. Pronghorn and mule deer were generally spatially separated from December through February, as pronghorn occupied the lower-elevation sagebrush flats and agricultural fields adjacent to the New Fork River. However, when snows began to recede in March, mixing of mule deer and pronghorn in the higher-elevation sagebrush communities of the northern PAPA was common. Deer tended to move off the PAPA earlier (mid-March) than pronghorn in the spring, after which pronghorn shifted into those areas deer occupied for the more severe winter months, until they continued the migration north in April.

Most (86%, n = 24) pronghorn monitored through two winters returned to winter ranges within the PAPA and occupied consecutive wintering areas within 5 miles (8 km). Although pronghorn spent most winters in close proximity

(0-3 miles) of the New Fork River, they used nearly the entire northern half of the PAPA, from November through April. Periodic southerly movements of 10 to 20 miles (16-32 km) were made by 8 of the 24, but only for brief periods. The four (14%) pronghorn that did not use the same winter ranges during consecutive years appeared to be very mobile, never remaining in one area long. It was not uncommon for these pronghorn to move 20 to 40 miles (32-64 km) at a time during the winter. All pronghorn captured in the GVRD demonstrated strong site fidelity to summer ranges, while as many as 40 percent of GTNP pronghorn used summer ranges in different areas.

Migration Bottlenecks

Radio-collared mule deer and pronghorn seasonally migrated 40 to 150 miles (64-241 km) between winter and summer ranges. Several bottlenecks were identified along migratory routes. We defined bottlenecks as those areas along migration routes where topography, vegetation, development or other landscape features restricted animal movements to limited regions (less than 0.5 mi, 0.8 km). Some bottlenecks exceeded 1 mile (1.6 km) in length and were less than 0.25 miles (400 m) in width. Several bottlenecks were used exclusively by pronghorn, while others were used by both mule deer and pronghorn. Telemetry records indicated approximately half of the deer (2,000-3,000) and most of the pronghorn (1,000-1,500), that winter in the PAPA, migrated through at least one bottleneck, and as many as five migrated through twice a year. Pronghorn traveled quickly through bottleneck regions and used open gates and roads to facilitate movements through fenced areas (see Sawyer and Lindzey 2000a, Sawyer and Lindzey 2001).

Discussion

Mule deer migrations in western Wyoming generally were much longer than movements of other deer populations in the western states, including Colorado (Garrot et al. 1987), Idaho (Brown 1992, Merrill et al. 1994), Washington (Eberhardt et al. 1984) and California (Nicholson et al. 1997). Although mule deer migrations of 60 miles (100 km) have been reported in parts of Montana (Mackie et al. 1998) and Idaho (Thomas and Irby 1990), the mule deer herd on and adjacent to the PAPA is likely the most migratory deer population in the western states. The 100- to 150-mile (161-241 km) seasonal pronghorn migration appears to be the longest of its kind in North America. Mule deer and pronghorn management in western Wyoming is complicated by the long-distance (40-150 mi, 64-241 km) migrations that occur through a variety of habitats and across a mix of land ownership. Because the PAPA provides winter range for mule deer that occupy four different mountain ranges across western Wyoming and pronghorn that summer, greater than 100 miles (161 km) away, conserving seasonal ranges and migration routes is essential for the long-term maintenance of this population. Additionally, potential negative effects of oil and gas development will not be localized or restricted to the PAPA, rather they will be evident across western Wyoming and the summer ranges these animals occupy.

Similar to other studies (Eberhardt et al. 1984, Garrott et al. 1987, Thomas and Irby 1990, Brown 1992, Porter 1999, Sawyer and Lindzey 2000b), mule deer in western Wyoming demonstrated some degree of fidelity to winter and summer ranges. Although traditional use of pronghorn winter ranges has been documented in Alberta (Barret 1980) and Wyoming (Ryder et al. 1984), winter distribution of other pronghorn herds tends to be weather dependent and annually variable (Bruns 1977, Hoskinson and Tester 1980, Mitchell 1980, Raper et al. 1989). Winter range fidelity of pronghorn to the PAPA appeared high, at 86 percent. Consistent, documented use of seasonal ranges should allow agencies to modify seasonal range maps used to assist with management decisions and identify mitigation opportunities. Current range maps used by state and federal agencies in Wyoming underestimate the amount of winter range consistently used by mule deer and pronghorn in the PAPA. Winter range designation is intended to identify areas critical to the survival of a given population. Designated crucial winter ranges receive special protection on public lands and guide management decisions by federal agencies in situations where land-use practices may have adverse impacts. Accurate delineation of crucial ranges will assist state and federal agencies with ungulate management and improve the NEPA process by providing quality data for environmental impact statements (EIS) and environmental assessments (EA). Aside from parturition areas, designated crucial winter ranges are typically the only habitats considered in EIS impact analyses for big game.

The function of winter range is to decrease the rate at which adult and fawn body condition declines by providing forage and thermal cover. Because most native forages available during the winter are often too low in nutritional value to meet the energetic requirements of deer (Wallmo et al. 1977), they must accumulate energy reserves prior to winter, on summer and transition ranges, if they are to survive. Deer cannot maintain body condition on winter ranges because of poor or moderate forage availability combined with the increased cost of thermogenesis (Reeve and Lindzey 1991). Body condition and energy reserves gradually decline over winter as deer expend more energy than they take in (Short 1981). The rate at which body condition declines depends on forage quality, forage availability, winter severity (temperature, wind speed, snow depth) and age class. Although little can be done to reduce the energetic costs of animals traveling through snow, unnecessary energy expenditures can be reduced by limiting human-related disturbances (Parker et al. 1984). The energy balance determining whether a deer will survive the winter is thought to be relatively narrow, especially for fawns (Wood 1988). Overwinter survival of deer, particularly fawns, may decrease in response to human activity or other disturbances (Stephenson et al. 1996). Successful overwinter survival depends on the ability and capacity of the winter range to minimize the rate at which body condition declines. If natural gas development in the PAPA reduces the ability or capacity of the winter range--either directly, by habitat loss, or indirectly, by human disturbances that increase energy expenditures–mule deer and pronghorn populations will suffer.

Unlike other mule deer populations (Ryder et al. 1985, Gillin and Lindzey 1986, Allen 1995, Porter 1999, Sawyer and Lindzey 2000b), deer from the PAPA utilized a large area of mid-elevation transition range during spring and autumn migrations. As a result, the rate of movement (0-3 mi, 0-5 km per day) by migrating deer was substantially slower than travel rates in Idaho, where mule deer migrations were characterized by rapid movements of 3 to 12 miles (5-20 km) with periodic breaks (Thomas and Irby 1990). Seasonal migrations of mule deer captured in the PAPA took as long as 90 days to complete. The relatively gradual rate of movement and extended periods of time spent on transition range demonstrated the importance of this habitat component to the PAPA mule deer herd. In the absence of high quality forage on winter range, the most appropriate migratory behavior for deer is to remain on high-elevation ranges, where vegetation is typically of better quality (Garrott et al. 1987). Small improvements in body condition during late autumn or early winter may substantially reduce overwinter mortality (Hobbs 1989).

Generally, transition ranges provide deer with better foraging opportunities than those often available on winter ranges, allowing them to recover body condition earlier in the spring and maintain body condition later in the fall, before entering winter (Short 1981). Effective transition ranges alleviate pressure on winter ranges and minimize the amount of time deer must spend on winter range. Thus, maintenance of effective transition ranges not only increases mule deer survival and productivity, but also contributes to the health and vigor of winter range forage by minimizing its use. The ability to alter their rates of movement, even to retrace their movements if weather dictates, to change their pathways as needed and to hesitate before moving onto summer or winter ranges are behaviors that allow mule deer to best exploit transition ranges. Energy development, housing subdivisions, road networks, fences, increased human activity and other changes on transition ranges that reduce options available to mule deer will reduce the effectiveness of these ranges, just as they will on winter ranges within the PAPA. As oil and gas development within the PAPA increases, active management and conservation of transition ranges will be key when attempting to maintain healthy mule deer herds in western Wyoming.

Summer, transition and winter ranges are equally important components to the PAPA mule deer population. The importance of each likely will change annually, but loss or degradation of one will not be compensated for by the others, and the mule deer population will suffer in the long-run. Managers should recognize the importance of all seasonal ranges for maintaining healthy and productive mule deer populations (Short 1981, Clements and Young 1997). Currently, summer ranges appear most secure because of their large size, productivity and land-status in the Bridger-Teton National Forest. The smaller transition and winter ranges, however, are threatened by extensive energy development on BLM lands and subdivision expansion on private parcels. The importance of seasonal ranges to mule deer or pronghorn is of little consequence if migration routes to and from these ranges are not maintained. Bottlenecks create management concerns because the potential to disrupt or threaten established migratory routes is much greater in these areas. Misguided development or other land use practices may easily fragment and further restrict wildlife access through these naturally occurring bottlenecks. Archaeological records suggest ungulates have migrated through at least one of the identified bottlenecks for thousands of years (Miller et al. 1999). A recent dig, conducted by the Office of the Wyoming State Archaeologist, documented a 6,000 year-old pronghorn kill site in the core of the Trapper's Point bottleneck. Prehistoric hunters took advantage of the natural bottleneck and killed migrating pronghorn with primitive stone-tipped weapons. Small amounts of mule deer remains were also revealed. The development of fetal bones found at the site indicated the kills occurred in late March or early April, corresponding with the timing of modern-day pronghorn migrations through this corridor. Focusing conservation efforts on bottleneck areas may provide a sound, objective method to prioritize management concerns and direct proactive measures towards maintaining long-distance migrations.

Oil and gas development on the PAPA will result in additional roads (276 mi, 444 km), pipelines (401 mi, 645 km), habitat loss (700-900 well pads), fences and increased human disturbance on winter ranges used by thousands of mule deer and pronghorn in western Wyoming. How, when and to what degree mule deer and pronghorn populations will be impacted is unknown. However, reduction in effective winter range size, potentially caused by extensive natural gas development in the PAPA, may increase deer density on remaining winter ranges, reducing forage quality, fawn survival and overwinter carrying capacity. Overwinter fawn survival decreases as densities approach carrying capacity (White et al. 1987, Bartmann et al. 1992), and low overwinter fawn survival may be interpreted as density-dependent population regulation (Bartmann et al. 1992). A reduction in winter range capacity also increases the probability of deer moving onto poorer quality ranges, where adult survival is further decreased. Additionally, any reduction in the ability of mule deer or pronghorn to move freely on winter ranges reduces their options for coping with a variety of environmental conditions (i.e., snow depth) and human disturbances. Flexibility in movement across ranges is ultimately reflected in the survival and productivity of the deer population and likely enhances their ability to recover from population declines. Brown (1992) suggested that winter movement flexibility also reduced mule deer density and competition for available resources.

The acquisition of GPS and geographic information system (GIS) technologies now allow visualization, analysis and recognition of land use patterns of radio-collared animals across large spatial scales. The combination of intensive telemetry study (funded by industry) and GIS capabilities identified potential concerns for managers of the mule deer and pronghorn populations that winter on the PAPA. Migration routes where natural and man-made features funnel movements of many mule deer and pronghorn through narrow corridors (bottlenecks) are examples of situations where the need for action is obvious, and the lack of action will be detrimental to mule deer and pronghorn in western Wyoming. These same data may form the basis for guiding the development of energy resources and housing subdivisions, with conservation of mule deer and pronghorn populations in mind.

The major shortcoming of efforts to evaluate the effects of disturbances on wildlife populations is that they seldom are addressed in an experimental framework, but rather tend to be short-term and observational in nature. Ideally, these pre-development data will be used to design an experimental study, with the cooperation of industry and agencies, that examines the long-term effects of oil and gas development on mule deer and pronghorn distribution, reproduction and survival.

Acknowledgments

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Closing Remarks

Len H. Carpenter
Wildlife Management Institute
Fort Collins, Colorado

First, I would like to thank all the speakers for providing excellent insights to the issues at hand.

I will now highlight some key points from these presentations and provide thoughts on potential strategies to address these points.

The topic of this session is not a new one. In 1989, the International Association of Fish and Wildlife Agencies charged a committee to develop guidelines for "oil and gas development and fish and wildlife resources." The committee developed and published a four-year, comprehensive analysis of state and federal wildlife agency rules, regulations and guidelines, which existed to protect fish and wildlife resources in oil and gas development areas. Much information in this document applies today and should not be overlooked by those interested in this topic.

Today, we learned that energy resources are not distributed around the world in an even manner. They are concentrated. Consequently, there will be certain geographical areas, which will be most influenced by energy developments. As Dru Bower remarked, "the resources are where they are."

