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Transactions of the Eightieth North American Wildlife and Natural Resources Conference

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appreciates and respectfully acknowledges the special
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80th North American Wildlife and Natural Resources Conference

Welcome and Opening Remarks

Steve Williams
Wildlife Management Institute
Gardners, Pennsylvania

Welcome to the 80th North American Wildlife and Natural Resources Conference. The Wildlife Management Institute (WMI) thanks you and all the conference partners, exhibitors, and state agency sponsors who are critical to making this conference successful.

Although this is the 80th North American conference, it is the 100th gathering of fish and wildlife leaders under the administration of WMI and its forerunners. Known first as the National Game Conference, it was initially held in New York City in 1915. At that time, WMI was called the American Game Protective and Propagation Association. In 1936, the annual meeting was renamed and the numbering started anew as the 1st North American Wildlife Conference. In 1960, the meeting was finally re-named the North American Wildlife and Natural Resources Conference, but the consecutive numbering continued. Therefore, the 79th North American was actually the 100th. However, as the 1943 conference was not held because of World War II restrictions, the North American conference celebrates its true centennial in 2015.

I want to thank the special session organizers and the speakers for sharing their expertise with us. This year, the sessions will address: conflict resolution in conservation, creating customers out of consumers, species sustainability and the Endangered Species Act, and the Cooperative Fish and Wildlife Research Units. I encourage you to attend and participate in the discussions.

Normally I try to report some of the conservation events and issues that have occurred since we last met. This year, I am not going to spend much time on this because I have another concern I want to share. However, I will take a few moments to recognize some of the major activities of the past year.

The landscape-level planning, implementation plans, and actual work on the ground to conserve lesser prairie chickens and greater sage grouse have been truly remarkable. The collaboration among the state fish and wildlife agencies, U.S. Fish and Wildlife Service, Bureau of Land Management, forest service, Natural Resources Conservation Service, industry, and private landowners has been unprecedented. This work should serve as a model for the conservation of all species, not just those in dire need of conservation.

Although Congress fumbled the ball on the Sportsmen's Act of 2014, we hope to push the Sportsmen's Act of 2015 across the goal line. The Council to Advance Hunting and Shooting Sports has a national game plan to advance hunting recruitment, retention, and reengagement. By establishing the Blue Ribbon Panel on Conservation Funding, the Association of Fish and Wildlife Agencies has brought together head coaches from across the spectrum to plot a path for enhanced conservation funding. This year, the National Conservation Leadership Institute reached its 10-year milestone and will have provided leadership training to more than 350 program fellows, placing quarterbacks on the field at the federal, state, tribal, and private levels. Finally, and to totally wear out my awkward football analogy, the Land and Water Conservation Fund (LWCF) has reached its 50th year of existence with an unfortunate 1-and-49 record. A record that needs to be inflated not deflated.

LWCF has provided tremendous treasures for this nation; however, some of us envision a better future. We would like to see fish and wildlife conservation included as a stated purpose of a modernized conservation funding mechanism. We would like to see public access to public lands be an integral component of a new trust fund, one derived from nonrenewable resource revenues that would address renewable resource issues. A modern funding mechanism could cast off the baggage that LWCF unduly carries. It could be more relevant to the American people and those in Congress who were not even born

when LWCF was first enacted. It would be a long and rocky road to pass a new conservation-funding bill. To chart a new path forward we must engage relevant stakeholders, both on the revenue and expense side of the ledger. The path must recognize the needs and desires of diverse interests: urban, rural, conservation, historical, recreational, the regulated, and the regulators. A number of us have been working toward that outcome.

Now, on to my concern—in thinking about 100 years of conservation progress, I immediately thought about some of the technological advances that have enhanced fish and wildlife science. Early biologists labored without the technological tools of radio telemetry, remote sensing, geographic information systems, DNA analysis, and population modeling. The development of these tools provided advances in population management, landscape ecology, and a better understanding of the ecosystem concept. Today, fish and wildlife biologists have the knowledge, skills, and tools that were unimaginable 100 years ago.

As a result, one might think that fish and wildlife science would be widely respected across the continent. Decisions would always be made with the best science at hand. Obviously that is not always the case. Our science-driven decisions are today, as in the past, muddled by politics, economics, lawsuits, and a distrust of science. For the next few minutes, I want to focus on science and the public's views on science.

This past January, the Pew Research Center, in collaboration with the American Association for the Advancement of Science (AAAS), released a report entitled, "Public and Scientists' Views on Science and Society." I will cite just three examples to demonstrate the difficulty we face in shaping public opinion about our natural world.

First, although 98 percent of AAAS scientists believed humans have evolved over time, only 65 percent of U.S. adults surveyed agreed; 31 percent believed humans have existed in present form since the beginning. Almost half of those respondents believed scientists agree that humans have existed in present form since the beginning. Second, according to the report, 97 percent of AAAS scientists believed in climate change and 95 percent believed it is a serious problem. Only 73 percent of U.S. adults believed in climate change and 25 percent believed there was no solid evidence of climate change. Third, with respect to animal use, 89 percent of AAAS scientists were in favor of the use of animals in research while less than half of U.S. adults surveyed shared those same views.

Evolution, climate change, and animal use are complex issues. Science is hard. Most humans chose to pursue other academic subjects to make a living. But we all know science provides the underpinning of civilization and the understanding of our world. To make good decisions, it is not necessary for everyone to understand science but it is necessary that everyone respect science. That goes for public policymakers even more than the general public. Of the AAAS scientists surveyed, only 27 percent responded that the best scientific information guided government regulations most of the time for clean air and water, and only 15 percent believed that scientific information guided regulations for land use.

This dichotomy between the public and scientists' views is even more disturbing because the gap seems to be widening not closing. Think about the recent debate over vaccination. Social media allows anyone to advance their beliefs in 140 characters or less. Celebrities, who are better known than scientists, express their views on television and social media. Twenty-four-hour cable news networks provide a microphone to almost anyone who raises objections about science. Lobbyists undermine science that may economically harm their clients' interests. Politicians listen to those same lobbyists and their ill-informed constituents. Advocacy organizations make a lot of money touting or dismissing science. It is not hard to understand why science appears to be losing ground to misunderstanding, misinformation, and ideology.

Where does that leave us as fish and wildlife scientists and policymakers? Every one of us has had to deal with situations where science was misunderstood, ignored, or rejected. It is easy to place the blame on others. However, we better assess our public information and outreach efforts before we cast the first stone. We have reveled in the advances in our science. We hold conferences to explain our work to our colleagues. We make up new terms and acronyms and throw them about in meetings like they were so many intellectual spitballs.

How often have we taken the time and effort to inform the public, in layman's terms, about population dynamics, ecosystem functions, cumulative effects, or the public trust doctrine? Everybody in this room has a good understanding of these terms. Our constituents, our customers, do not. Unless we want to become irrelevant to society, we better figure out a way to explain our use of science so the public can understand and appreciate it.

Leopold had a way with words, "When we see land as a community to which we belong, we may begin to use it with love and respect." That simple quote captures what we do. However, we face challenges that Leopold could not have imagined. We have science knowledge and tools that were unavailable to him. As the science has become more sophisticated, we must find ways to simplify our explanations to the public. How are we going to convince the public that science matters, that fish and wildlife conservation matters? We can only accomplish this by telling our story in ways that are relevant to and resonate with the public.

Please keep those words in mind—"relevant" and "resonate." We have to describe conservation in ways that are relevant to the public and in ways that resonate with the public. To fail in either is a failure for conservation.

Thank you for participating in this conference and I thank you for your dedication to fish and wildlife conservation.

It Is Going To Take All Of Us To Do It: Reflections on Past Progress and its Lesson for the Future

Paul W. Hansen
The Murie Center
Jackson, Wyoming

Introduction

This year, in recognition of the 100th year of the North American Wildlife and Natural Resources Conference, the Wildlife Management Institute and the steering committee for this meeting came up with a very different idea for the plenary keynote.

The committee decided that rather than have an outside speaker, or even one of our own, this year we are going to hear from all of you—from the profession itself. That is, at least from the 800 of you who completed the survey instrument sent to you in late January.