Generally, in the United States, many of these energy sources are located mid-continent and in the Rocky Mountain West, and they tend to be associated with the sagebrush steppe ecosystem, which supports many important and highly valued bird and mammal species. We learned about importance of large landscapes to migratory species, such as pronghorn and mule deer, and important bird species, such as sage grouse. Hall Sawyer emphasized the need to protect the few historical "bottlenecks" or funnels that serve as critical access points to these migrations.

We learned that, while domestic oil production may be decreasing in the United States, production of other energy reserves, such as natural gas and coalbed methane, are increasing. This is especially true in Wyoming, Colorado, Utah and New Mexico. However, coalbed methane developments could become prominent in numerous other areas across North America.

It was discussed how direct habitat (surface acres) lost to oil and gas development may not be large in terms of total land base (i.e., 24.5 out of 640 acres). However, we learned that indirect impacts, such as roads, power lines, compressor plants and habitat fragmentation, are bigger concerns for the well-being of many species of wildlife, including sage grouse.

We heard there are sharply different perspectives on the adequacy of environmental protection strategies. It was suggested there are adequate existing environmental protections in place, but they are neither adequately implemented, monitored or enforced.

Tom Lustig discussed the importance of updated, land-use plans to guide where and how energy developments occur. He pointed out that, currently, surface restrictions or stipulations are the most commonly used environmental protection strategies. He also observed that stipulations typically only apply during exploration and development stages, and they do not apply during the production phase.

Tom addressed importance of a thorough environmental analysis being completed during the leasing stage. Unfortunately, this is not done currently. This is an important issue, which federal agencies need to address in updates of land-use plans.

We heard several times that we do not know the effectiveness of wildlife protection strategies commonly employed. The value of many of these is purely speculative and debatable.

A general lack of knowledge is a definite limitation to the credibility and effectiveness of our public agencies. We need carefully designed, experimental, long-term studies with adequate controls to provide this knowledge. These studies need to be applied to an adaptive management framework that drives management decisions. Obviously, as Dru Bower indicated, the studies must be objective and free of bias.

In absence of this approach, it is predictable that we will merely continue to chronicle the demise of many of these important wildlife resources. The need for better science must be heeded by everyone if we are to implement the president's energy plan.

There is a difference in opinion as to whom should pay for these studies: proponents of developments, federal government, state government or all of the above. It was clear that state fish and wildlife agencies are not adequately funded to do this job alone. Today's speakers referenced positive cooperative approaches that have been tried in Wyoming. These should be further expanded and explored.

One question that emerged from today's session is at what cost do wildlife and fish adapt to further intrusions on the landscape because of energy development? Neither wildlife managers nor the energy industry have the answer to this important question.

To date, the Bureau of Land Management has not been willing to consider the larger issue of incremental effects. The issue, in most cases, will not be that a single road nor a single development nor a single industry should be blamed for its effects on wildlife. The issue is at what point do cumulative impacts become insurmountable? The habitats of mule deer, elk, pronghorn, sage grouse and other wildlife have long been affected by roads, fences, agriculture and urban developments. This approach was referred to by Tom as the "weasel of nibbling."

Big game animals migrating long distances depend on many seasonal habitats. How long can these historic migrations continue if key pathways to these seasonal habitats are altered or lost?

The draft environmental impact statement for the Powder River Basin Oil and Gas Project, in Wyoming, currently under review, acknowledges that for many sensitive species in the project area, the proposed development may adversely affect individuals, may result in a loss of viability on federal lands or range wide, and may result in a trend toward federal listing. We must all work to avoid the need to list species under the Endangered Species Act.

Debra Higley reminded us of the tremendous challenges facing us as we deal with water quantity and quality issues associated with coalbed methane developments.

A critical need for coping with these expected impacts is effective, science-based monitoring designed to answer specific questions about survival and reproductive status of animals in impacted populations. Obviously, these measurements must be made on populations not facing developments to serve as controls.

Many effects of accelerated energy development are subtle, long-term and difficult to measure. This outcome results in a continuing standoff where wildlife mangers say, "Look at those roads, structures and activities; they obviously have an impact," and development interests say, "Look at the wildlife standing around the structures; they do not bother the wildlife." This impasse of differing opinions settles nothing!

Because funding for these studies seems to be a key need identified by our speakers, I would like to suggest a strategy deserving more attention.

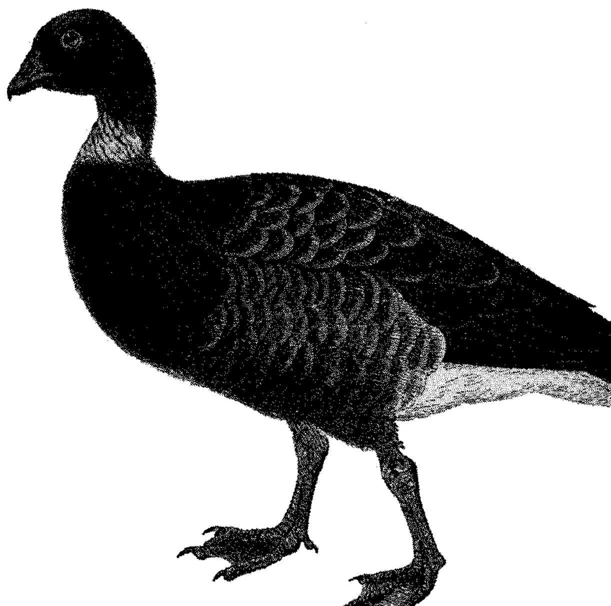
A fund for energy development and wildlife measures is an idea that the Wildlife Management Institute and others have been developing. Federal and state revenues from energy development are significant, and federal revenues already collected from onshore oil and gas producers that currently go into the United States Treasury offer a logical source of funding for this need.

For a specified number of years, a portion of these funds could be redirected to build a substantial dedicated fund. Annual proceeds from this funding base would be available for monitoring and evaluating impacts, and for wildlife habitat protection and enhancement for those habitats influenced by development. Once sufficient funds were available, all revenues could once again be returned to the federal treasury.

These funds would provide an opportunity to learn and document the long-term nature of impacts and would suggest appropriate management strategies to minimize these impacts. All appropriate property rights and other concerns could be dealt with directly in the proposed legislation. Designated funds, in proportion to development activity in each state, would be returned to pay for programs to manage wildlife impacts through the development period.

I might note that a similar proposal in Wyoming recently died in the state legislature. This proposal, called The Wildlife Legacy Trust, called for a portion of existing state mineral revenues to create a permanent endowment, with interest income used to maintain and enhance Wyoming's renewable wildlife resources. The goal of this proposal was to build a trust fund to provide \$20 to 25 million in annual interest to fund needed projects.

Sound scientific information is critically needed before we can answer the question "does big oil mix with big game?" Significant steps must be taken to fund this knowledge base. We suggest that implementing this funding concept or something similar would reflect positively on Congress, the administration and the energy industry. It would also bring solutions back to the states where the issue arose. We urge your support of this approach.



Special Session Six.
Conservation, Communication, Commitment: Moving Forward with Farm Bill 2002

Chair
Ronald Helinski
Wildlife Management Institute
Washington, DC

Cochair
Krysta Harden
American Soybean Association
Washington, DC

Panel I: Modeling Conservation and Commodity Successes via the 1996 Farm Bill

Opening Remarks: Are We There Yet?

Ronald Helinski
Wildlife Management Institute
Washington, DC

Welcome to the Special Session entitled, *Conservation, Communication, Commitment: Moving Forward With Farm Bill 2002*. My name is Ron Helinski, Conservation Policy Specialist with the Wildlife Management Institute. I want to express my appreciation to my co-chair, Krysta Harden, of the American Soybean Association, Myra Hyde, of the National Cattlemen's Beef Association, Kirby Brown, of Texas Park and Wildlife, Tom Van Arsdall, of the National Council of Farmer Cooperatives, and Pete Heard, of the Natural Resources Conservation Service (NRCS) Wildlife Habitat Management Institute (WHMI) for their assistance when pulling this session together.

Today's session is relevant to contributing to the success of the future Farm Bill. We will highlight and model what it takes to make Farm Bill conservation programs successful, to meet both landowner, economic and conservation goals.

Since 1985, conservation has been a major objective of the Farm Bill. Here we are, 17 years later, continuing to work toward a better environment for farmers, ranchers and society alike. The Farm Bill conservation programs have produced some major successes. The successes are the product of the hard work of private landowners, along with many cooperators from various groups, many of which are present today. It is important that the groups desired to contribute to a similar goal. All value the land, its soils, the water that runs through their property, as well as the wildlife surrounding their homes. Farmers and ranchers want what is best for the land, for it is the foundation of their livelihood.

We have learned, over these past years, the ability to talk to each other, to share ideas and to seek resolution to farm and ranch conservation problems. We can achieve our mutually desired goals, be they economic or environmental. Yes, it can be done; we are not there yet!

Collaborative efforts and partnerships have enabled us to take significant steps forward in the interest and pursuit of conservation. Today, we have a unique opportunity to see and hear about both economic and conservation successes. I want to begin by sharing a video, produced by NRCS-WHMI, entitled *Land of Life*. It will help set a tone for today's special session. It was developed in cooperation with both commodity, conservation, agribusiness and governmental agencies. It is a tribute to farmers and ranchers and a reminder of the importance of the inter-relationship and co-dependence between farmers, ranchers, fish and wildlife habitat, and our environment.

Success comes through hard work. It takes vision on behalf of the landowner to create a successful farm or ranch. It does not come via luck. As shown in your program, we have two panels today. Those speakers will share the realities of what it takes to be successful in today's agricultural setting. We will see what it takes to accomplish both economic and conservation goals; we will look at the future and get recommendations to best take advantage of the opportunities being offered via the next Farm Bill.

Ranching Successes on the Texas Gulf Coast: Achieving Mutual Economic and Conservation Objectives

Bob McCan
National Cattleman's Beef Association
Victoria, Texas

Introduction

My name is Bob McCan, and I represent the National Cattleman's Beef Association, as their Vice-Chairman for the Property Rights and Environmental Committee. I also represent Texas and Southwestern Cattle Raisers Association (TSCRA), on which I serve as First Vice-President.

I am a fifth generation rancher from Victoria, Texas. I grew up in Victoria County working on my family's property, the McFaddin Ranch. In 1980, I graduated from Texas A&M University with a degree in Range Science. After a year or two of working in a feedyard in the Texas Panhandle, I came home to work for the family operation.

After going through a family property partition in 1987, our immediate family restructured our operating company to make it strictly cow and calf production and a recreational hunting operation. Historically, we had operated lease hunting operations with our cow-calf operation, so we felt these were our areas of expertise. At about that time, I was given the lead managing position and the responsibility of managing the 75,000-acre operation. Seventy percent of our operation is on leased property, and the other 30 percent is on two separate family-owned properties, most of which is comprised of native pastureland. Our ranch in southern Victoria County comprises about 13,000 acres, which sit in the heart of the Gulf Coast Prairie Eco-region of Texas.

My first task was to set goals for the company and the property. Having experienced one family property partition already, it was of utmost importance that the ranch produce as much economic benefit as possible to our heirs and still be able to protect and improve our resources. Some of the inherent problems of the ranch were brush encroachment onto the native prairie. I wanted to increase our livestock production levels, such as weaning weights and conception rates. Our white-tail deer populations were satisfactory, but not what they could be. I wanted sustainable solutions that would incorporate our economic goals and our conservation goals. These goals had to be mutually beneficial for our cattle company and our wildlife hunting enterprises.

Most of these goals could be achieved by implementing a good rotational grazing system and establishing better water and range conditions for game and cattle. Also, our pastures were too large (2,500-3,000 acres) to effectively manage. Any brush control management system would have to be multi-tiered, incorporating mechanical, chemical and prescribed burning. Therefore, we began cross-fencing to facilitate burning our pastures to allow deferments, better range improvement and better nutrition for wildlife and the cow herd.

It became evident that improvements were going to be very expensive and would take a long time to complete with the existing cash-flow projections. There was a definite need for a cost-share program, as well as some technical expertise. Then, in 1992, I became involved with our local Soil & Water Conservation District, and I learned more about, what I like to refer to as, our federal-state-local conservation delivery system. I refer to the Natural Resource Conservation Service's (NRCS) relationship with the State Soil and Water Board and our local Soil and Water Boards.

The local Soil and Water Board was able to help me to establish our rotational grazing system. I also discovered a good cost-share program, called the Coastal Prairie Conservation Initiative, which I will talk more about later.

The ranch originally had seven pastures, ranging in size from 800 to 3,500 acres, and we had six herds of cattle. Now, we have 14 pastures, ranging in size from 500 to 800 acres, and we have three herds. Basically, we have two five-pasture, one-herd systems; we have one four-pasture, one-herd system, and we have one set of working pens on this particular ranch.

Working with the NRCS and the local Soil and Water Conservation district, I became aware of the Grazing Lands Conservation Initiative (GLCI). This was a movement to try more technical practices to help private landowners. In the 1996 Farm Bill, GLCI was acknowledged and given financial allocations. So far, this program has been very successful in many states by helping to provide technical help in areas where it is severely lacking. In my area of the state, we now have a grazing land specialist and other range specialists that are available through our cost-share program, the Coastal Prairie Conservation Initiative.

In 1997, I signed a 10-year contract with the Coastal Prairie Conservation Initiative. This program is funded by the US Fish and Wildlife Service (FWS). It was started by the Sam Houston R.C.&D. Council, which is a larger version of Soil & Water District Board. The R.C.&D. Council wanted a native prairie habitat restoration program and hoped it might help endangered species, such as the Atwater prairie chicken.

The board's biggest fear was that private landowners would be scared of the program and not utilize funding it had acquired. Therefore, it got a Safe Harbor Permit for the program. The program protects two species: the Atwater prairie chicken and the Houston toad. Landowners are required to perform baseline survey.

At that time, Environmental Quality Incentive Program (EQIP) contracts were very hard to obtain. They discriminated against large operations, and they penalized good operations. Therefore, we were very fortunate to be involved with this program, which is also administered through our local Soil and Water District. This program has done well in the last few years. Last year, in my area of the state, it signed about six ranches that range from 6,000 to 20,000 acres.

Safe Harbor protection is certainly attractive, as well as a provider of extra technical assistance. The program is voluntary and tries to keep flexibility in the program for landowners. Not only will this conservation program achieve habitat improvement for all the native wildlife species, but it has helped me tremendously, as a ranch manger, to reduce operating costs for the cattle company. By providing fresh pastures for the herds every two to three weeks, I can maintain good nutrition throughout the year.

To give an idea of how these economic investments from our company and the cost-share program have paid off our economic and conservation goals:

- The cost-share program made it happen much faster, and the technical assistance we received has made me a much better manager.
- White-tail deer populations have increased, wild turkey populations seem to be flourishing, as well as bobwhite quail.
- Hunting lease values have increased from $4.50 per acre to $7.00 per acre.
- Weaning weights on our cattle operation have increased significantly, as well as our conception rates.
- Supplemental feed costs on our cows were cut to $15 to $20 per head.

- Cow herds can now sustain droughts better.
- The native plant diversity has exploded for two reasons:
    - more vetches and clover grow than before and
    - better perennial grasses, such as Indian grass, little bluestem and switchgrasses, have increased substantially; we now have colonies of big bluestem in every pasture on the ranch, where, prior to our rotation system, we had none.
- We better facilitate prescribed burning, which is critical in our brush control progress, by rotating our pastures; burning also provides better nutrition for cattle and wildlife.

I would like to leave you with food for thought about the 2002 Farm Bill and other government programs. I think it is a given that there is going to be more dollars for conservation programs. This is good, however we need to ensure that we can provide the levels of technical assistance needed to carry out these programs. As I mentioned before, the federal, state and local conservation delivery system is the best way to provide this. Programs like GLCI need to be continued and funded at higher levels in order to make sure private landowners will receive technical asistance (TA) on a voluntary basis, with respect for our private property rights. EQIP can be a great program; we need more flexibility within the states, to the local levels. Keep the TA at the NRCS where they know how to apply it. Do not let the Endangered Species Act (ESA) be a deterrent to attracting landowners to these programs.

The best solution is to replace the ESA with more science-based, common-sense, species-recovery programs that focus more on habitat recovery. Land fragmentation is one of the main reasons for habitat loss and loss of wildlife species. Also, one of the largest reasons for land fragmentation is the estate tax, or death tax. Let us make the death tax repeal permanent.

Private landowners have embraced the programs I have spoken about today because:

- it is voluntary;
- it is mindful of private property rights;
- they can work with local administrations in the delivery of the program;
- it does not penalize for endangered species, on the other hand it rewards for habitat improvement through financial assistance.

Takings and condemnations do and solve anything. Private landowners can manage wild lands more efficiently than government bureaucracies can, so let us remove the barriers to give us the tools we need to be the best environmental stewards we can be.

Land and Wildlife Stewardship in the High Plains of Texas: Combining Conservation Programs with Successful Agriculture

Randy M. Sublette
Sublette Farms
Dalhart, Texas

Gene T. Miller
Texas Parks and Wildlife Department
Canyon

My family and I operate Sublette Farms, located in Hartley County, just east of Dalhart in the High Plains of Texas. Our area is also referred to as the Southern Great Plains and the Playa Lakes Region, and we may receive 16 inches of rainfall in some years. To give some geographical perspective, we are located closer to the state capitols of New Mexico, Colorado, Kansas and Oklahoma than to Austin, the capitol of Texas. A portion of the land we farm today was established as an agricultural operation by my father-in-law, pioneer farmer H. H. Hogue, who moved from Oklahoma to the Texas Panhandle in 1932. He arrived just in time for the Dust Bowl, yet he survived drought and economic hard times, holding on to his farm. Furthermore, he lived to see the health of his land restored through installation of modern soil and water conservation practices during an era of tremendous agricultural production and economic prosperity in the last century. Today, our family's operation is comprised of 5,700 acres of irrigated and dryland farming that provide a home for wildlife through the voluntary use of state, federal and private conservation programs. We farm approximately 3,500 acres of center-pivot irrigated corn, approximately 500 acres of irrigated wheat, approximately 500 acres of dryland wheat and sorghum, with rotations of alfalfa and soybeans on irrigated acreage utilizing conservation tillage techniques. We have seeded 1,200 acres of farmland with permanent cover, using the Conservation Reserve Program (CRP), and established woody habitat plantings for wildlife, through the Stewardship Incentives Program (SIP). We plan to continue habitat enhancements by using the Continuous Conservation Reserve Program (CCRP) to install additional woody plantings for wildlife (McKenzie 1997), and we plan to restore a small playa wetland basin and buffer area, using free technical assistance and monetary incentives offered through

Playa Lakes Joint Venture (PLJV). During the next few minutes, I will describe strategies that have worked for us in integration of habitat improvements into our farming operation, why we believe these practices have worked, and I will provide examples of incentive programs that we utilized to achieve habitat improvements and enhanced aesthetics. Finally, I will offer some thoughts and suggestions regarding implications of the 2002 Farm Bill (Wildlife Management Institute 2000) for producers and wildlife conservation on private lands in the High Plains of Texas.

Agricultural Economics and Conservation Incentives

We have always had a soil and water stewardship mentality, that is we have enjoyed a very close working relationship with the Dallam and Hartley Soil and Water Conservation Districts and professionals employed by the US Department of Agriculture (USDA) Natural Resources Conservation Service, in Dalhart. We sought their advice on best management practices in an agronomic sense, realizing that a direct relationship exists between land health, agricultural productivity and our financial viability as a family farming operation. At the same time, we have always explored the latest production agriculture technology for maximum efficiency of farming dollars expended and time spent in the field. After all, one cannot play if not in the game. Admittedly, wildlife was an accidental by-product of our farming operations. Even though our area has been renowned for ring-necked pheasants (*Phasianus colchicus*) in Texas, high-quality permanent cover for the birds and other wildlife was often lacking in many areas of the High Plains prior to the Food Security Act of 1985 (Berthelsen 1989). As local farmers in our area established high-quality cover through the CRP, we saw an increased abundance and distribution of wildlife, (Cantu and Richardson 1997), namely mule deer (*Odocoileus hemonius*) and white-tailed deer (*Odocoileus virginianus*), even in extensive areas of native short-grass prairie interspersed with crop fields (Kamler et al. 2001). I could cite more examples, but the point is that, as we began to see more wildlife, our level of awareness increased. Still, farm economics was the first order of business for our operation. Like any other business, we have financial obligations that must be met.

At the same time, the financial situation for our operation in the mid-1980s was conducive to exploring diversification and the use of incentive programs. Considering the fact of 18-percent interest on annual operating loans, low grain prices, overall low farm prices and high input costs (equipment, fuel and fertilizer), the monetary incentive of seeding certain parcels of land to permanent cover through the CRP was appealing from a financial standpoint. Therefore, we enrolled a portion of our land in the program. When we began to see a proliferation of wildlife and improved aesthetics because of habitat improvements, our desire to conduct additional habitat enhancements increased. We began to investigate the particulars of other incentive programs and to seek technical guidance services for wildlife habitat management. Although we might not have thought of it in exact terms, we were engaged in a strategic planning and implementation process that continues to evolve today. So, the CRP is one example of something that worked, and financial feasibility is why it worked. And, it worked as a catalyst to increase our awareness of the habitat needs of wildlife, which, in turn, led to our interest in deliberate habitat enhancements to provide for those needs, especially where technical assistance and financial incentives were offered on a voluntary participation basis.

A Circle of Cooperation for Conservation

We found a suite of willing professionals who were ready to assist us in this endeavor. Today, the circle of cooperation that began at Dallam and Hartley Soil and Water Conservation Districts and our USDA Service Center 10 years ago has led to repeated collaborations with representatives of the Natural Resources Conservation Service, the Rita Blanca Chapter of Quail Unlimited, Inc., the Texas Forest Service, the Texas Parks and Wildlife Department, and the Farm Service Agency. We have utilized technical assistance and financial incentives on a voluntary basis, which is very important to private landowners in Texas. I mention that fact a second time because it is noteworthy in a gathering of wildlife professionals like that assembled here today. Farmers like me are willing to conduct permanent habitat enhancements that are voluntary and incentive-based to benefit publicly-owned wildlife resources living on privately-owned land for which we bear temporary stewardship responsibility. That is the reality of the situation and why programs like those offered in the 1996 Farm Bill (and hopefully continued in the 2002 Farm Bill) have worked successfully with agricultural producers. In our case, cooperation led to lasting work relationships and friendships. That happens over time, and it takes work on the part of private landowners and agency professionals (Gillen 2001).

It is also worthy to mention agency turf at this point, as related to delivery of conservation programs. It has been said that tremendous good can be accomplished if it does not matter who gets the credit, and we have been the beneficiaries of that attitude among agency professionals in our area.

Conservation Tools that Worked

Evolving technology and weed barrier fabric mulch enabled our successful establishment of woody plantings for wildlife food and cover (Lutz et al. 1994). The Texas Parks and Wildlife Department's Private Lands Initiative and a funding grant from the National Fish and Wildlife Foundation helped us start the first project in 1993, which was tremendously successful. A key part of that endeavor was cooperation from the Dallam and Hartley Soil and Water Conservation Districts, The Texas Forest Service, the Rita Blanca Chapter of Quail Unlimited, Inc., and the Natural Resources Conservation Service. Following that, we utilized the SIP to establish additional plantings. Currently, we plan to establish more windbreaks for wildlife through the CCRP. Additionally, a playa wetland restoration project is planned through the use of PLJV funding, with technical guidance from biologists with the Texas Parks and Wildlife Department and the US Fish and Wildlife Service. Today, the circle of cooperation for conservation is contagious in the local community, resulting in our farm being the site of field days and wildlife seminars for landowners. We have adopted the conservation tool bag approach, first espoused, by the Secretary of Agriculture at the time, Dan Glickman, and the USDA administrators upon passage and signing of the 1996 Farm Bill.

Looking to the 2002 Farm Bill and Beyond

Continuation and expansion of user-friendly conservation provisions in the 2002 Farm Bill is of paramount importance to farmers wishing to preserve family lands, improve land health, improve aesthetics and aid wildlife populations, while maintaining a profitable agricultural operation. First, farmers must be able to make a profit. Second, conservation provisions and price supports must be in place to create incentives for American farmers who want to do the right thing for publicly-owned wildlife resources that reside on privately-held farms, ranches, waters and wetlands, while growing food for the American people at a profit. The Wildlife Management Institute (2000) has suggested that the CRP (including CCRP), the Environmental Quality Incentives Program (EQIP), SIP, the Wildlife

Habitat Incentives Program (WHIP) and the Wetland Reserve Program (WRP), to name a few, be continued and enhanced. It has also espoused the need for adequate funding for conservation program delivery by USDA personnel and other state and federal agency wildlife staff. Furthermore, it has suggested that wildlife habitat improvement needs to remain a co-objective (along with soil and water conservation) and that agricultural support payments be linked to conservation compliance. Finally, it has stated the need to establish a conservation security program to reimburse landowners with green payments for providing key conservation practices to benefit wildlife on their land. To the extent that these provisions will be included in the legislation, I think that any farmer working toward the strategic goal of managing healthy land, wildlife and agricultural profitability should have some useful tools to use, should the farmer voluntarily choose to do so. As the 2002 Farm Bill becomes a reality, it is time for those who care about the future of American agriculture and the family farm, our rural lifestyle, and wildlife stewardship on private lands to work cooperatively at the local level to make conservation incentives as attractive as possible to more family farmers.