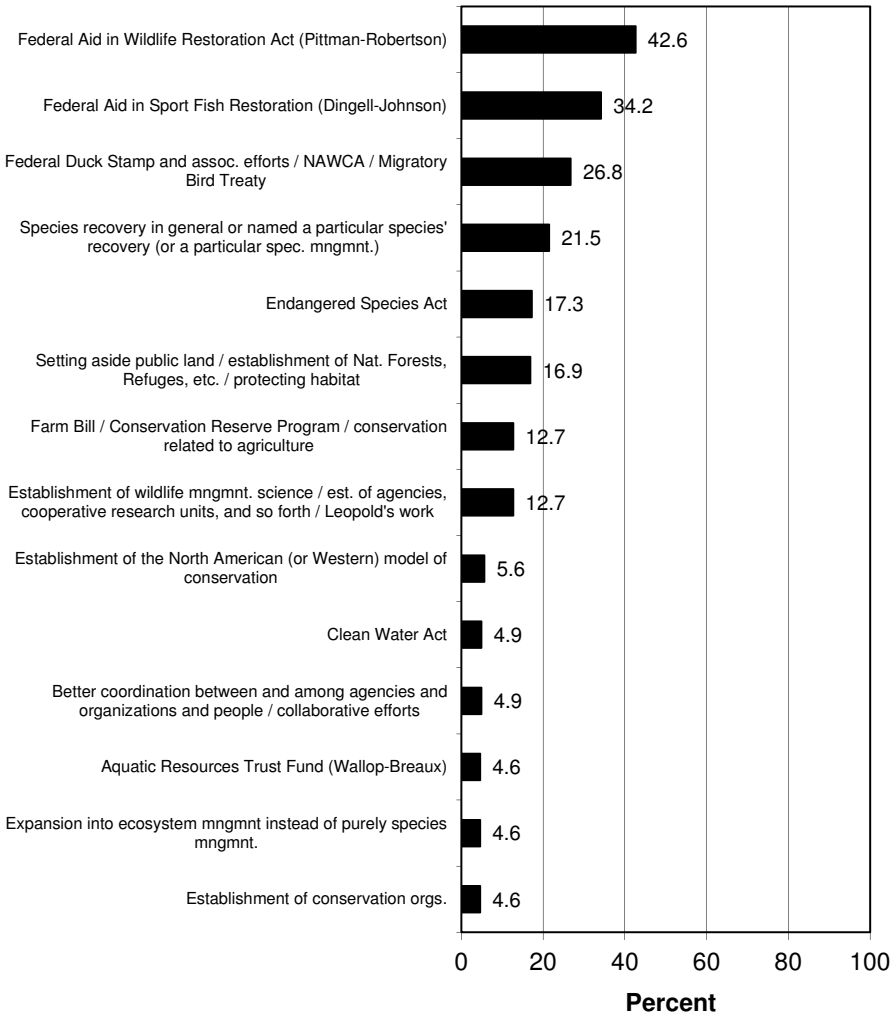
Our thought, which we have been working on now for the last nine months, was to look back at what has defined success for our profession over the past century. We asked you to identify the most successful initiatives, programs, and/or efforts over the past 100 years as well as the strategies that led to that success and made it possible. Most importantly, we considered what all of this tells us about how we can most effectively go about the vital task of managing America's wildlife and natural resources going forward in the next 100 years.

Obviously, this is a very large and very broad topic. We wanted to approach it as scientifically as possible, so we enlisted the help of Mark Duda and his team at Responsive Management. From the moment last summer when I called Mark to ask if he could help us, he was extremely excited to participate, calling this effort a "game changer of considerable importance." Mark's contribution is a real gift to the community.

More than 800 of you took the time to participate in this survey. While the results are not fully analyzed, and some of the findings will come as no surprise, I have read every one of your comments at least twice, all 262 pages. There is a lot of thought and wisdom here. As one of you put it: "These are 20 beer questions."

In the next 15 minutes, it is my task to try to summarize what I think you told us about success in the past century, and how we got there. Keep in mind that these are responses to open-ended questions. We plan to eventually have a summary paper available to all attendees.

Q1. In a few words, what would you say are the most successful initiatives, programs, and/or efforts of fish and wildlife management over the past 100 years at the national level? (Part 1)



Q1. In a Few Words, What Would You Say are the Most Successful Initiatives, Programs, and/or Efforts of Fish and Wildlife Management During the Past 100 Years at the National Level?

Dedicated Funds

Dedicated taxes—federal aid in Wildlife and Sport Fish Restoration Program funds and the Duck Stamp—predominated as the most successful things we have done. As you can see, your first three top-ranked accomplishments were all about dedicated funding, the excise taxes on hunting and fishing gear, and the Duck Stamp. This comes as no surprise, given the impact this funding has had on species restoration, habitat protection, and management across the board.

Species Restoration

Right behind dedicated funding, you ranked species recovery and management. In the early years, dedicated funds helped to drive wildlife management away from patronage and toward professionalism. After the 19th century, when populations of a number species plummeted and others became extinct, professional management and dedicated funding in the 20th century enabled the restoration of a broad spectrum of species. You cited many of them, from elk, turkeys, deer, pronghorn, wild sheep, Peregrine falcons, bald and golden eagles, striped bass, and Atlantic shad to trumpeter swans, whooping cranes, marine turtles, alligators, brown pelicans, New England cottontails, and even the Puerto Rican parrot.

Many of us noted that the $1 billion per year these funds now generate are a fundamental source of support for sustaining this success and for making progress on other species where success has yet to come: Pacific salmonids, woodcock, bobwhite, grassland songbirds, Eastern brook trout, and California condors were all cited.

Endangered Species Act (ESA)

The Endangered Species Act is ranked high as one of most successful, but it also ranked very high as one of the least successful initiatives, so I will talk about it in minute.

Land Conservation

Land conservation in two categories—public and private—was your next most successful area. You cited both the emergence of managed public lands—national forests, wildlife refuges, waterfowl production areas, wildlife management areas—as well as private land conservation: farmland wetland and conservation reserves as well as conservation easements on private lands.

That most native of American philosophies, pragmatism is thought by many to be part of what makes America great. The Farm Bill is often cited as an example of where alignment with another interest yielded far more funding for conservation than we could have received on our own. While the outcomes were somewhat unstable, there is little doubt that the Farm Bill's conservation title was a net positive for fish and wildlife. Highway funding was given as another example where more funding was made available—for wildlife crossings, habitat connectivity, and access—than might have been possible through direct appropriations.

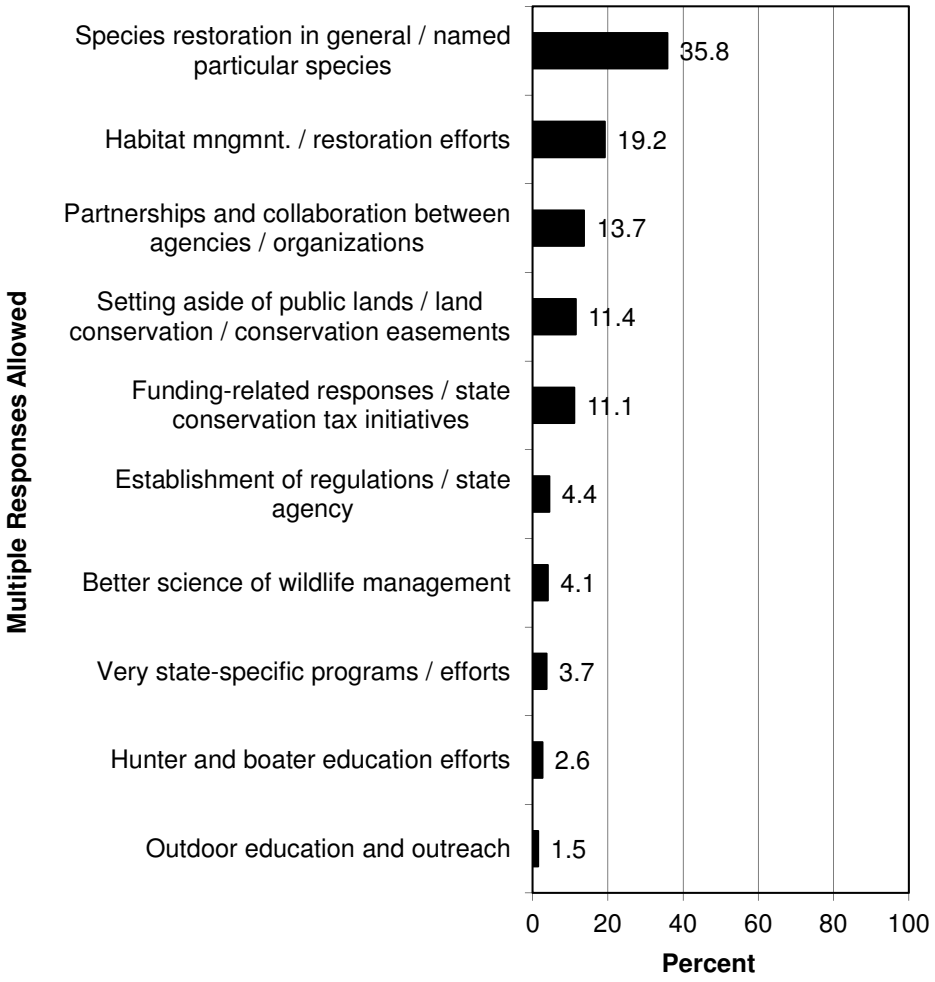
Regarding private lands, in the United States roughly 50 million acres of open space and wildlife habitat, an area equal to the entire state of Nebraska, have been voluntarily conserved over the past few decades. About half of this was accomplished using conservation easements whereby landowners get payment, a tax deduction, or a combination of both in exchange for donating the development rights on their land. It is a voluntary mechanism.