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Coming Together on the Farm Bill

James L. Byford
University of Tennessee
Martin

The 1985 Farm Bill was, perhaps, one of the most important pieces of conservation legislation in the latter half of the 20th century. It came at a good time, too. Farmers were struggling, and farm wildlife members were at their lowest. Unparalleled demand and high prices for crops in the 1970s enticed farmers to convert marginal and erodible land into production. Farm game numbers, already low, were reduced even further as odd areas used for cover were converted to crops. Soon after, South America started increasing production, too. By the 1980s there was a glut in the world's food grain and oilseed production. Prices plummeted and the farm economy started spiraling downward.

The 1985 Farm Bill was designed, not to subsidize farmers, but to help farmers by reducing production so commodity prices would rise. It paid farmers not to farm marginal, erodible land. In addition to raising commodity prices, it reduced erosion and reestablished wildlife cover. The conservation provisions of the 1985 bill, especially the Conservation Reserve Program (CRP), were popular with both farmers and the conservation community. This win-win idea continued in the 1990 and the 1996 Farm Bills.

To prepare for debates on the 2002 Farm Bill, the Wildlife Management Institute led a bold effort to build agriculture and conservation coalitions in the various states. This collaborative process evolved from a Farm Bill Workshop held in Washington, DC, where two key issues were identified: (1) the need to build coalitions, find common ground and work with Congress to achieve common goals and (2) the need to improve communications through enhanced information and education efforts with the legislature, landowners, commodity and forestry interests, and fish and wildlife advocates. Most importantly, a consensus was established among participants at the workshop. It became clear that we need to work together to achieve increased resources for conservation in Farm Bill 2002; at the same time the Farm Bill comes to the aid of our beleaguered farmers. The idea was that these groups–often at odds–work together to settle differences. These groups could develop proposals our legislators could agree on. It seems to be working.

In Tennessee, the University of Tennessee's Agricultural Extension Service and the Tennessee Wildlife Resources Agency formulated a plan. The plan was simple: bring together representatives from all agencies and organizations, including commodity groups, who would have an interest in the Farm Bill. I was asked to serve as facilitator. Because legislative discussions were developing rapidly, we scheduled three meetings, in rapid succession–June 12, June 19 and July 11, 2001.

For the first half-day meeting, we had 29 people, representing 18 agencies and organizations. After introductions, I explained that our series of meetings had two objectives: (1) brainstorm on Farm Bill issues in Tennessee and (2) draft a common ground proposal that was based on issues our coalition agreed on. The proposal would be provided to key members of Congress, particularly to legislators from Tennessee and Agriculture Committee members of both the Senate and the House of Representatives.

During the initial brainstorming discussion, it soon became evident that there was a great deal of agreement. Actually, there was very little disagreement. The Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) explained and clarified. One of the most important things that happened during that meeting was the realization that these various groups could work together. The stage was set. At the conclusion of the first meeting, I passed out a form that posed three questions: (1) what worked with the 1996 Farm Bill, (2) what did not work and (3) what needed to be added? These forms were returned to me soon after the meeting, and I tabulated them. Sixteen items that worked were listed, 14 that did not, and 17 that need to be added.

During the second meeting, we focused on items that needed to be changed and ones that needed to be added. At the conclusion of that meeting, I asked all representatives to prepare short written proposals on behalf of their agency or organization for the next meeting, things they would like the coalition to consider.

At the final, all-day meeting, we used parliamentary procedure to debate and act on all proposals that were presented. The proposals were presented as motions, seconded, discussed, amended as necessary and voted on.

Twenty-five proposals were presented. Twenty-four were approved; 21 were unanimous, and the other three were approved with only one negative vote.

At the conclusion, we had 45 people, representing 26 groups. Even though the main focus was on conservation provisions of the Farm Bill, the Tennessee Farm Bill Coalition elected to include other Farm Bill provisions as well. The final report is quite detailed, but a summary follows. Items are listed randomly–no priority intended:

- Provide sufficient funding to address landowner demands for program enrollment and technical assistance.
- Reauthorize the CRP to provide the opportunity for states to enter into Conservation Reserve Enhancement Program (CREP) agreements.
- Reauthorize the Wetlands Reserve Program, and increase the enrollment cap to 250,000 acres annually.
- Reauthorize the Wildlife Habitat Incentives Program at $100 million annually.
- Reauthorize the Forest Legacy Program at $100 million annually.
- Reauthorize the Farmland Protection Program at $100 million annually.
- Reauthorize the Forest Stewardship Program, Stewardship Incentives Program and the Forestry Incentives Program (FIP) at $50 million annually for each program.
- Reauthorize the Environmental Quality Incentive Program (EQIP), and fund it at $1.25 billion annually; fish and wildlife resources should be recognized as equal with soil and water resources and fully integrated into program delivery.
- Establish a grasslands reserve program that authorizes up to 5 million acres for grassland restoration, enhancement and conservation through easements.
- Increase funding for education programs and scientific research.
- Discourage a reduction in tobacco quota for farms enrolled in CRP, provided there is sufficient acreage to grow the entire quota.
- Expand EQUIP to assist all agriculture in meeting Environmental Protection Agency regulations on pollution.
- Develop a target price program for all commodities and provide direct deficiency payments during times of low market prices to include crop and livestock operations.

- Expand the Disaster Program to cover natural disasters better, but also be more specific, to reduce the abuse in the current program.
- Provide adequate funding for the Animal Plant Health Inspection Service to carry out necessary programs for animal disease control.
- Encourage the creation of a sustained grant program in US Department of Agriculture to stimulate partnerships between the NRCS, state fish and wildlife agencies, the Cooperative Extension and other groups that result in cost effectiveness.
- Increase funding by 20 percent for educational programs for producers and agency personnel in Cooperative Extension, the NRCS, the FSA and other soil, water, plant, livestock, forestry and wildlife management agencies.
- Refrain from taxing funds received through the Farm Bill self-employment taxes.
- Classify the forestry activities for the production of fiber or lumber products as an agricultural activity, and grant access to all the benefits thereof.
- Provide a more flexible CRP that would allow entry and exit for shorter periods–5 to 7 and 10 to 15 years with payments based respectively at 70, 80, 100 percent of normal rates.
- Eliminate the requirement in CRP to always have to plant permanent vegetative cover; allow natural vegetation to occur on new CRP ground when appropriate, such as in the southeastern United States.
- Utilize and modify USDA programs to promote conversion of exotic cool season forage reserves while increasing wildlife benefits.

I commend the Wildlife Management Institute for its vision and leadership. Building state-level coalitions provides an excellent opportunity for natural resource and agricultural professionals within the state to build new relationships, eliminate misconceptions and reach consensus concerning future Farm Bill conservation programs. Ultimately, trust among the groups who care about farming, forestry and wildlife will be realized, and positive, long-term results will be realized as well.

Panel II: How Do We Keep the Momentum Going to Continue to Foster the Development of Relationships to Meet Conservation and Landowner Goals?

Opening Remarks

Rob Manes
Wildlife Management Institute
Pratt, Kansas

Our discussion for the next few minutes is going to be about keeping the momentum going, regarding the positive things that you have heard this morning. It's about maintaining progress, so that we continue to realize the benefits of conservation and agricultural production in a cooperative climate. And, I don't think that we have to convince any of you that so much of the need for, so much of the essence of, this forward momentum is based on clear, open honest communication. This makes me think of a time when I was fairly little. I went to visit my grandparents, to stay with them for a couple of weeks. I was too young to work on the farm but old enough to visit without my folks. My grandmother was playing bridge at the dining room table when I ran in the house, and I said, "Grandma, Grandma, I have to take a leak." And, she grabbed me by the ear and pulled me aside and said, "That's not the way we announce that when we come in the house." I was communicating clearly, I thought. She said, "When you need to do that and there are people in the house, you say, 'Grandma, I have to whisper'." So, I took that to heart and did what my Grandma said because she could pinch my ear hard. The next evening, I woke up in the middle of the night with the same urge and went into my grandma and grandpa's bedroom. Grandpa was sleeping on the near side of the bed. I said, "Grandpa, I need to whisper." He grumbled something in his sleep, and I repeated, "Grandpa, I have to whisper." He rolled over, and he said, "Well, just whisper in my ear." Clear communication is really important.

I have been in the wildlife business for more than 20 years. I also come from an extended family, many of which farm and ranch in Ellsworth County, right in the middle of Kansas. When Ron first told me that we were going to gather these diverse coalitions in a room, with the door shut, everybody sitting, looking at each other, I will admit that I was a bit skeptical. I had seen and was sold on the pragmatics and the effectiveness of getting farmers and ranchers together in the field with conservationists to talk about things that worked. But, the notion that we would get together in a closed room to talk about what we did not agree on and what we did agree on made me a little bit skeptical. But, being the good team player that I am, I said, "Alright Ron, how do I help with this?" The end result was that I sat in on the coalition meetings in Oklahoma and Kansas. It was an incredibly positive experience. I believe that has set the stage for this forward momentum that we had need to sustain. A couple of comments about where we direct that momentum before we have our next speakers come.

When this new Farm Bill is passed, we will immediately find ourselves in the midst of all kinds of rule-making and policy-making. The partnerships that we have started have to continue. In some of those coalition discussions that I participated in, there was considerable disagreement, sometimes vehement disagreement;.3 sometimes folks were downright ticked off, and, frequently, they left the room not agreeing on all important issues. The fact of the matter is that clear, open and honest communication enabled us to reach consensus on many of the important issues and to trust each other on the ones we did not agree on. In the absence of agreement, trust is a mighty powerful piece of détante. So, as we enter into the rule-making process, enter into policy-making and implementing the plans, this momentum can be sustained by that same clear and open communication. That is what I expect we will achieve.

As I got older, and I went back to my Grandpa's place, I was allowed to work on the farm. He even paid me a little bit–dang little most of the time, but he did pay me. And, I remember when he got his first John Deer 4020, and it came rumbling through the farmyard. It was the largest machine that ever rolled across the face of the earth. I was about 12 before he let me run it with a little Krause disk that I though was the biggest piece of earth-turning equipment that would ever be invented. I remember getting on it and Granddad walking me through the orientation. The throttle had the rabbit and the turtle on it; the old Allace-Challmers tractor I was used to had no rabbit and turtle. Granddad said, "Boy, this isn't rocket science. Just look at the rabbit and the turtle."

Our first speaker could have done it, even if it was rocket science. Marc Curtis graduated from Georgia Tech in 1967, with a Bachelor's degree in aerospace engineering; he's a rocket scientist. However, he does not work as a rocket scientist; instead he is a highly regarded producer in the Mississippi

Delta, a very productive part of the country. His education and training have given him a firm foundation to be an important leader in his chosen and difficult profession. He has held a number of state and national offices. And, Marc also served as president of the National Soybean Association, in 1999 and 2000, and as chairman, in 2000 and 2001, and he is still on the Board of Directors for the National Soybean Association. He is a founding member, by the way, of the Mississippi Corngrower's Association. With this background, it is clear that he is a leader in commodity organizations. He has been involved with local and state conservation activities. He has served on the Washington County Soil and Water Conservation District's, and was chairman from 1995 to 1998. He also served on the Mississippi Association of Conservation Districts. This is a man with a national, regional and local commitment to conservation. He has held a number of key positions with the organization and is currently state president. Marc has often been recognized for his leadership in these areas, including being named the outstanding soybean producer by the Delta Council in 1998. He was appointed by then US Department of Agriculture Secretary, Dan Glickman (a Kansan, by the way) to serve on the USD Cooperative State Research Extension Education Economics Advisory Board in 2000. Just last year, Marc and his wife Cheryl were awarded the American Soybean Association Conservation Legacy Award for the southeast region. With that background and that experience, Marc brings a lot of credibility and a unique view of how farming and conservation go hand in hand. I would appreciate it if you would help me welcome him.

Fostering Conservation with Economic Realities

Marc Curtis
American Soybean Association
Leland, Mississippi

Good morning. I am Marc Curtis, a soybean, rice and wheat farmer from Leland, Mississippi. I have been farming for 30 years in the Mississippi Delta.

I learned early in my career that farming was much more than just putting seed in the ground and harvesting the result. It was also about finding a balance between using our natural resources to produce food and fiber and protecting our natural resources. If producers do not make the investments to protect the land and the soil, those resources may be lost to people currently farming, like me, and for future generations.

Today, I am going to talk as someone who has held leadership positions in the industry; I do not think that my thoughts are much different from my neighbors.

During the time I have farmed, I have seen many changes, including the introduction of new seed varieties, improved crop protection products and the usage of precision application. I have also witnessed a change in farming practices. At one point, farmers were encouraged to plant fence row to fence row. Corners and hedgerows were plowed, and every inch was cultivated, leaving little habitat for birds and small animals. We plowed or disked every acre, sometimes two or three times a growing season, to incorporate the chemicals. We did not focus on erosion or water quality concerns.

Our crop protection products were not as environmentally friendly as they are today, and, frankly, many of us used larger doses than were actually needed to control weeds and pests. Spray drift or the disposal of chemical containers was not a concern. Often, birds and animals were untargeted victims of the practices.

In the autumn, I love to watch hawks soar and hunt as they migrate through the Delta. Often, I can see six or eight at one time. Thirty years ago, I would be lucky to see one a day.

Many of the government policies also encouraged weak conservation. One example of this happened in the late 1980s. During this period, many producers were going out of business and loans were being recalled. The US Department of Agriculture (USDA) Farmers Home Administration (FHA) actually allowed farmers to forfeit a portion of the land in exchange for the clearing debt to the agency. Some of the recovered property was supposed to be managed by the US Fish and Wildlife Agency. However, due to lack of adequate funding or appropriate policies or a combination of both, nothing was done to much of the land. For years, only weeds and a few small trees provided cover for these acres. There was no managed effort to control weeds or erosion. I have pictures of a farm that joins my farm that shows the results of these bad policies. These areas are not just an eyesore to the neighborhood; they promote weeds and other harmful pests for active producers like me. This happens when one removes the farmer from the land, but does not have the ability to manage it. I do not believe this is what the taxpayers expect from these programs.

Fortunately, we are doing a better job to promote good conservation. Many of our federal policies are built around voluntary programs that encourage private landowners to protect our resources. And, farming practices have changed. There is a much stronger awareness of the need to protect our environment by farming smarter. I became active in the local conservation district over 20 years ago, and I am still very active at the state and federal level. I became involved when a neighbor encouraged me to join the local district organization, and I soon understood that good conservation made sense for the success of my farming operation. For the last 15 years, up until the last two, I spent, on average, over $20,000.00 per year on capital expenditures that resulted in good conservation. I do this mostly for economic reasons, but improved conservation is also an important benefit. This investment has made my operation more productive and efficient and has been a key to improving my profitability.

An example of this investment is precision, land-forming fields to increase rice production. I put pads around the field so I can control and save water used for irrigation. I also have filled in washed out areas, installing water-control structures that helps to keep silt from the fields out of the streams. This process allows for winter flooding for waterfowl habitat, which is good for the wildlife in our region and the duck hunters. When I started farming, we had to use a dragline for two to three weeks every winter to clean out ditches. We have not needed to clean out a ditch for five years. This practice is much better for maintaining wildlife habitat.

I have also been involved in a precision agriculture project first with the State Extension Service and, now, with the Remote Sensing Lab at the Stennis Space Center. The land and crop are sampled from the ground and observed from the air. This results in a measured and precise distribution of agriculture chemicals and inputs. My farm is uniform, so I have not witnessed major changes in the application rates, although others in the project with more variable ground have. However, I am excited about the aerial observations. This view provides an early and better detection system for problems in the fields. The early stages of disease and even drought can be identified, thus treated, before a real problem develops. Because the exact location of the situation is known, spot application is possible. So, an entire field does not have to be treated when only a small portion needs attention. This reduces chemical use and unnecessary expense, while improving water quality and habitat for wildlife. Although expensive, this process is the future for US producers. It will help to remain as efficient and productive as our competitors around the world.

Now, I would like to shift gears to talk about our national policies, specifically the Farm Bill. Before I discuss conservation policies, which is the reason I am here, I want to address concerns regarding the commodity groups' priorities in the Farm Bill.

The American Soybean Association (ASA) has a strong record on conservation policies, and I will talk more about that in just a moment. However, soybean producers, just like all producers, must be able to make a living on their land. So, commodity policies and programs are our first priority in any bill. This does not diminish our strong commitment to good conservation or to providing adequate resources to producers for good conservation. In fact, successful producers make the best conservationists!

Direct support of agriculture is critical to the survival of farmers. Since I represent ASA today, I will use the price of soybeans as my example. In 1972, I sold soybeans for $14 per bushel; in 1995 the price was $8 per bushel; today the price is $4 per bushel.

During this same period all of my inputs and fixed costs (i.e., land, taxes, equipment, fertilizer, seed, chemicals) have increased. For example, in 1972, labor costs were 90 cents per hour. Today, minimum wage is $5.25 and my costs are closer to $8 per hour, for reliable workers. Increased efficiency has offset some of this disparity, but not nearly all of it.

It is helpful to realize that farmers are facing difficult times and tough decisions. Many are not deciding what to plant this year, but, instead, how to quit farming before they lose everything. Private landowners have been key to the preservation and protection of our natural resources and their survival will be important to the continued commitment to those ideals. I believe that, without farmers, more land and natural resources will be lost to development and uncaring owners.

As I mentioned earlier, I think many of our federal conservation policies have improved, since the late 1980s. However, I have concerns with the direction some would like to take us.

First, I will focus on the positive. There is a growing awareness that private landowners' conservation measures have a public benefit. There seems to a strong commitment by many to invest taxpayer dollars into programs that provide cost-share funds for capital improvements on privately owned land, especially in the livestock industry. There has been support for land retirement programs, such as the Conservation Reserve Program (CRP) and the Wetlands Reserve Program (WRP), which have protected some of our most fragile and vulnerable lands.

However, there must be the same commitment to conservation on lands in production, not just structural improvements eligible for cost share from programs, such as the Environmental Quality Incentives Program (EQIP). Resources are needed by producers who do not need to make structural changes, but want to practice good conservation.

Many producers know and value the importance of best management practices but may also suffer several years of bad crops, low prices or the inability to afford the same level of investment in these practices. The last two years, I have not had the money to reinvest in my land as I had before.

As a leader within the American Soybean Association, I helped to develop and promote a *Best Management Practices (BMP) Handbook and Implementation Program* for soybean growers. The ASA placed a high priority on providing current and accurate information to all soybean growers interested in conservation. The BMP manual has been widely distributed, and we are now holding workshops and education programs in several states; we hope to expand this program in the future.

ASA supports ensuring producers have the resources, both financial and technical, to establish conservation practices. That is why we have supported an increased focus on USDA programs for lands in production. The Senate Agriculture Committee called their program the Conservation Security

Program, and other organizations have similar programs. There should be a stronger emphasis within the USDA program structure to assist producers with conservation practices.

I firmly believe most producers want to protect our environment and to practice good conservation. It just makes sense. However, to do so, producers need both monetary support and technical assistance. I hope that, when this Farm Bill is finalized, it will include a conservation incentives program so our conservation priorities will reflect a lasting emphasis on working lands and a limited focus on land retirement programs. Investments must be made to help the next generation of farmers remain competitive in an ever-changing world market. We need effective income support, risk management tools, strong trade and promotion programs, and environmental and conservation systems that provide the needed resources to produce efficiently and competitively.

I would be remiss if I did not touch on a very important and sensitive issue: private property rights. I think most farm organizations and wildlife groups agree on many of the principles of private land ownership. However, we may disagree in some areas regarding hunting and fishing rights.

While it is the right of the landowner to decide to allow hunting and fishing on the land and make money while doing so, I stress this does not work for every landowner and the rights of those who do not wish to do so should be recognized.

Hunting reserves are beneficial to non-landowners, as well as landowners who like outdoor sports, including hunting, fishing and bird watching. The reserves can be disruptive, however, to the local rural community. This is certainly the case when the land is in retirement and the collateral benefits of producing a crop are lost on a small community. I have seen presentations on a number of projects designed to take row cropland out of production and, instead, plant trees. In the long term, these lands are projected to be more profitable to the landowner than farming would be. I do not doubt those projections, but I am concerned about the 30 years it will take the trees to become profitable. During that period, what happens to the local businessman who, today, makes a living supplying the farmer, the local government and school system. That farmer will have fewer taxes to serve the citizens with?

Hunting is often cited as an enterprise to bridge this gap. Places like Stuttgart, Arkansas, with an international reputation and established infrastructure, will continue to prosper. The hunting industry in Stuttgart is based on people coming from far away to hunt, and the businesses have adapted to participate economically. However in many areas, hunters come from no more than a two-hour drive away. They buy their food, clothes, licenses and supplies from their local store–not from the store in the area where they hunt. Thus the local businesses do not benefit economically from hunting and suffer, along with the local government because of lost sales taxes and less property taxes. As more land is developed for hunting, each parcel is less valuable and is taxed at a lower rate. Additionally, contrary to what some may think, there is not an inexhaustible supply of hunters.

There must be a balance between land-use issues, and I hope our groups continue this discussion. I believe we have more in common than we have differences, and we should seek compromises.

I would like to thank Ron Helenski for his invitation to be here today. I enjoy working with Ron and discussing many of the issues I have outlined in these remarks. Ron has been to the Mississippi Delta. I am impressed with his eagerness to learn about production agriculture's priorities and his willingness to listen to our side of the situation. Thank you, Ron and the leaders of the Wildlife Management Institute for not giving up on the need for better communication. I hope this meeting is the first of many, held around the country between producer organizations and wildlife groups. I know that the ASA is willing to participate in these discussions, and I bet our colleagues in other associations will as well. We need direct communication to improve our relationship and to achieve our mutual goals.

A Northeast Dairy Perspective of Farming and Conservation

Carl W. Schwartz
US Fish and Wildlife Service
Cortland, New York

An oxcart brought Colonel John Randall the 300 or so miles from Stonington, Connecticut, to Pharsalia, New York, to build the first house in town in 1797. The lands were wooded with mixed northern hardwoods (beech, birch, maple) growing in thin rocky soils. By 1875, when Berthier Mathewson, farmer and justice of the peace, owned the property, nearly 70 percent of the 23,458 acres in Pharsalia had been improved, leaving only 7, 651 acres wooded. Gross sales of farm products that year totaled $71,382 and, aside from a couple of merchants, a hotel keeper and a saw mill, farming was the dominant occupation of the 1,103 residents.

The property settled by Colonel Randall is now one of four dairy farms remaining in Pharsalia. In 1990, there were 795 residents, and the pastures were grazed with more than 80 Holsteins. My deed tells of six other owners since Colonel Randall's time who have cleared fields, built rock walls and allowed other fields and pastures to revert to forest. Pharsalia is now 65 percent forested (15,250 acres) with second and third growth as northern hardwoods interspersed with pine and spruce plantations.

In some ways, these land-use changes are seen throughout New York and the Northeast. Currently, New York loses 100,000 acres a year from agriculture, even though agriculture continues to be the largest sector of the state's economy. This loss of agricultural land may be the greatest common interest that dairy farmers have with conservationists because farms provide far more and higher quality fish and wildlife habitats than housing and commercial developments. Dairy farms not only contribute to the economy through the sales of farm products and the purchase of labor and supplies, but they are also important to the tourist industry by providing the vistas that many visitors expect.

One of the ways that both the federal and state governments have addressed this issue is through the enactment of the Farmland Protection Program and corresponding state legislation. Although Pharsalia declined in population between 1880 and 1990, New York State increased from 5,082,871 to 18,976,457, making it the third most populated state in the country. This density of humans (401/square mile) has put considerable and constant pressure on open space, including agricultural land. Competition for agricultural lands has also increased dramatically, with development prices being several times what would be profitable for agricultural use.

One program targeting this issue is the purchase of development rights using a combination of private, state and federal funds. The demand for these funds far exceeds supply. The state's Farmland Protection Program currently has $75,000,000 in demands that they have no funds to fulfill, and the federal program has $6,000,000 more in requests than current funding available. These programs are one option to keeping open space, wildlife and agriculture in the face of a bourgeoning human population. However, ultimately, the best way to keep farms on the landscape is to make them profitable.

Another common interest between conservationists and dairy farmers is water quality. Nutrient management is the preeminent issue currently facing the dairy industry, and water quality is of concern to all persons who drink either water or milk. The water quality issue is the principal link that dairy farmers have with the United States Department of Agriculture (USDA) programs.

The Environmental Quality Incentives Program (EQIP) assists with nutrient management, barnyard structures and efforts to keep the thousands of miles of streams from excessive sediment and coliform loads. Dairy is the state's largest sector of agriculture, and New York ranks third in the nation in milk production and first in the production of some soft cheeses.