Public support for this type of voluntary, incentive-based land conservation has been very popular. According to Landvote, which tracks federal, state, and local ballot initiatives, since 1988 voters have approved more than $72 billion in dedicated conservation funds, primarily for open space and habitat protection. At times, citizens have literally forced their elected officials to accept these programs. Again, it seems that public supports well-used dedicated taxes.

The North American Model

Next ranked, but somewhat lower, is the North American Model of Wildlife Conservation, which we looked at more carefully later in the survey and I will get to in a moment.

Q2. In a few words, what would you say are the most successful initiatives, programs, and/or efforts of fish and wildlife management over the past 100 years at the regional or state level in your region or state?



Q2. In a Few Words, What Would You Say are the Most Successful Initiatives, Programs, and/or Efforts of Fish and Wildlife Management During the Past 100 Years at the Regional or State Level in Your Region or State?

The state and regional findings tracked the national ones pretty closely, with some significant exceptions.

Species restoration and habitat management were again ranked highly. Land conservation, set asides, and conservation easements were close behind. Dedicated funding at the state level, however, was ranked much lower than at the national level, which pretty much reflects reality in all but a few states. Overall, at the state level, we have not done as well securing dedicated funding for fish and wildlife. The largest exception is Minnesota, where the $250 million per year Outdoor Heritage Fund, passed by ballot initiative in 2008, yielded this comment:

> Hunter support was the driving force for most of the 20th century. However, it was the collaboration of environmental and conservation groups (Guns and Greens) that provided the big home runs around the turn of the century. Reinvest in Minnesota, Environment and Natural Resources Trust Fund, and Outdoor Heritage Fund all passed because of this collaboration.

Partnerships and collaboration ranked very highly at the state level. This was surprising, since this is more of a tactic than a program or initiative. It was almost as though you anticipated the next question, which gets us to Question 3, for which we do not have a graph, for good reason.

Q3. What Would You Say are the Reasons the Initiatives, Programs, and/or Efforts You Listed Have Been Successful at the National, Regional, and/or State Level(s)?

In response to this question, almost every commenter said something that attributed success to partnerships, to a broad base of support. The word "public" was used in about half the comments. Overall, you used slightly different language, but your reasons for success seemed consistent and clear:

- partnerships
- public participation
- diverse stakeholders
- sharing responsibility
- open communication
- common purpose
- common ground
- strong sportsmen/women support
- public support was vital
- cooperation and involvement of stakeholders
- true collaboration and cooperation
- public support that motivates political support
- dedicated revenues (but more importantly, dedicated individuals)
- collaborative public-private partnerships with a strong educational component
- radical fringes hold too much sway over wildlife/habitat management decisions

You cited many examples of these principles in practice. Here are two of my favorites:

1) I mentioned previously that in the past 40 years around 50 million acres of private land have been voluntarily protected. About half of it was accomplished using conservation easements. Just over a decade ago, several members of Congress proposed to eliminate this tool—the charitable tax deduction for gifts of development rights on private land. It was a bad idea. Most of the groups represented in this room rallied to support retaining conservation easement tax deductions. We worked with a number of the great land trusts—Land Trust Alliance, The Nature Conservancy, Trust for Public Land, Conservation Fund—and a bunch of other nontraditional allies we don't always agree with: the American Bird Conservancy, Defenders of Wildlife, and the Environmental Defense Fund. The result of the effort of this broad group was breathtaking.

Not only did Congress reverse itself and keep the deductibility of conservation easements in place, it greatly increased the percentage of one's adjusted gross income that could be used from 30 percent to 50 percent and for some qualifying ranchers and farmers even 100 percent. Even more importantly, the number of years that the easement donation deduction could be taken was extended from six to 16 years. This made a real difference for many land-rich but cash-poor landowners. As a result, the annual rate of voluntary habitat conservation on private land nearly doubled. When we came together, we won big.

Unfortunately, the enhanced deduction for conservation easement donations expired December 31, 2014. This initiative has strong majority support from both political parties, something as rare as a passenger pigeon these days, but just missed a two-thirds majority vote procedural requirement in the last Congress (275 to 149) by eight votes. I hope our groups will continue to come together to work to make this enhanced deduction permanent to help voluntary private land conservation.

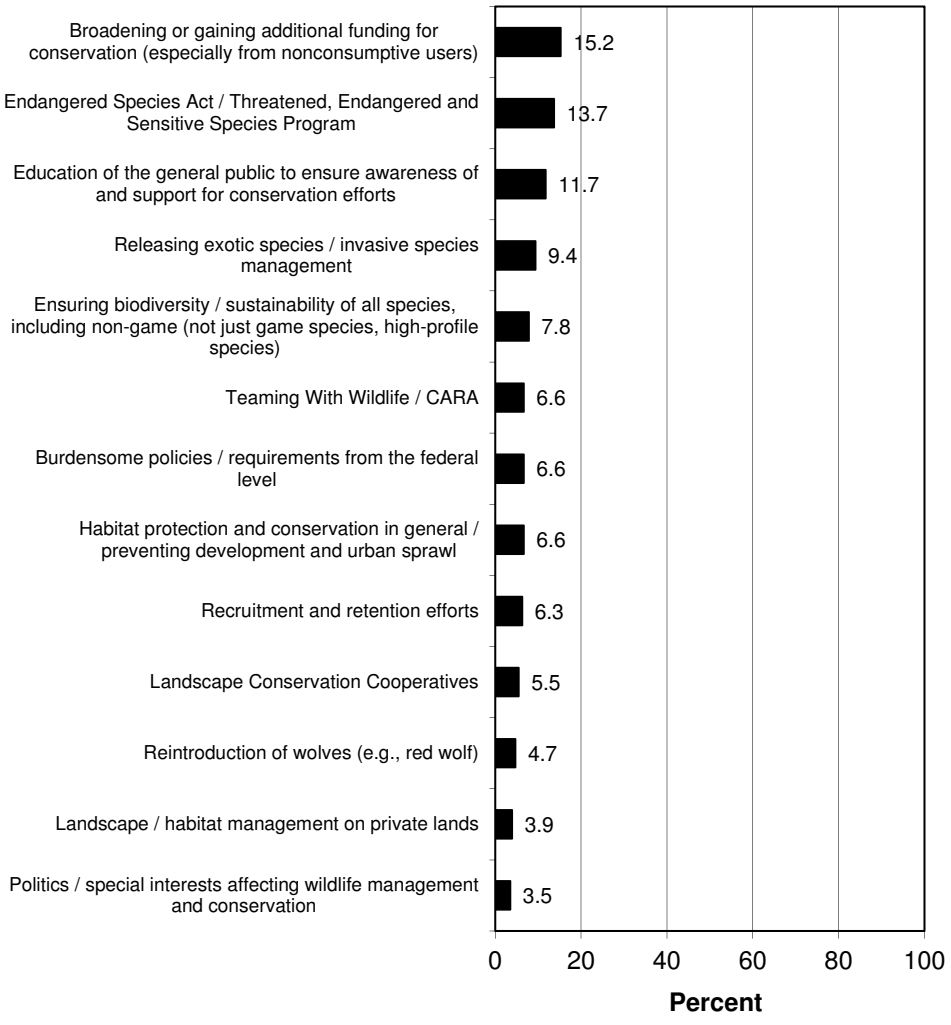
2) In 1997, Congress finally provided much-needed legislation codifying the refuge system mission with the passage of the National Wildlife Refuge System Improvement Act. National parks and forests had "organic act" legislation like this since Theodore Roosevelt's time and the Bureau of Land

Management since the 1976 Federal Land Management and Policy Act. Again, the success of the refuge act was marked by broad support and strategic compromise whereby, after some clashing, a large number of diverse groups agreed that:

- the primary purpose and use of national wildlife refuges would be wildlife conservation,
- wildlife dependent recreation of all kinds was deemed a legitimate but secondary use, and
- all other uses would be allowed only if there was a compatibility determination that concluded there was no conflict with the primary purpose.

One interesting comment was that the establishment of marine refuges, at least in areas easily accessible to people, has been much less successful than the establishment of terrestrial refuges, perhaps due to less effort toward achieving this type of consensus.

Q4. In a few words, what would you say are the LEAST successful initiatives, programs, and/or efforts of fish and wildlife management over the past 100 years at the NATIONAL level? (Part 1)



Q4. In a Few Words, What Would You Say are the Least Successful Initiatives, Programs, and/or Efforts of Fish and Wildlife Management During the Past 100 Years at the National Level?

What we regarded as least successful was a little more spread out, but the failure to expand dedicated funding predominated. If you look at the Conservation and Reinvestment Act and Teaming With Wildlife for "finding additional dedicated funding from non-consumptive users," it is pretty clear we regard this area as overall the least successful effort.

On the other hand, as I mentioned, the Endangered Species Act was rated as both one of the most successful (17.3 percent) and least successful (13.7 percent) initiatives.

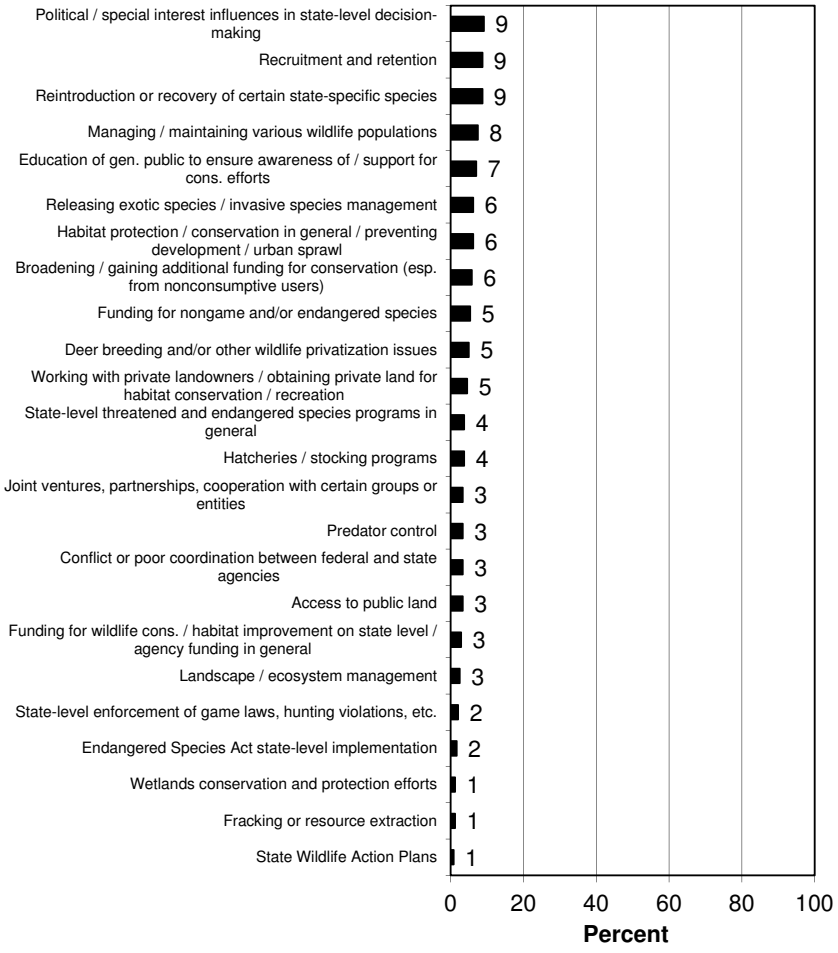
While many of you acknowledged that the ESA had been successful at focusing attention and resources, many others bemoaned the spate of lawsuits and diversion of resources spawned by ESA. I thought some of the most compelling opinions came from state and federal agency leaders who overwhelmingly felt we would be further ahead if more of the dollars spent responding to lawsuits had been used more productively and proactively on the ground. We heard this a lot.

Others pointed out that while a positive outcome on one issue can be made possible by litigation, it can simultaneously increase mistrust and divisiveness among natural allies who might then find it difficult to find common ground on other issues. There seems to be pretty widespread agreement that most of the more capricious lawsuits are destructive.

That said, in no part of the entire survey were your comments more thoughtful. Many of you noted that ESA has driven collaborative efforts that have successfully avoided species listings, and some formerly listed species are now doing well. Again, these were open-ended questions and many of your comments were quite remarkable. Here are a few examples:

> The ESA, because it is well written. Implementation is horrible. [Most successful.]
>
> It is tough because I think it has had some tremendous successes. However, the politicization of the act, and subsequent management actions, created a terrible environment of litigation around a truly noble law. [Least successful.]
>
> While I am a strong supporter of the ESA, I think that its application through the courts has made it often ineffective, cumbersome, burdensome and counter-productive. [Least successful.]
>
> The time and money spent in the courtroom has redirected many good conservation efforts. The intent of the law is good, but it is time to correct the problems with this law for the overall benefit of wildlife. [Least successful.]

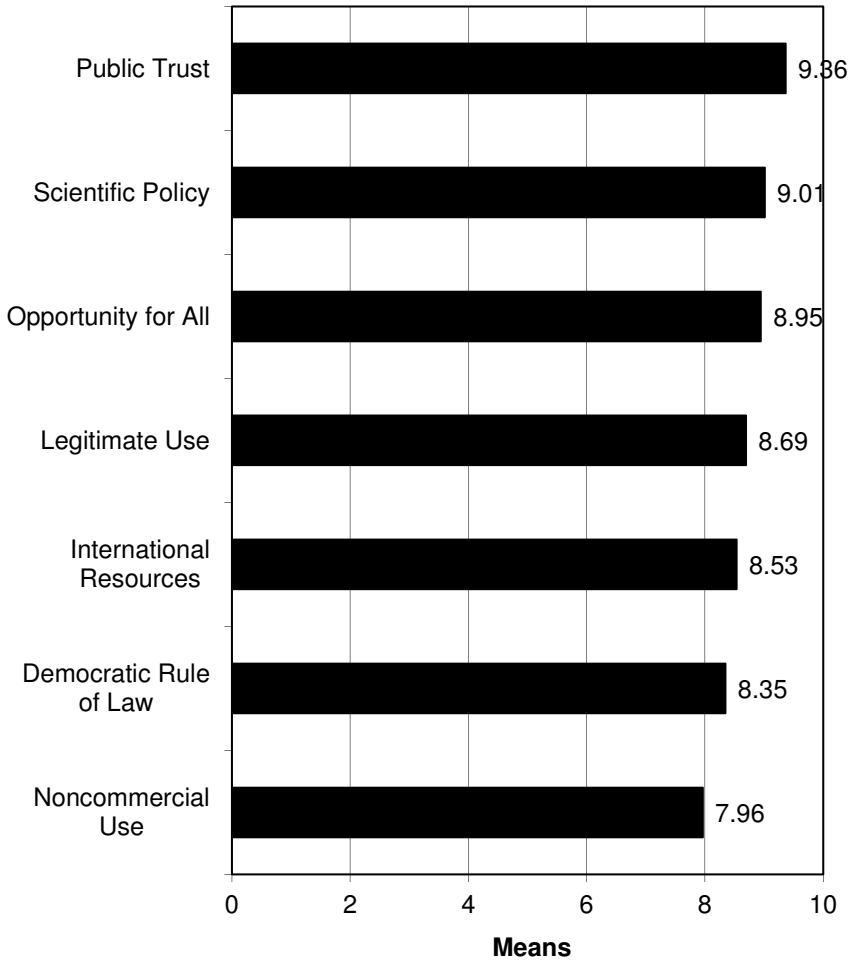
Q5. In a few words, what would you say are the least successful initiatives, programs, and/or efforts of fish and wildlife management over the past 100 years at the regional or state level in your region or state?



Q5. In a Few Words, What Would You Say are the Least Successful Initiatives, Programs, and/or Efforts of Fish and Wildlife Management During the Past 100 Years at the Regional or State Level in Your Region or State?

This is one area where many important things were noted, but we found no dominant consensus. No one idea made double digits. Getting politics and special interests out of decision-making—i.e., letting science be the basis for determinations—showed up here and elsewhere. There are another 16 items mentioned, all with lower percentages. That said, in this section we had the longest and most detailed comments of all—58 pages with hundreds of thoughtful comments on what we could do better. Again, this data needs more analysis.

Q7a. On a scale of 0 - 10, where 0 is "not at all important" and 10 is "extremely important," the mean ratings of how important each principle or tenet is for the future of fish and wildlife conservation:



Q7a. On a Scale of Zero to 10, Where Zero is "Not at All Important" and 10 is "Extremely Important," the Mean Ratings of How Important Each Principle or Tenet is for the Future of Fish And Wildlife Conservation.