Today's dairy business is far more sophisticated than it was in 1875, requiring considerable business management skill blended with crop management, animal science and knowledge of machinery, computers and government programs. Northeast dairy farmers do not like the idea of a government handout, but as expenses constantly increase, while milk prices do not, the government quickly becomes one option. Operators strove to be as efficient as possible, but many are no longer in business, leaving about 9,000 farms currently in the state. At the national level, the dairy industry is not united and has not been a big player in shaping the Farm Bill. The regions of the country are very different from a milk marketing standpoint, with the Northeast being primarily a fluid milk market. The New York City, Boston and

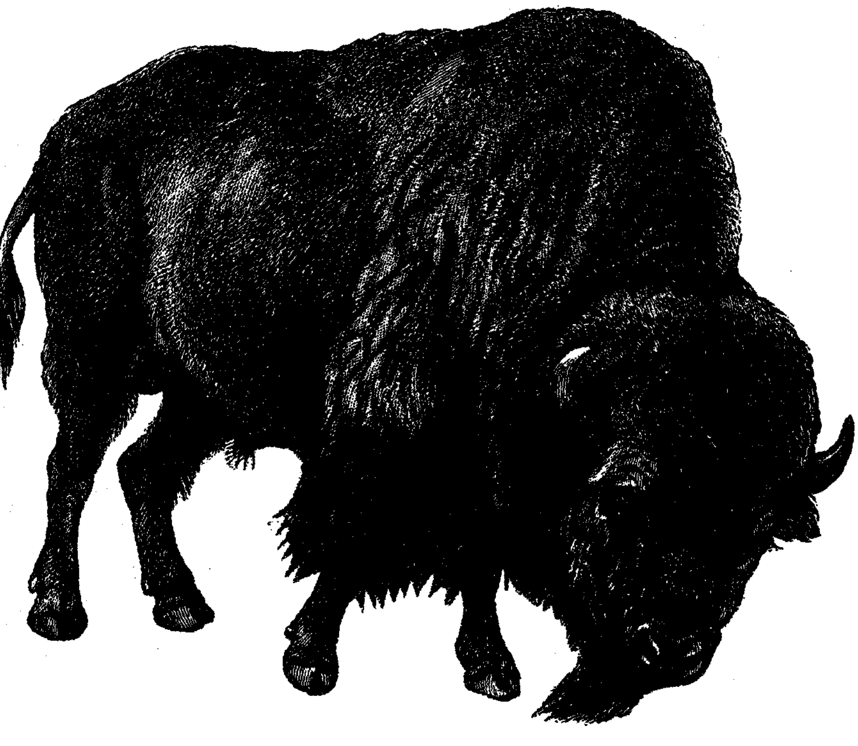
Philadelphia markets consume about 50 percent of the milk produced in the Northeast with the large soft cheese market (Ricotta and Mozzarella) taking most of the remainder of the milk produced. Fluid milk is priced higher than milk used for other products, but the price paid to farmers is calculated on a blend price, which includes both prices. This has led many Northeast dairy operators to believe they are not getting a fair price for their product. This is some of the logic behind the Northeast Dairy Compact, which Congress did not extend, due to pressure from other regions of the country.

Two other USDA programs that farmers and conservationists benefit from are the Wetlands Reserve Program (WRP) and the Wildlife Habitat Improvement Program (WHIP). New York has the highest number of WRP contracts in the nation. The sale of easements for WRP has given many dairy farms some capital to pay for other areas of the farm, and it is better management to concentrate agricultural management on the most productive lands while using other lands for recreation. WHIP also allows for an investment in wildlife habitat, by both public and private entities, that benefits both parties. Wildlife on farms in the Northeast is often highly prized for sport, aesthetics and stress relief given from an occasional commune with nature. There is another side of the issue that includes crop damage, however most farmers I am familiar with place more emphasis on the positive aspects of wildlife than the negative.

The Conservation Reserve Program (CRP) and Enhanced Conservation Reserve Program (CREP) also benefit both farmers and conservationists. In New York, both programs emphasize water quality, buffer strips and rental payments to landowners. To the farmers these programs contribute to the cash flow of the operations as well as providing cost share on important management projects, such as fencing livestock out of streams and wetlands. These fences and buffers reduce sedimentation in streams, reduce nitrogen, phosphorus and pathogen levels, and they improve fish and wildlife habitat. The farmers also get additional interior fencing that contributes to better grazing management.

New York is 55 percent forested and the Forestry Incentives Program (FIP) could improve both woodlot management and wildlife habitat, however the funding level is so low that only a few counties are involved in the program. FIP funds typically go to timber stand improvement on small private woodlots, as commercial thinning on these properties has not been cost effective for landowners. Some funding is also used to improve maple sugar stands. Maple sugar is a business which is typically done as a sideline on small dairy farms.

Agricultural producers and conservationists have much in common and can work in a symbiotic relationship to affect agricultural legislation that benefits both groups and the American public. The Northeast has not utilized yet its resources of numbers of conservationists, numbers of farmers, climate and proximity to market in as effective a manner as have other regions of the country.



Registered Attendance

Alabama

Jerry de Bin, David C. Hayden, M. N. "Corky" Pugh

Alaska

David B. Allen, Ellen Campbell, Ken Coate, Linda Coate, Tina Cunning, Ken Denny, Glenn Elison, Christopher Estes, Winifred B. Kessler, Gary Larsen, Robert R. Leedy, Thomas J. Liescher, Deb Lipyanic, Jeff Mason, Kellie N. Peirce, Cindy Ragland, Wayne Regelin, Steve Reidsma, Matthew Robus, Terry Schick

Arizona

Bruce D. Taubert, Jay R. Adkins, , Roy C. Averill-Murray, Kerry Baldwin, Carol Beardmore, Manuel Chee, J. Dart, James C. deVos, Jr., Jim Hessil, Terry B. Johnson, John Kennedy, Paul R. Krausman, Sam R. Lawry, Jennifer Martin, Richard Rico, Duane L. Shroufe, Linda Shroufe, Bill Van Pelt

Arkansas

Katherine Bisbee, King Bisbee, Mike Checkett, Mike Gibson, David Goad, James F. Goodhart, Sabrina Kirkpatrick, David Long, Amanda J. Maurer, Donald F. McKenzie, Laurel Moore, Bobbi Patterson, Gregg Patterson

California

Chad E. Carber, Tamara S. Conkle, Steve Covell, Diana Craig, Julie J. Eliason, Rhys M. Evans, Laurie Fenwood, Danielle Flynn, Dale E. Garber, Geoff Geupel, Mark Hagan, Wally Haussamen, Art Hazebrook, Catherine Hickey, Robert C. Holmes, Gordon Long, Deborah Maxwell, Archie S. Mossman, Sue Y.Lee Mossman, Laura Muhs, Colleen Schneider, Ronald A. Stromstad, Steve Thompson, Chris White, Barbara Williams

Colorado

Tom Blickensderfer, Arthur W. Allen, Marcene Amend, Spencer Amend, Mike Antolin, Craig C. Axtell, Carol A. Beidleman, Bernard Black, John A. Blankenship, Rick D. Cables, Janice Carpenter, Len H. Carpenter, Richard D. Curnow, Tim J. Davis, Wayne Deason, David Dolton, Peter Dratch, Michael R.

Dunning, Michael W. Fall, Rebecca Frank, Paul E. Gertler, Walter Graul, Debra Higley-Feldman, Josh Kellar, David M. Knotts, Skip Ladd, Carol A. Lively, Jeremy D. Maestas, William R. Maynard, Bruce McCloskey, James McDermott, Patricia Mehlhop, Brian Mihlbachler, Ralph O. Morgenweck, Tim Moser, Larry R. Nelson, Sandy Nelson, Randy Robinette, Christopher M. Roe, Kelly Roe, David Sharp, Susan Skagen, Gene Stout, Jeff Trousil, Jeffrey M. Ver Steeg, Tom Warren, Rob Werge, Michael Worthen

Connecticut

Jodi DiCamillo, Doug Painter, Edward C. Parker, Sharon Rushton

District of Columbia

Fred Abraham, Kevin R. Adams, P. David Allen II, Mike W. Anderson, Ron Archuleta, Henri R. Bisson, Marc Bosch, Dale N. Bosworth, Jason Campbell, Jack Capp, William H. Clay, Dave Cross, Tom Darden, Megan Durham, Naomi Edelson, Jacob Faibisch, Gary Frazer, Nancy Green, Krysta Harden, Tami Heilemann, Mike Hickey, Evan Hirsche, Matt Hogan, William Robert Irvin, Chris Jauhola, Marshall P. Jones, Marshall P. Jones, Jr., Gary Kania, Daniel E. Kugler, Gideon Lachman, Donald MacLauchlan, Noah Matson, Thomas Melius, Bob Miles, Imogene Miles, Angela R. Nelson, Ira F. Palmer, R. Max Peterson, Debbie Pressman, Monica Schwalbach, Bart Semcer, Mark L. Shaffer, Cathleen Short, Len Singel, Liz Skipper, Allan T. Smith, Cindy J. Smith, David P. Smith, Susan Solaiz, Jodi Applegate Stemler, James Tate, Jr., Gary Taylor, Robyn Thorson, Samara Trusso, Len Ugarenko, David L. Walker, Steve Williams, John Paul Woodley, Jr., Bill Woodson

Delaware

H. Lloyd Alexander, Karen Dean, Catherine Martin, Eugene Greg Moore

Florida

Michael Camardese, Isora Labisky, Ronald F. Labisky, Marian Lichtler, Jack Mobley, Keith Morin, Tim O'Meara, Norm Roettger, Rob Southwick, Stuart D. Strahl

Georgia

Tim Beaty, Bert Bivings, Frank Bowers, Thomas Bryce, Rebecca S. Crader, Dean Demarest, John R. Fischer, Sam D. Hamilton, Noel Holcomb, William C.

Hunter, Robert T. Jacobs, Mitch King, Gregory W. Lee, Victor Nettles, David E. Stallknecht, James M. Sweeney, Peter K. Swiderek, Linton L. Swindell

Hawaii
Conrad Erkelens, Randy M. Miyashiro, Timothy Sutterfield, Ron Walker

Idaho
Stephen M. Barton, Mark Hilliard, Steven Huffaker, Brian Kernohan, George LaBar, Sheila Lien, Angelia Martin, Cal McCluskey, Marjorie McHenry, Aaron Pearse, Terrell D. Rich, Greg Schildwachter, J. Michael Scott, Al Van Vooren

Illinois
John Buhnerkempe, Kirby Cottrell, David Delaney, Dick Gebhart, Tim Hickmann, Steve Hodapp, Frank Koenig, Brent Manning, Ray Marsahlla, Craig A. Miller, Gary E. Potts, Forrest "Skip" Starkey, Michael Ward, Alan Woolf

Indiana
Dave Case, Ken Day, Jim Denoncour, Terry Hobson, David Howell, Hannah Kirchner, Trent Osmon, Glen Salmon, Phil T. Seng, Ed Theroff

Iowa
Lynn Betts, Richard A. Bishop, Doug Clayton, Marion Conover, Dale L. Garner, Bruce W. Menzel, Jeffrey R. Vonk

Kansas
Ken Brunson, Chris Chaffin, Chris Deurmyer, Kevin Jones, Joe Kramer, Robert R. Manes, Mike Mitchener, Kent Montei, Clint Riley, Keith Sexson, Roger Wells

Kentucky
Tom Baker, Tom Bennett, Tom Biebighauser, Lee Carolan, Richard Fischer, Jonathan W. Gassett, Roy Grimes, Scott Porter, Tom Young

Louisiana
Mark Gates, Gerald Grau, John J. Jackson III, Suna Adam Knaus, Scott Knaus, Robert E. Stewart, Jr., Fred Whitrock

Maine

Dan McAuley, Col. Timothy E. Peabody, Lee Perry

Maryland

Helene Cleveland, Joseph Dudley, Brian Eyler, Yolanda Finney, Jeffrey M. Fleming, Tom Franklin, Susan Hagood, Paul W. Hansen, Ronald R. Helinski, Harry E. Hodgdon, Mary S.Hodgdon, William W. Howard, Judd A. Howell, Jim Kushlan, Eric Lawton, Daniel L. Leedy, Virginia Lee Leedy, Doug Lister, Margaret Lorenz, Dick Masse, Richard E. McCabe, Bette S. McKown, James A. Mosher, Heidi Prescott, Rosemary Queen, Tim Richardson, Tom Sadler, Josh Sandt, Steve Sekscienski, Jerry Serie, David Smith, Jacqueline C. Smith, Elizabeth Stallman, Melanie Steinkamp, Jim Terry, Angela M. Watland, Paul Wilson, Thomas Wray