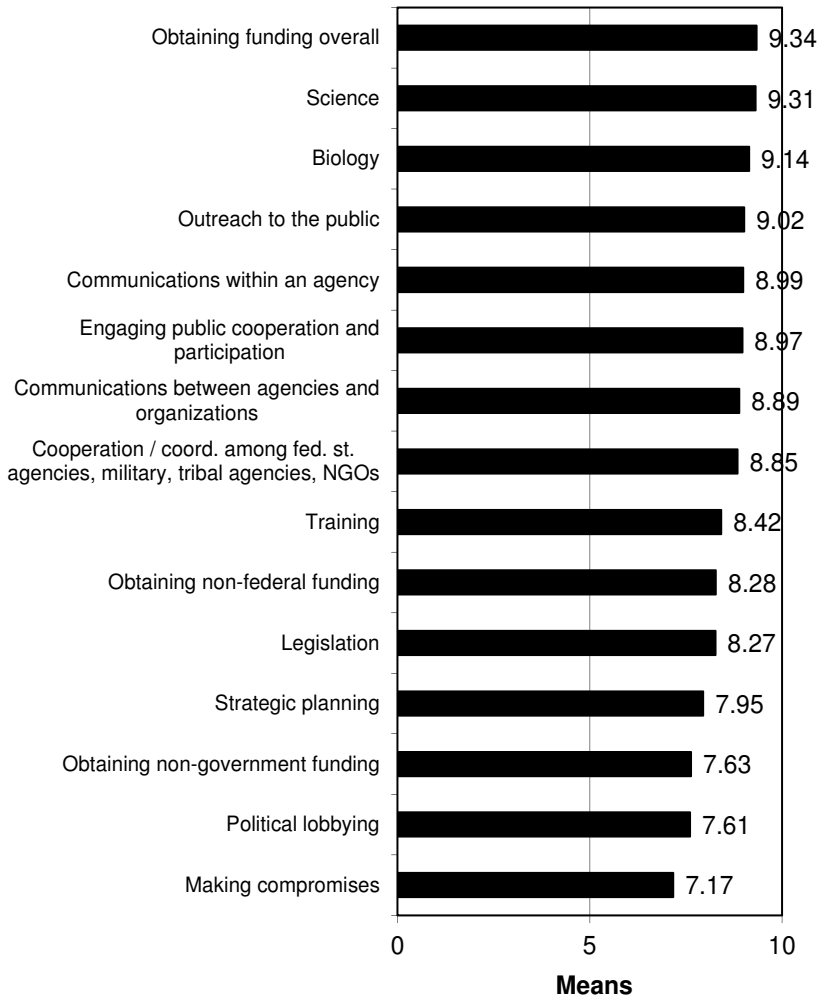
This is where we asked some detailed questions on the North American Model, though we did not label it as such. Since you ranked this lower than some other items, let me make just two quick points.

The concept of public trust. The statement: "Natural resources, including fish and wildlife, are managed by the government for public use and enjoyment, as well as for sustainability, and that individuals do not own wildlife," received very strong support. Often thought of as the keystone principle of the North American Model, this concept was overwhelmingly confirmed by this group. There appears to be very little support in our profession for moving to a more privatized system for hunting and fishing or for the divestiture or transfer of public lands.

Science. A driving principle of the North American Model of wildlife management, there seems to be much agreement that good science can drive good policy but less agreement on the details. At times, we have seen the hazard of bringing preliminary science forward too quickly. On the other hand, for some it seems that no amount of good science is enough, as we have seen on the basic dynamics of climate change or on the toxicity of lead in the environment—now the leading cause of bald eagle mortality, according to the USGS National Wildlife Health Center.

Others point out that we have, at times, not used our own science very well, with examples like letting overharvest continue too long despite what good science called for. Again, you expressed a lot of concern about politics trumping science and the desire to keep politics out of wildlife and natural resource decision-making. In fact, at the end of the survey, where you were asked to volunteer any other ideas, this concept was the one most frequently mentioned.

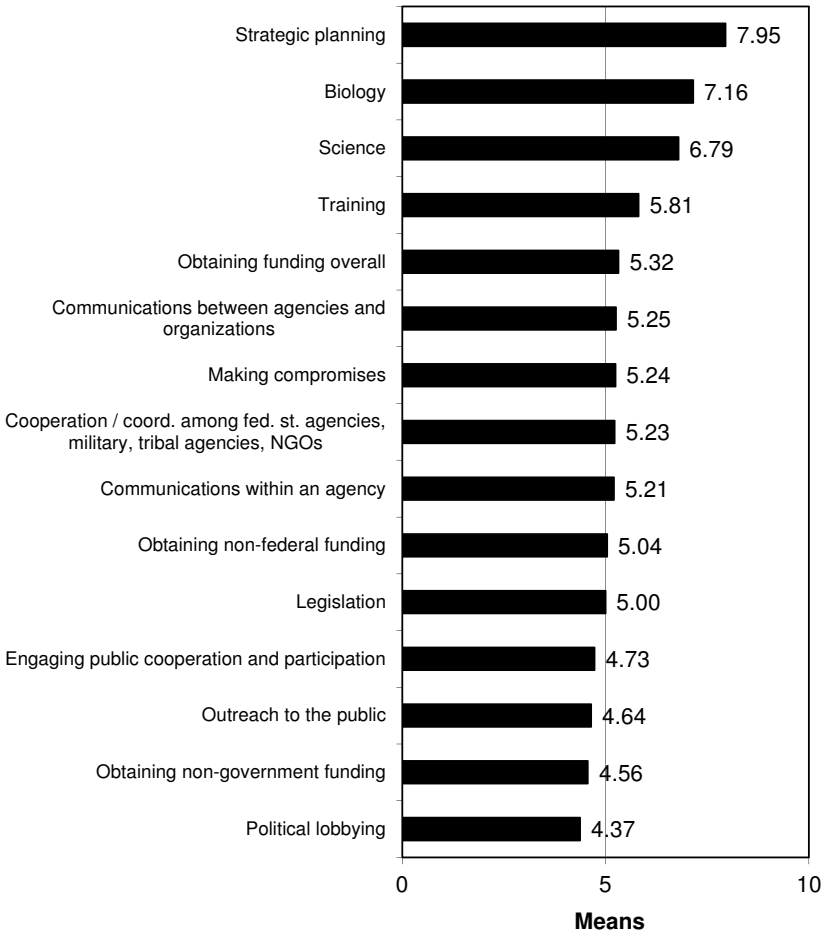
Q29a. On a scale of 0 - 10, where 0 is "not at all essential" and 10 is "absolutely essential," the mean ratings of how essential each component is to successful fish and wildlife management:



Q29a. On a Scale of Zero to 10, Where Zero is "Not at All Essential" and 10 is "Absolutely Essential," the Mean Ratings of How Essential Each Component is to Successful Fish and Wildlife Management.

Again, funding is rated at the top, but ironically, the mechanisms needed to get that funding—i.e., political lobbying and finding compromise or common cause with natural allies—seemed to be rated quite low. We rate science, outreach, and communications as quite important to success but seem less comfortable with human dimensions and policymaking. While we did not ask the question, from your comments it would seem that our approval rating for the U.S. Congress is probably around the 9 percent favorable rating given by the general public—about where we might rate a really noxious invasive species.

Q29b. On a scale of 0 - 10, where 0 is "poor" and 10 is "excellent," the mean ratings of how well each component has been performed:



Q29b. On a Scale of Zero to 10, Where Zero is "Poor" and 10 is "Excellent," the Mean Ratings of How Well Each Component has Been Performed.

The good news is that we seem to be self-aware of the areas in which we feel we have not done well, i.e., those areas of social science and policymaking needed to move forward. There is a stark contrast between the absolute importance we placed on public outreach and its correlation to success and the fact that we rank it very low in how well it has been performed. This clearly needs more thought and discussion.

So, this is, in a nutshell, what we as a community of professionals said about this work during the past century. If I could summarize what I think we heard in just one phrase, it would be the phrase one of my mentors, the naturalist and writer Margaret Murie, used to quote her wildlife biologist husband Olaus, who spoke from this podium in 1958: "It is going to take all of us to do it."

The Elements of Success in Fish and Wildlife Management: Looking Back at the Successes and Failures of Wildlife Conservation to Guide the Profession Over the Next 100 Years

Paul W. Hansen
The Murie Center
Jackson, Wyoming

Rollie Sparrowe
Daniel, Wyoming

Mark Damian Duda
Responsive Management
Harrisonburg, Virginia

Introduction

In the 100th year of the North American Wildlife and Natural Resources Conference (Conference), the Wildlife Management Institute (WMI) and the Conference Steering Committee for the Conference chose a unique approach for the plenary keynote address: rather than have an outside keynote speaker, or even a conference official, the committee decided to hear from the profession itself. This idea was first proposed by Paul Hansen in response to a call for ideas for the special sessions. The Conference Steering Committee decided that this should be the focus of the plenary session and asked if Responsive Management, Rollie Sparrowe, and Paul Hansen would undertake the project. For this project, fish and wildlife professionals were surveyed for their opinions and ideas concerning successes and failures during the past 100 years of fish and wildlife management, including the strategies that were responsible for those successes, the strategies that did not work, and the implications of those successful and unsuccessful strategies for the future of fish and wildlife management in the next 100 years in North America.

To achieve this task as scientifically as possible, WMI and the Conference Steering Committee partnered with Responsive Management to conduct a survey of fish and wildlife professionals. The results provided substantial insight into the strengths and weaknesses within the fish and wildlife management profession. While some of the findings may have been expected, other results were illuminating and thought provoking. Overall, it is clear that the fish and wildlife management efforts that are considered by the professionals who implement them to be the most successful during the past 100 years are dedicated funds (such as the Federal Aid in Wildlife and Sport Fish Restoration funds and the Duck Stamp), species recovery and management, the Endangered Species Act (ESA), land conservation, and the North American Model of Wildlife Conservation. However, these initiatives, and the model itself, have aspects that are problematic in their implementation that were highlighted by professionals. The next 100 years in fish and wildlife management (to include conservation—anytime fish and wildlife management is referred to, conservation is considered to be part of it) will rely on the fish and wildlife profession's ability to learn from the efforts that have been highly successful as well as those that have had less success.

The quantitative analysis of data for this project was performed using Statistical Package for the Social Sciences. The qualitative analysis was performed by Responsive Management, Paul Hansen, and Rollie Sparrowe. The qualitative analysis looked at the extensive verbatim responses to questions gathered in the survey, as well as comments provided at the end of the survey. There were hundreds of open-ended discussions recorded in response to survey questions—many respondents wrote entire, well-considered paragraphs. The qualitative analysis entailed reviewing all of these open-ended responses and making conclusions based on them.

Background

This project examined aspects of the North American Model of Wildlife Conservation. This model is based on seven generally accepted principles or tenets:

1. *Public Trust*. Natural resources, including fish and wildlife, are managed by the government for public use and enjoyment, as well as for sustainability.
2. *Democratic Rule of Law*. Laws allocate the use of fish and wildlife by citizens to protect the public trust. Citizens can participate in creating and amending laws associated with fish and wildlife conservation and use.
3. *Opportunity for All*. Every citizen has a fair and equitable opportunity under the law to participate in hunting and fishing.
4. *Noncommercial Use*. To protect the resources and the public's right to those resources, commercial markets in dead wildlife and animal parts are prohibited.
5. *Legitimate Use*. To protect and maintain wildlife populations, legal use of wildlife is deemed to be the harvest of wildlife for food and fur, self-defense, and property protection, as well as the "use" of wildlife for recreation such as viewing.
6. *International Resources*. Because fish and wildlife migrate freely across boundaries of states and nations, fish and wildlife management policies and laws consider fish and wildlife to be international resources.
7. *Scientific Policy*. Fish and wildlife management and policy is directed by science and trained professionals.

These principles or tenets have evolved in North America during the past 100 years, starting with the establishment of fish and wildlife and natural resource agencies themselves, and these principles guide the work of fish and wildlife agencies today. Note that the survey did not specifically refer to the model since some respondents, although being guided by these principles, may not formally know of the concept of the North American Model of Wildlife Conservation. Instead, the survey referred to the "principles and tenets of fish and wildlife conservation."

Methodology

This study was conducted to scientifically measure fish and wildlife management professionals' opinions through quantitative data, as well as to obtain qualitative data based on their knowledge and experience regarding implementing fish and wildlife management efforts. The survey explored critical elements and strategies that contribute to successful fish and wildlife management and conservation efforts, with the intention of identifying meaningful patterns and components of the most successful endeavors to guide the future of the profession. The study entailed a survey of fish and wildlife professionals who had attended the Conference in 2014, current state fish and wildlife and natural resource agency directors and assistant directors, and fisheries or wildlife division chiefs (or those in equivalent positions).

The survey questionnaire was developed cooperatively by Responsive Management, WMI, and the Conference Steering Committee based on the research team's familiarity with fish and wildlife management and conservation, as well as natural resources in general. The survey asked questions about the most successful and the least successful initiatives, programs, and efforts of fish and wildlife management during the past 100 years at both the national and regional/state levels. The survey also asked respondents to rate the importance of principles and components of fish and wildlife management, to identify any suggested changes to the tenets or principles of the North American Model of Wildlife Conservation (although the model was not formally named in the survey, which instead simply referred to the "principles or tenets of North American fish and wildlife conservation"), and to identify key elements

contributing to the success of specific, self-selected fish and wildlife management initiatives, programs, and efforts.

Responsive Management obtained a total of 361 completed interviews with 2014 Conference attendees and agency directors, assistant directors, and division chiefs. The sample of Conference attendees was obtained from WMI. Responsive Management used its internal database for the sample of agency directors, assistant directors, and division chiefs. The survey was conducted in January and February 2015.

The survey was conducted online because of the universal availability of email addresses in the samples, as each Conference attendee provided an email address during the Conference registration process, and all agency employees have a valid work email address. In the case of such closed populations, Internet surveys allow for scientific sampling and data collection, and they allow for respondents to begin and complete the survey at their convenience. Internet surveys also have fewer negative effects on the environment than do mail surveys because of reduced use of paper and reduced energy consumption for delivering and returning the questionnaires.

The Most Successful Fish and Wildlife Management Efforts

At the national level, each of the top three fish and wildlife management initiatives, programs, and efforts that are most commonly cited as being the most successful during the past 100 years provides a stable funding source for fish and wildlife management: the Federal Aid in Wildlife Restoration Act (Pittman-Robertson), the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson), and the Federal Duck Stamp (Figure 1). Each of these three dedicated funding sources had more than a quarter of respondents citing the initiative as being one of most successful, with the Federal Aid in Wildlife Restoration Act receiving the greatest recognition (42.6 percent of respondents).

These three efforts are, not surprisingly, at the top because of the substantial impact the funding sources have had on fish and wildlife management in North America. Indeed, many respondents noted the role of these dedicated funds (generated by taxes) as a fundamental source of support for many of the other successes on the list, such as species recovery and restoration, efforts to address fish and wildlife diseases, and public access programs. Furthermore, it may be that the crux of the issue is that the funding is *dedicated* to fish and wildlife management (after all, the excise tax on firearms existed prior to the Pittman-Robertson Act, but the taxes were not stipulated as going to wildlife management prior to the act).

In continuing down the list of successes in Figure 1, the fish and wildlife professional community also considers species recovery or restoration to be among the most successful accomplishments during the past 100 years. At the national level, species recovery or restoration is the next most commonly cited successful fish and wildlife management effort, with 21.5 percent naming efforts related to species recovery and restoration. At the regional or state level, species recovery and restoration was the most commonly cited success (35.8 percent named it at the regional/state level). While some respondents cited species recovery *in general*, many cited the restoration of *specific* species, including elk, turkey, deer, pronghorn, peregrine falcons, bald and golden eagles, striped bass, trumpeter swans, and whooping cranes.

Note that none of the initiatives, programs, or efforts was cited by a majority of fish and wildlife professionals. Asked in an open-ended manner (in which no answer set is presented to respondents, who can respond with anything that comes to mind) to obtain top-of-mind responses, the question about the most successful efforts did not yield a clear consensus on the most successful accomplishment of the profession during the past century.

Responses that were related to land and habitat conservation also were commonly cited successes at the national level during the past 100 years. There are two elements to consider under the umbrella phrase “land conservation.” Fish and wildlife professionals cited both the emergence of managed public lands, such as national forests and wildlife refuges, as well as private land conservation facilitated by

government acts such as the Conservation Reserve Program and private land conservation done by nongovernmental organizations.

Another important facet of fish wildlife management on the list is the establishment of fish and wildlife management as a science, as well as the concomitant establishment of fish and wildlife agencies themselves. Using science in fish and wildlife management and the establishment of agencies are both components of the North American Model of Wildlife Conservation.

The regional and state efforts cited as most successful reflect the national efforts fairly closely, with one key exception: dedicated funding (Figure 2). While the top ranked regional and state efforts also focused on species restoration and land and habitat conservation, dedicated funding at the state level ranked much lower. At the state level, with a few notable exceptions, the fish and wildlife management profession has not done as well at securing dedicated funding.

Partnerships and collaboration between agencies and organizations also ranked relatively high among the most successful efforts at the regional and state level. This is interesting because it could have also been cited in the follow-up question, which asked about the reasons or strategies responsible for success. In response to that question, a common theme among the reasons given for the success of fish and wildlife management efforts was having a broad base of support. Respondents commonly attributed the success of efforts to public support, spokesperson support, and partnership or collaboration. Additional components of success frequently mentioned are having a diversity of stakeholders and having effective communications.

The Least Successful Fish and Wildlife Management Efforts

Overall, there is less agreement or commonality among responses for the *least* successful fish and wildlife management efforts at the national level compared to responses for the *most* successful. Nonetheless, at the top of the least successful are responses related to funding, emphasizing a *lack of success* at broadening or gaining additional funding for conservation, particularly among nonconsumptive users: 15.2 percent of respondents cited the lack of success at gaining additional funding at the national level, and 6.6 percent cited the lack of success with Teaming With Wildlife and the Conservation and Reinvestment Act (CARA) (Figure 3).

At the regional or state level, many efforts were noted, but there was no predominant consensus (Figure 4). The category "politics and special interest influences on decision-making" was cited by 9.2 percent. This is the obverse of the use of science/biology, since, almost by definition, political influence tries to force the agency to ignore or discount the use of science/biology. This top item on the survey results is closely followed by recruitment and retention efforts (in part an outgrowth of funding needs) and species recovery or restoration—often respondents named an individual species on this question at the regional/state level rather than giving a more broad response.