Massachusetts

Richard O. Bennett, Stephen Brown, Jim Corven, George Haas, Scott Johnston, Wayne F. MacCallum, Andrew Milliken, Robert M. Muth, John F. Organ, Mamie A. Parker, Tom Poole, Robert J. Sousa

Michigan

M. Carol Bambery, Henry Campa, K. L. Cool, Robert D. Hoffman, Rebecca A. Humphries, Robert E. Humphries, William E. Moritz, Richard Pierce, Tina Yerkes

Minnesota

Edward K. Boggess, Todd Boonstra, Timothy P. Bremicker, John Christian, Doug Grann, Faith Grenzow, Bill Hartwig, Robert Jackson, Bradley Johnson, Rex Johnson, James Kelley, Mark LaBarbera, Jeff Lawrence, Harvey K. Nelson, Dave Nomsen, Barbara Pardo, Larry Pollard, Bill Stevens, Al

Sullivan, W. Daniel Svedarsky, Howard K. Vincent, Paul Webster, Steve Wilds, Tom Will, Rick Young, Mike Zagata, David Zentner, Margo Zentner

Mississippi

Ken Babcock, Charles K. Baxter, Jim Copeland, John DeFazio, Jr., Steve Demarais, G. Sam Foster, Michael Grodowitz, Ed Hackett, Pete Heard, Colleen Heise, Bruce D. Leopold, Nancy Magee, Chester O. Martin, Ross Melinchuk, Doris J. Miller, James E. Miller, Jean O'Neil, Dave Tazik, William B. Uihlein III, Robert R. Wilson, Lisa Yager

Missouri

Neil Bass, Janet Conley, Jerry M. Conley, Dave Erickson, Ray Evans, Dennis E. Figg, Jane Fitzgerald, Ken Gamble, Diana L. Hallett, John Hoskinsm Bill McGuire, David Nichols, John H. Schulz, Jane A. Smith, John W. Smith, Liz Smith, Betty Torgerson, Ollie Torgerson, James H. Wilson, Steve Young

Montana

Sunni Baker, Keith Balfourd, Chuck Bartlebaugh, George Bettas, Don Childress, Jim Claar, Kay Ellerhoff, Lisa Flowers, William Geer, M. Jeff Hagener, Jonathan Haufler, Rod K. Heitschmidt, Jeff Herbert, Tom Hinz, Julie Houk, Eric Johnston, Bobbi Keeler, Skip Kowalski, Kevin Lackey, Rich Lane, David L. Ledford, Carolyn Mehl, Sterling Miller, Bob Munson, Larry G. Peterman, Daniel H. Pletscher, Brad Powell, Jack Reneau, Laird Robinson, Loretta Robinson, Ralph Rogers, Bill Ruediger, Christopher Servheen, A. C. Smid, Christian A. Smith, Bob Summerfield, Cindy Swanson, Jack Ward Thomas, Gary J. White

Nebraska

William L. Baxter, Ted Blume, Justin Boner, Alicia Childress, James N. Douglas, Mace Hack, Keith W. Harmon, Mark Humpert, Noelyn Isom, Bruce Morrison, Kirk Nelson, Steve Riley, Mark Vrtiska

Nevada

Terry Wayne Cloutier, Michael W. Collopy, Gary Cottle, Terry R. Crawforth, Jean Fisher, William Fisher, William A. Molini, Earl E. Morgenroth, Jim Purrell

New Hampshire

Judy Stokes, Wayne E. Vetter, Steve Weber, Bonnie Williamson, Scot J. Williamson

New Jersey

Robert McDowell, Jan McDowell, Larry Niles

New Mexico

David Lee Anderson, Dan Baggao, James A. Bailey, Larry G. Bell, David Bennett, Don DeLorenzo, Leon Fisher, Rand French, Richard A. Gooding, Susanne M. Gooding, H. Dale Hall, Bill Huey, Joyce Johnson, Junior D. Kerns, Joanna Prukop Lackey, Eugene A. LeBoeuf, H. Stevan Logsdon, David Melman, James M. Ramakka, Luis Rios, Roberta Salazar-Henry, Jim Smith, Craig Springer, Bruce Thompson, Roy Tomlinson, Gail Tunberg

New York

Gerry Barnhart, Gordon R. Batcheller, James A. Beemer, Daniel J. Decker, Peter S. Duncan, David A. Egelston, Lawrence E. Johnson, John Major, George F. Mattfeld, Raymond Rainbolt, Elsie Roemer, Peter Roemer

North Carolina

Johanna E. Arnold, D. A. Brown, W. Emmett Carawan, Robert Montgomery, Larry Nielsen, Pete Poulos, John Townson, Evelyn C. Watkins

North Dakota

Steve Adair, Douglas Askerooth, Kristine Askerooth, Jay B. Hestbeck, Michael A. Johnson, Bev Kobriger, Jerry Kobriger, Randy Kreil, Greg Link, Jeff Nelson, Jim Ringelman, Joe Satrom, Keith Trego

Ohio

Susan Adkinson, Michael Budzik, Mike Cornelius, Steve Gray, Gary Isbell, Doug Jeanneret, Roy W. Kroll, Tony J. Peterle, Patrick Ruble, Rob Sexton, Kendra Wecker

Oklahoma

James E. Bellon, Brent Bristow, Richard Hatcher, Ana Hiott, Toni M. Hodgkins, Kevin McCurdy, Harold Namminga, Mike O'Meilia, Alan Peoples, William R. Starry, Glen Wampler

Oregon

Ron Anglin, Brad Bales, Brad Bortner, Jim Caplan, Robert P. Davison, W. Daniel Edge, Edgar Espinoza, Gina Espinoza, Rowan Gould, Dana R. Green, Jim Greer, Grant Gunderson, Steve Mealey, Judy Nelson, Hal Salwasser, Robert Trout, Sara Vickerman, Ron Wenker, David J. Wesley

Pennsylvania

Robert Boyd, John Cecil, Gary J. Crossley, Calvin DuBrock, Ann Dunkerton, Brian Hoppy, Joseph Hovis, Richard Z. Kimmel, Jan Klinger, Scott Klinger, Gary J. San Julian, Nancy San Julian, Jonathan D. Van De Venter

South Carolina

Robert Abernethy, Tammy Bristow, C. Dennis Daniel, Billy Dukes, Drenia Frampton, John Frampton, Keith D. Harris, Gary S. Herndon, Tom Hughes, James Earl Kennamer, Fred W. Kinard, Jr., Michael G. McShane, Stanley Rikard, Paul A. Sandifer, John R. Sweeney, Ernie Wiggers, Dave Wilson

South Dakota

Pete Gober, Doug Hansen, Emmett Keyser, Carl Madsen, Charles G. Scalet, James B. Stengle, George Vandel

Tennessee

Bruce Batt, Jim Byford, Troy Ettel, John Lamb, Larry C. Marcum, Keith McKnight, Gary Myers, Alan Wentz, Scott C. Yaich, Anne Zimmermann

Texas

Mary Anderson, Michael Aubele, John T. Baccus, Maria Norma Barrera, Herman A. Bennett, Mike Berger, Vernon Bevill, Ron Bisbee, Laura Bonneau, Brenda Brisbee, Robert D. Brown, Kirby Brown, Tim Buchanan, Kevin Cagle, Ruben Cantu, Ken Cearley, Rafael D. Corral, J. D. Davis, Steve DeMaso, Kay Drawe, Lynn Drawe, Ernest B. Fish, William Forbes, Tammy Ford, Richard Fuhrman, Nathan P. Garner, Ron George, Selma Glasscock, Jena Golightly, Gary L. Graham, Lee Graham, Dennis M. Herbert, John Herron, Kent Irvin, Linda Jarrett, Charles Kowaleski, Carl Lahser, Lynne Lange, David K. Langford, Gene T. Miller, Jennifer Mock, Howard P. Monsoor, Jr., Dave Morrison, James A. Neal, Iliana A. Peña, Jay A. Roberson, Paul B. Robertson, Denise Ruffino, Nova Silvy, Michael Smart, Bob

Spain, Don Steinbach, John Stevens, Randy Sublette, Louis Verner, Gary Waggerman, Steve Walker, Neal Wilkins, Clayton Wolf, Dennis Woods

Utah

Marty Bushman, Jim Cole, Kevin K. Conway, Brian Ferebee, Chuck Gay, Miles Moretti, Jack M. Payne, Jack G. Troyer, Michael L. Wolfe

Vermont

John Buck, Bill Crenshaw, Steve Hill, Ronald Regan

Virginia

Robert L. Anderson, Brad Andres, Jon Andrew, John L. Bardwell, Terry L. Bashore, Cathy Benoit, L. Peter Boice, Hannibal Bolton, Tom Busiahn, Robert L. Byrne, Richard B. Cash, Charles W. Chase, Frances K. Chase, Jamie Rappaport Clark, Glen Contreras, Alison Dalsimer, Don Dennerline, Nancy L. Derey, Chris Eberly, Robert Ellis, Mitchell R. Ellis, Dennis B. Fenn, W. James Fleming, Bob Ford, Jeannette Gallihugh, Ann Gallus, Dorothy Gibb, Gino Giumarro, Robin Goree, Sue Haseltine, Timmy Hess, Yuri Horwitz, E. Brian Hostetter, Ashlie T. Houston, Stephanie Hussey, Mark W. Indseth, Doug Inkley, George C. Iverson, Gayle Jackson, Peter W. Jackson, Heather L. Johnson, Stephanie Kenyon, Patsy Kerr, Ron Kokfl, Robert Kull, Jim Kurth, Stephanie K. Lamb, Kris E. LaMontagne, Susan Lamson, Bruce A. Lemmert, Paul A. Lenzini, Andrew Manale, Tessa E. Martin-Bashore, Chris McKay, Fred Mock, Seth Mott, Marjorie Nelson, Donald J. Orth, David N. Pashley, Pat Patterson, Carol J. Peddicord, Militsa Plavsic, Jim Preacher, Herbert A. Raffaele, Jennifer L. Rahm, Kathryn B. Reis, Terry Z. Riley, Gordon C. Robertson, Paul Schmidt, Elizabeth Scholl, Gregory J. Smith, Bettina Sparrowe, Rollin D. Sparrowe, Robert T. Stamps, Joe Starinchak, Billy R. Templeton, Janet Tennyson, Tom Thompson, David L. Trauger, Mark Van Putten, Beatrice Van Horne, Susan Walsh, David K. Whitehurst, Ken Williams, James R. Woehr, Paula Woehr, Carol Wynne

Washington

Dave Brittell, Doug Buffington, Gerald T. Johnson, Jeff Koenings, Don Larsen, Maureen Liang, John Mankowski, Wayne R. Marion, Bob Nelson, John Phillips, Bernard Shanks, Sandra Staples-Bortner

West Virginia

Dwight Guynn, Sally Guynn, Scott Hartman, Anne Johansen, Paul R. Johansen, Suzette Kimball, John R. Lemon, Curtis I. Taylor, Michael Tome

Wisconsin

Kimberly Anderson, Greg Butcher, Jared S. Cacciatore, Jim Christenson, Dan Dessecker, Dan Gonnering, Tom Hauge, Bob Hollingsworth, Steve Kessler, Deloris Larson, George Larson, Diane Lueck, Butch Marita, Robert McLean, J. Kim Mello, Don Meyer, Tom Niebauer, Cherrie Nolden, Joseph Ostervich, Harry Slawter, Holly Sromek, Ron Sromek, Christine Thomas, Norm Weiland, Arleen Wurman, Leonard H. Wurman

Wyoming

John Baughman, Lynda Cook, Arlene P. Hanson, Robert H. Hanson, Brent Knotts, Larry L. Kruckenberg, Jay Lawson, Frederick Lindzey, Robert J. Luce, Mona Model, Robert Model, Hall Sawyer, Steve Sharon, Steve Tessmann, Bill Wichers, Beth Williams

Canada

Michael G. Anderson, B. T. Aniskowicz-Fowler, Rick Baydack, Danielle Bridgett, Bob Carles, Bob Carmichael, Dale Caswell, Doug Chekay, Brigitte Collins, Lorne Colpitts, Kenneth W. Cox, Jack Dubois, Patricia Dwyer, George Finney, Valerius Geist, Brian Gray, Deanna Knudson, Art Martell, Bob McLean, Henry R. Murkin, Kalina Tamara Noel, Michael O'Brien, Rob Olson, Richard Pratt, Barbara Robinson, Ken Ross, Raymond Sarrazin, Gary Stewart, J. Stephen Wendt, John Williamson, Amy Wobeser, Gary Wobeser

England

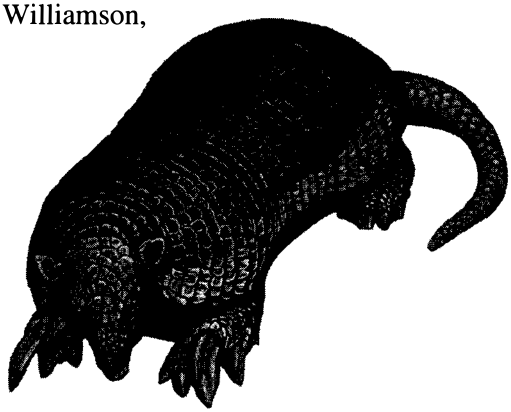
Monir Hossain

Puerto Rico

Jose Chabert

Russia

Evgeny Kuznetsov, Sergei Minkov



On behalf of the Roswell, New Mexico Field Office of the Bureau of Land Management (BLM), accepting the Wildlife Management Institute's 2002 Presidents Award from WMI President Rollin Sparrowe, were Rand French (left), Dan Baggao (second from right) and Henri R. Bisson (right), BLM Assistant Director for Renewable Resources and Planning. *Photo by Tami Heilemann.*

Bureau of Land Management's Roswell Field Office receives Wildlife Management Institute's 2002 Presidents Award

The Roswell Field Office of the US Bureau of Land Management (BLM) received the Wildlife Management Institute's (WMI) prestigious Presidents Award for 2002. The Presidents Award, specifically, recognizes an agency's department, division, office or program for particular ingenuity, initiative and accomplishments that advance scientific management of natural resources in North America.