It is interesting that the ESA falls on both lists as one of the *most* successful as well as *least* successful initiatives/programs/efforts. For this reason, it is discussed in more detail in the next section, as are several other aspects of initiatives, programs, and efforts.

The Endangered Species Act

Interestingly, the ESA is ranked fifth among the *most* successful fish and wildlife management efforts at the national level, but it also ranked second among the *least* successful efforts. While it ranks higher among the least successful efforts, the percentage of respondents citing it as one of the most successful efforts is actually higher: 17.3 percent named it as one of the *most* successful fish and wildlife management efforts at the national level and 13.7 percent named it one of the *least* successful. Also note that some people named it in response to both questions—regarding the *most* successful as well as the *least* successful initiatives/programs/efforts.

The aspects that fish and wildlife professionals felt were successful relate to the attention to individual species that it provides, as well as the legal protections it provides to species. The problems

cited with the ESA include the litigation engendered by the ESA, which are seen as a diversion of resources. Indeed, many of the directors and other agency personnel who discussed the ESA as being of limited success felt that resources expended on lawsuits could have been better used actually conducting conservation work in the field. The ESA and the concomitant lawsuits, according to some in the survey, have led to an increase in mistrust and divisiveness among those who should work together. In fact, one respondent noted that "the politicization of the act...has created a terrible environment of litigation around a truly noble law." However, the final word on litigation is that many acknowledged that, at times, lawsuits are the final recourse.

Thoughtful insight into the conflicting ratings of the ESA is found in the qualitative responses that were provided by respondents in the open-ended follow-up question asking for the reasons that efforts had been successful or unsuccessful. While respondents, in general, acknowledged the success of the ESA at focusing resources, many expressed frustration with implementation and application of the act, particularly the concomitant litigation associated with the act:

- Comment regarding the most successful: "The ESA, because it is well written. Implementation is horrible."
- Comment regarding the least successful: "While I am a strong supporter of the ESA, I think that its application through the courts has made it often ineffective, cumbersome, burdensome, and counter productive."

The Diversity of the Fish and Wildlife Community's Opinions

The fish and wildlife professional community is clearly diverse in their opinions. Many different interests and opinions were expressed in the study, which is an important finding in itself. Fish and wildlife professionals appear, for the most part, to have passion for and commitment to the field, but they are working on myriad issues and are facing varied challenges. This means fish and wildlife professionals may share that passion and commitment, but the community is not necessarily a homogeneous one.

In addition to no single national (or regional or state) effort being named as one of the most successful by the majority of fish and wildlife professionals in this study, there also appears to be a definitive split in the community regarding the future of fish and wildlife management, particularly with respect to the amount of focus on consumptive fish and wildlife recreationists. While there are fervent supporters of the focus on fishing and hunting, another segment of the community expressed the opinion that the future of fish and wildlife conservation depends on a much broader public, including those labeled as nonconsumptive. Some also discussed the human benefits that fish and wildlife provide outside of fishing and hunting.

This refocus that some discussed is more pragmatic than ideological, related to obtaining funding rather than antipathy towards fishing and hunting. That is to say, the respondents referred to above are not anti-fishing or anti-hunting; they merely recognize the possible expanded funding base that a refocus could have. They also see the diversity of wildlife-associated recreation that exists.

The North American Model of Fish and Wildlife Conservation

The North American Model of Wildlife Conservation is a retrospective model—it is the result of numerous laws, policies, and decisions made a century or more ago that have developed into how fish and wildlife conservation is viewed in North America today. Although the model serves as the foundation for fish and wildlife management and conservation in North America, there has been no consensus on whether or how it might be further developed within the context of a specific future goal or ultimate objective.

Although only 5.6 percent of respondents cited the model as one of the most successful fish and wildlife efforts during the past century, many respondents named crucial components of the model. While the results of the study indicate that many of the model's principles or tenets are strongly supported by the

fish and wildlife professional community, some respondents expressed interest in discussing and improving some of the model's principles or tenets. They appeared to support a model that is not only retrospective but also forward thinking.

As discussed above, there are seven principles/tenets of the model: Public Trust, Democratic Rule of Law, Opportunity for All, Noncommercial Use, Legitimate Use, International Resources, and Scientific Policy. For each of the seven tenets/principles, respondents rated its importance to the future of fish and wildlife conservation, using a 0 to 10 scale, where 0 is not at all important and 10 is extremely important.

Wide support for all of the principles/tenets is demonstrated by the mean ratings, all of which are well above the midpoint in the scale: the lowest mean rating is 7.96 (Figure 5). Nonetheless, some differences emerged, with well more than a 1 rating point difference between the top and bottom of the ranking. The highest mean ratings are for Public Trust (a mean rating of 9.36), Scientific Policy (9.01), and Opportunity for All (8.95).

Another way to examine these ratings is to look at the percentage of respondents who gave a high rating—a 9 or 10. This reflects the percentage who feel strongly about the tenets/principles. In this analysis, Public Trust stands out at the top, with a huge majority of 85 percent giving it a high rating (Figure 6). In the second tier are Opportunity for All (74 percent giving it a high rating) and Scientific Policy (72 percent).

The concept of Public Trust—the understanding that natural resources, including fish and wildlife, are managed by the government for public use and enjoyment and that individuals do not own wildlife—is ranked the highest in importance. Also with high ratings of importance, Scientific Policy still appears to be a driving principle of the model. Respondents seem to agree that good science can direct good policy, but survey comments indicate there may be less agreement on the details.

The fish and wildlife professionals in the survey discussed the hazard of bringing preliminary science forward too quickly. Also commonly said or implied was that, at times, it seems science was ignored or undervalued. Many people cited climate change being seemingly ignored, while others cited the debate around the toxicity of lead. Still other comments emphasized times when the profession has not used science at all, using such examples as letting over-harvest continue too long despite clear science to the contrary. Finally, another major concern related to the Scientific Policy tenet is political influence that undermines science.

The tenets of Noncommercial Use, Democratic Rule of Law, and International Resources are ranked the lowest in importance. Noncommercial Use appears to generate the most debate and to be one of the elements of the model that fish and wildlife professionals are open to discussing and improving: it has the highest mean score in the amount the principle/tenet should be changed (Figure 7). In this line of questioning, respondents rated the amount of change that the principle/tenet should undergo, using a scale where 0 means no change at all and 10 means completely changed. This relatively high rate of desired change for Noncommercial Use may be perhaps due to the sometimes contradictory or inconsistent nature in which it is applied.

For example, Noncommercial Use is not applied to commercial fisheries, especially in marine environments—some of the same species that are recreationally fished. Other inconsistent applications of the principle/tenet were noted by respondents in the survey, such as the comment that trapping is a commercial use and deemed acceptable while elk ranching is not. Yet another respondent asserted that there are species of wildlife that are actively commercialized alive and dead, demonstrating that the Noncommercial Use tenet is not a reflection of reality today. Finally, an additional comment illustrates willingness to revisit the tenet: "There may be other commercial uses that would produce economic benefits for wildlife overall [that] do not violate the basic integrity of the North American model. If such a use is found, it should be permitted in closely controlled ways." Some respondents indicated that the potential of commercial markets as an important tool in the future for managing overabundant wildlife species may be worth considering.

Additional topics commonly mentioned or discussed in respondents' comments regarding changes or additions to the tenets of the model are biodiversity and private property or privatization issues

related to wildlife management. These are topic areas in which fish and wildlife professionals express either a desire or a need to further develop aspects of the model.

Components of Fish and Wildlife Conservation and Management

The survey presented 15 components of fish and wildlife management to respondents, who were asked to rate how essential each component is to successful fish and wildlife management (using a scale from 0 to 10, with 0 being not at all essential and 10 being absolutely essential). The broadest finding is that all components have a mean rating well above the midpoint: the lowest mean is 7.17 (Figure 8).

The top component is obtaining funding overall (mean of 9.34), which is commensurate with other results previously discussed in which dedicated funding is deemed important. Also important is that science and biology are used as the basis for management—these are ranked second (mean of 9.31) and third (mean of 9.14). In opposition to science and biology are compromises and political lobbying (which would not be needed if decisions were purely the result of science and biology): the lowest on the list are making compromises (mean of 7.17) and political lobbying (7.61). Communications are also deemed important, with outreach to the public ranked fourth (by the mean ratings), communications within an agency ranked fifth, and communications between agencies and organizations ranked seventh.