The award was presented during a special ceremony on April 5, at the 67th North American Wildlife and Natural Resources Conference, in Dallas, Texas.

WMI honored the BLM's Roswell Field Office for its determined efforts to aid conservation of the lesser prairie chicken within the Caprock Wildlife Habitat Area in New Mexico. In particular, the Roswell Office applied vision and consistent effort to adjust traditional land management practices, as well as to educate and coordinate conservation efforts with ranchers and energy companies.

The lesser prairie chicken is a candidate for federal listing under the Endangered Species Act. The species' decline is due to habitat loss from improper livestock grazing practices, habitat modifications and energy developments. Most lesser prairie chicken habitat is on public land under purview of the Roswell Office.

During the past several years, the Roswell Office worked to improve livestock grazing practices on grazing land allotments under the BLM's jurisdiction. The BLM drew on the best science and scientists to develop grazing and land management strategies to restore the health of vegetation within grazing allotments, thereby improving the lesser prairie chickens' habitat. The BLM staff carefully and thoroughly discussed concerns with impacted ranchers, conducting several meetings and field trips for that purpose.

In addition, the Roswell Office worked with energy developers to minimize impacts on wildlife habitats. When proposed energy exploration or development posed a potential threat to lesser prairie chickens or their habitats, the BLM implemented necessary seasonal and spacial guidelines to ensure that threats were minimized.

"The bottom line is that, when it counted, the BLM implemented necessary changes to benefit lesser prairie chickens and other wildlife species," Sparrowe said. "This award acknowledges the entire Roswell Field Office staff. The success of a program of this importance and sensitivity required a full team effort."

Scott Klinger of Middleburg, Pennsylvania, receives the Wildlife Management Institute's (WMI) 2002 Touchstone Award from WMI President Rollin Sparrowe. *Photo by Tami Heilemann.*

Pennsylvania wildlife biologist, Scott R. Klinger, receives 2002 Touchstone Award

Scott R. Klinger, a wildlife biologist for the Pennsylvania Game Commission, was awarded the Wildlife Management Institute's 2002 Touchstone Award. This award recognizes persons in natural resources management whose ingenuity and initiative have resulted in a program or product that has notably advanced sound resource management and conservation in North America. Klinger received the award at a special ceremony on April 5, 2002, at the 67th North American Wildlife and Natural Resources Conference, in Dallas, Texas.

Klinger was recognized for his farsighted creativity and tireless efforts to frame, expand and implement Pennsylvania's Conservation Reserve Enhancement Program (CREP), improving land and wildlife conservation on more than 80,000 acres of private lands in 20 Pennsylvania counties.

Established in 2000, in an agreement between Pennsylvania's Governor and the US Secretary of Agriculture, CREP provides $210 million to Pennsylvania farmers during the next 10 to 15 years to establish groundcover on erodible cropland and buffers next to streams. This arrangement is an incentive for farmers to protect marginal cropland, benefitting game and nongame wildlife, including grassland birds, mammals and riparian forest species. Approximately 45 percent of CREP acres also are enrolled in the Pennsylvania Game Commission's cooperative public hunting access programs, expanding opportunities for hunters.

Appointed as the Pennsylvania Commission's CREP coordinator, as well as chairman of the CREP subcommittee of the State Technical Committee, Klinger convinced Commission leaders to expand CREP's existing programs, largely focused on working with private landowners to develop public access. Klinger focused on increasing enrollment and funding; under his direction, the Commission hired wildlife biologists to work on a county level to craft conservation plans for CREP participants.

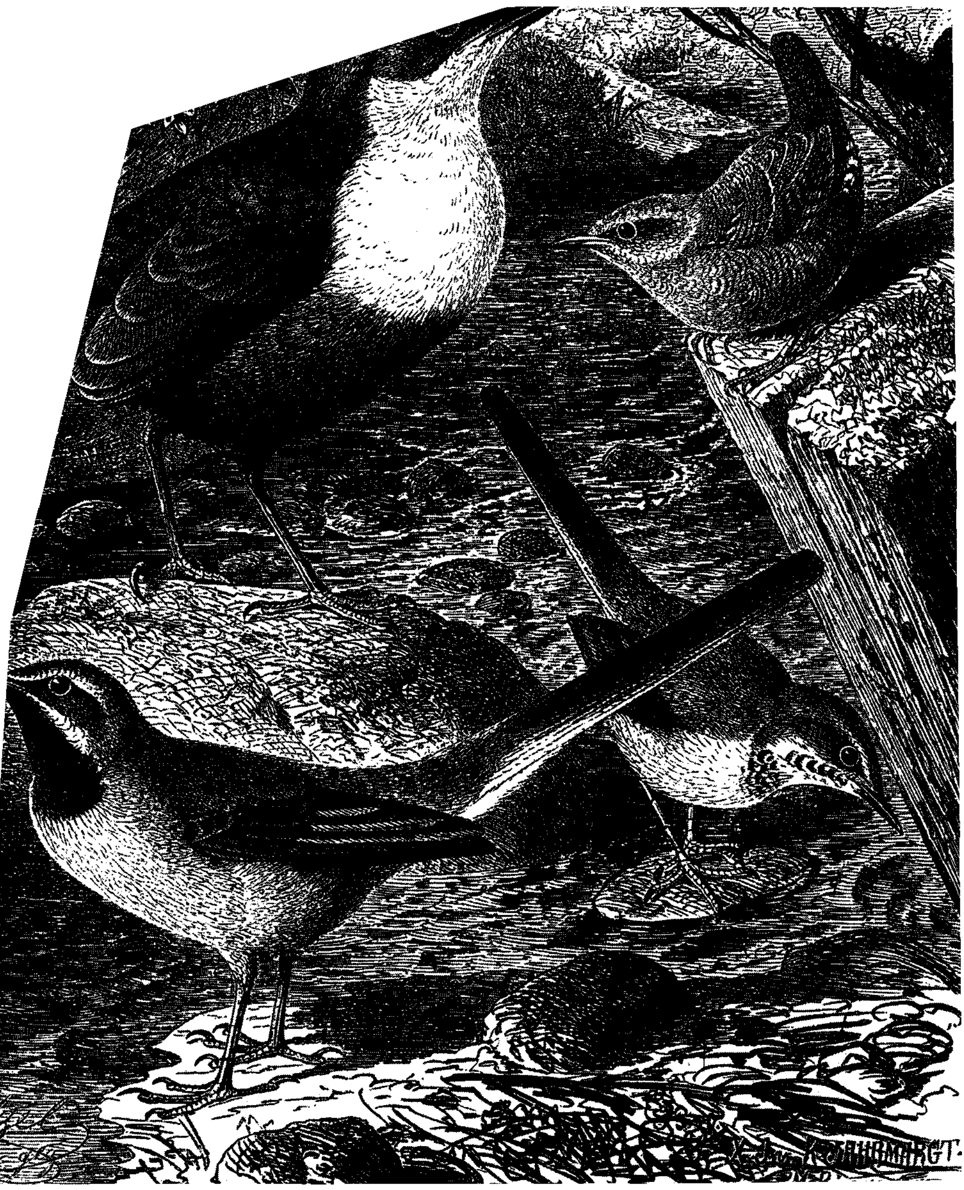
As well as positively affecting land and wildlife conservation, he improved relationships with Pennsylvania farmers and harnessed their broad support for CREP.

In the past two years, 2,000 landowners enrolled more than 80,000 acres in CREP, reestablishing marginal lands in warm season grasses and forested riparian buffers. As a result, there is more undisturbed grassland habitat in Pennsylvania since 1971. CREP should reach its authorized enrollment cap of 100,000 acres in June 2002.

Klinger coordinates CREP through various state and federal agencies, non-profit organizations and businesses. He also works with Penn State scientists to evaluate CREP projects.

"Due to his proactive approach, persistence and dedication, CREP is a major success in Pennsylvania," said Rollin D. Sparrowe, WMI president. "In fact, thanks to Scott, CREP is one of the most successful private lands conservation programs in Pennsylvania history. Significant, long-term conservation benefits will result from Scott's hard work on CREP and other private lands programs in Pennsylvania. As one of his colleagues said: 'Scott is a force for wildlife.'"

In addition to his role in CREP, Klinger currently serves as the Private Lands and Farm Bill Coordinator for the Pennsylvania Commission. For more than 20 years, Klinger's work has taken him across the country, studying white-tailed deer and bobwhite quail in Kansas, migratory songbirds in Georgia, and black bears and Indiana bats in Virginia. While working at Fort Riley Military Installation in Kansas, he oversaw the reintroduction of eastern turkey and Rocky Mountain elk.



Lee M. Bass, of Fort Worth, Texas, accepts the Wildlife Management Institute's (WMI) 2002 Distinguished Service Award from WMI President, Rollin Sparrowe. Co-recipient Perry R. Bass was unable to attend. *Photo by Tami Heilmann.*

Perry and Lee Bass Honored for Contributions to Natural Resource Conservation in Texas

Perry R. and Lee M. Bass, former members and chairmen of the Texas Parks and Wildlife Commission, received the Wildlife Management Institute's (WMI) 2001 Distinguished Service Award at a special ceremony on April 5, during the 67th North American Wildlife and Natural Resources Conference in Dallas, Texas. This international award recognizes individuals who have made extraordinary and enduring, but largely unsung, contributions to natural resources conservation.

The Texas Parks and Wildlife Commission establishes policies and rules to carry out programs of the Texas Parks and Wildlife Department. As commissioners for more than 20 years, Perry and Lee Bass have given sound direction to the Texas Parks and Wildlife Department by consistently meeting resource and constituent goals and providing necessary stability to make a quality agency. Their efforts helped make the department one of the premiere state fisheries and wildlife resource management agencies in the United States.

Perry's tenure with the Texas commission began in 1977; he served as chairman from 1979-1983 and chairman emeritus since 1988. Perry's son, Lee, was appointed to the commission in 1989. From 1995 to 2001, Lee served as its chairman.

"The best commissioners, like Perry and Lee Bass, lead by example," said Rollin D. Sparrowe, WMI President. "The Bass' wisdom, courage and understanding are reflected in the improved ability of the Texas department to manage effectively the fish, wildlife and other natural resources with whose stewardship the agency is charged. WMI recognizes the contributions made by these two generations of Texas' renowned Bass family to the success of the Texas Parks and Wildlife Department."

President George W. Bush sent a letter of congratulations to Perry and Lee, for their "contributions to wildlife conservation." The letter was read at the presentation ceremony by former Texas Parks and Wildlife Commission chairman Chuck Nash.

Perry and Lee Bass' continuing leadership in the natural resources world is extensive. Perry Bass serves in an advisory capacity for several conservation organizations, including the Atlantic Salmon Federation, Game Conservation International, the National Fish and Wildlife Foundation, the Texas Audubon Society, and the Wildlife Conservation Fund of America. Lee Bass is on the board of directors for The Peregrine Fund and is the founder of The International Rhino Foundation.