Although it is not surprising that obtaining funding is the highest ranked component, it is worth noting that several of the components that would be important to obtaining funding are actually some of the lowest ranked components, including legislation, political lobbying, and making compromises. Throughout the survey responses and comments, the extensive frustration with politics and political influence or interference is clear. Survey respondents suggest that, while the frustration may often be warranted, accepting and recognizing the critical role of politics in the future of fish and wildlife management and conservation, especially for obtaining funding, may prove necessary for achieving the profession's goals and objectives. As one survey respondent observed, "Wildlife conservationists don't feel comfortable lobbying, and we need to change that. Lobbying can be done legally, ethically, and successfully."

Respondents also gave a 0-to-10 rating for how well each component has historically been performed, in general, in fish and wildlife management in North America, where 0 is poor and 10 is excellent. This rating found that, while obtaining funding overall may be ranked the highest as an essential component of fish and wildlife management, its performance ratings were considerably lower—with a mean rating barely above the midpoint at 5.32 (Figure 9). The results and comments throughout the study clearly indicate that funding is a priority, and although the federal dedicated funding sources are considered successful, there is clearly agreement that securing additional stable and adequate funding at almost every level is crucial.

At the top in the ratings of performance is strategic planning (mean performance rating of 7.95), followed by science (7.16) and biology (6.79). Unfortunately, all of the other components have performance ratings that hover around the midpoint, and no single component averaged a performance rating of at least an 8.00, suggesting that the professional community believes there is considerable room for improvement in all areas of fish and wildlife management and conservation.

The ratings of how essential the components are and the ratings of performance are graphed on a scatterplot (Figure 10). Ideally, the two ratings would be commensurate with each other; in other words, those components considered the most essential would also be the components that have the top performance ratings. The diagonal line in Figure 10 shows where the essential ratings and the performance ratings are equal. As the graph shows, all of the components except one have mean ratings of essentialness that exceed ratings of performance, suggesting that the performance needs to be improved to be commensurate with how essential each component is.

Figure 10 shows the full scale (i.e., each axis goes from 0 to 10). Figure 11 shows a close-up of the components. Those components the farthest from the line are those for which the ratings are the least commensurate with one another. The items with the most disparate ratings are outreach to the public (essential rating of 9.02, but performance rating of 4.64), engaging public cooperation and participation

(8.97, 4.73), and obtaining funding overall (9.34, 5.32). Additionally, two communications components and cooperation/coordination among agencies and organizations are also far from the line. The data suggest that the performance of these components needs to be improved to become commensurate with the ratings of how essential they are.

The Next 100 Years

The majority of fish and wildlife professionals responding to the survey were very positive about the profession's accomplishments, most especially with respect to species restoration, land protection, and establishment of public lands. Yet, an underlying theme emerged from the responses and comments indicating that there is still more to be accomplished in every aspect of fish and wildlife management and conservation.

Recurring themes throughout nearly all portions of the survey included funding and politics. As mentioned previously, these two areas are undeniably connected. As the fish and wildlife professional community looks to the future, it is important not only to understand the successes but the failures as well so that the profession can avoid repeating the mistakes of the past. And preventing repeated mistakes may not be more important in any other area than that of funding and politics.

The broad agreement of the success of dedicated funding, such as the Federal Aid in Wildlife Restoration Act and the Federal Aid in Sport Fish Restoration Act, is not surprising. The evidence of the funding sources' important role in fish and wildlife management and conservation is clear. But can the profession depend upon it in the future? Will the American public support a similar dedicated funding proposal now? Unfortunately, such funding proposals may not be supported in the future at the federal or state level. More recent, similar efforts for Teaming With Wildlife and CARA, as well as long-term efforts to achieve stable funding at the state level, have not been successful. The few state efforts that have been passed were not easy to achieve and may never be considered permanent, as efforts are required to keep or maintain them each year. From these funding struggles, it becomes clear that politics and lobbying have become a necessary component of fish and wildlife management and conservation.

Fish and wildlife professionals understandably value science over politics and prefer that science be the foundation for every decision in fish and wildlife management and conservation. However, understanding that politics cannot be avoided or removed from fish and wildlife management and conservation efforts is crucial to implementing successful programs over the next 100 years. Fish and wildlife agencies are public entities funded by appropriations processes controlled by legislatures or Congress, which also establish the laws that protect fish and wildlife. Our society is a democratic one in which fish and wildlife resources have to compete with other needs supported by the public as well. Given this, it is impossible to keep fish and wildlife efforts separate from politics. The fish and wildlife professional community must accept that politics are inevitable and learn to navigate the politics more effectively in the coming century.

Partnerships and compromise will also be crucial to the success of future fish and wildlife management and conservation efforts. Fish and wildlife management and conservation needs are too great and too costly for fish and wildlife agencies to achieve alone. Such programs as the North American Waterfowl Management Plan, the related North American Wetlands Conservation Act, and the Joint Ventures concept based in both Canada and the United States have demonstrated that partnerships with other industries or interests are advantageous, often necessary, in securing funding and achieving conservation goals. Science should always be the guiding force, but engaging in strategic partnerships and political efforts that move efforts in the right direction to achieve those conservation goals is vital—the future of fish and wildlife management and conservation depends on it.

Figure 1. Most successful efforts at the national level.

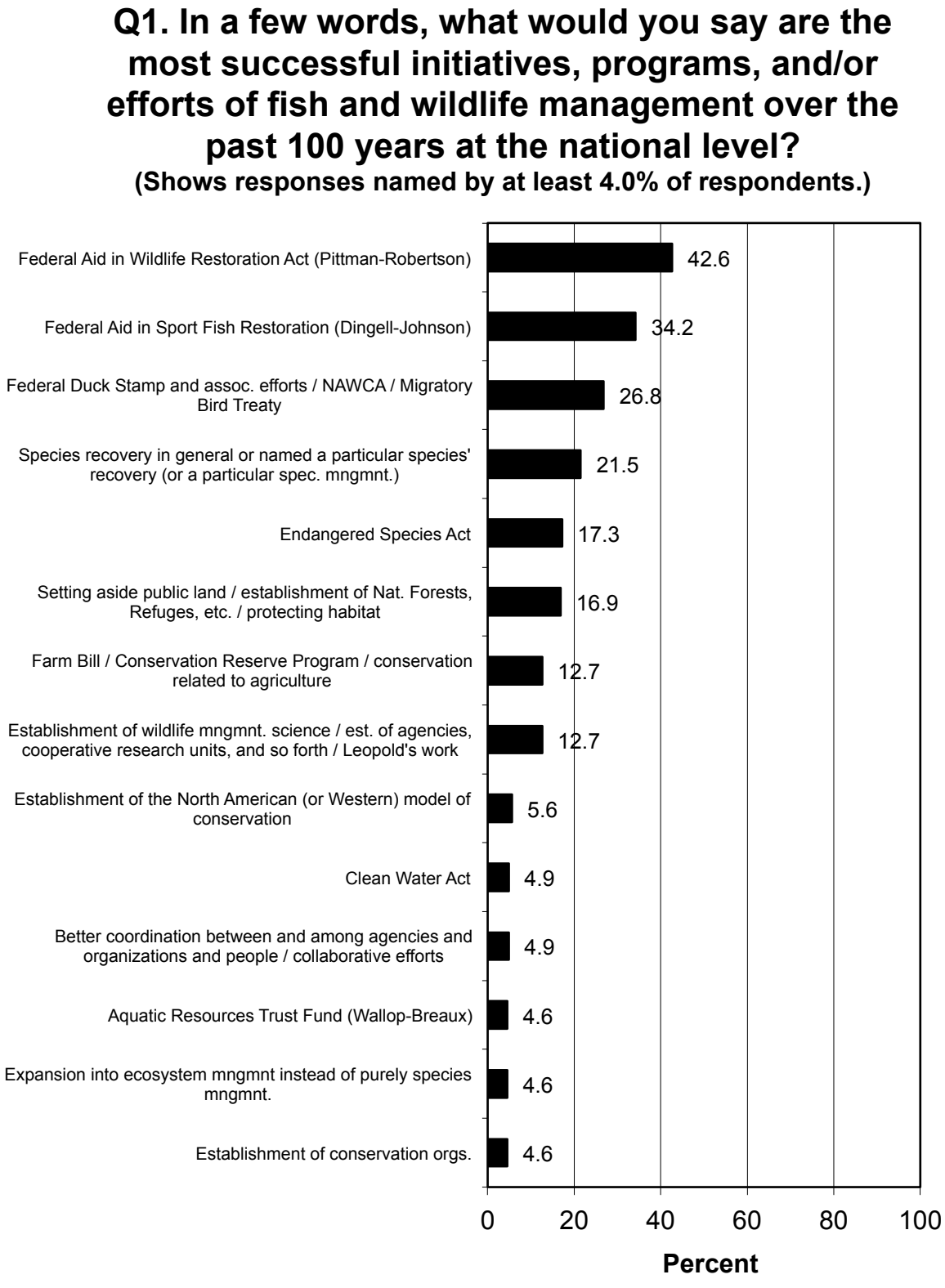


Figure 2. Most successful efforts at the regional/state level.

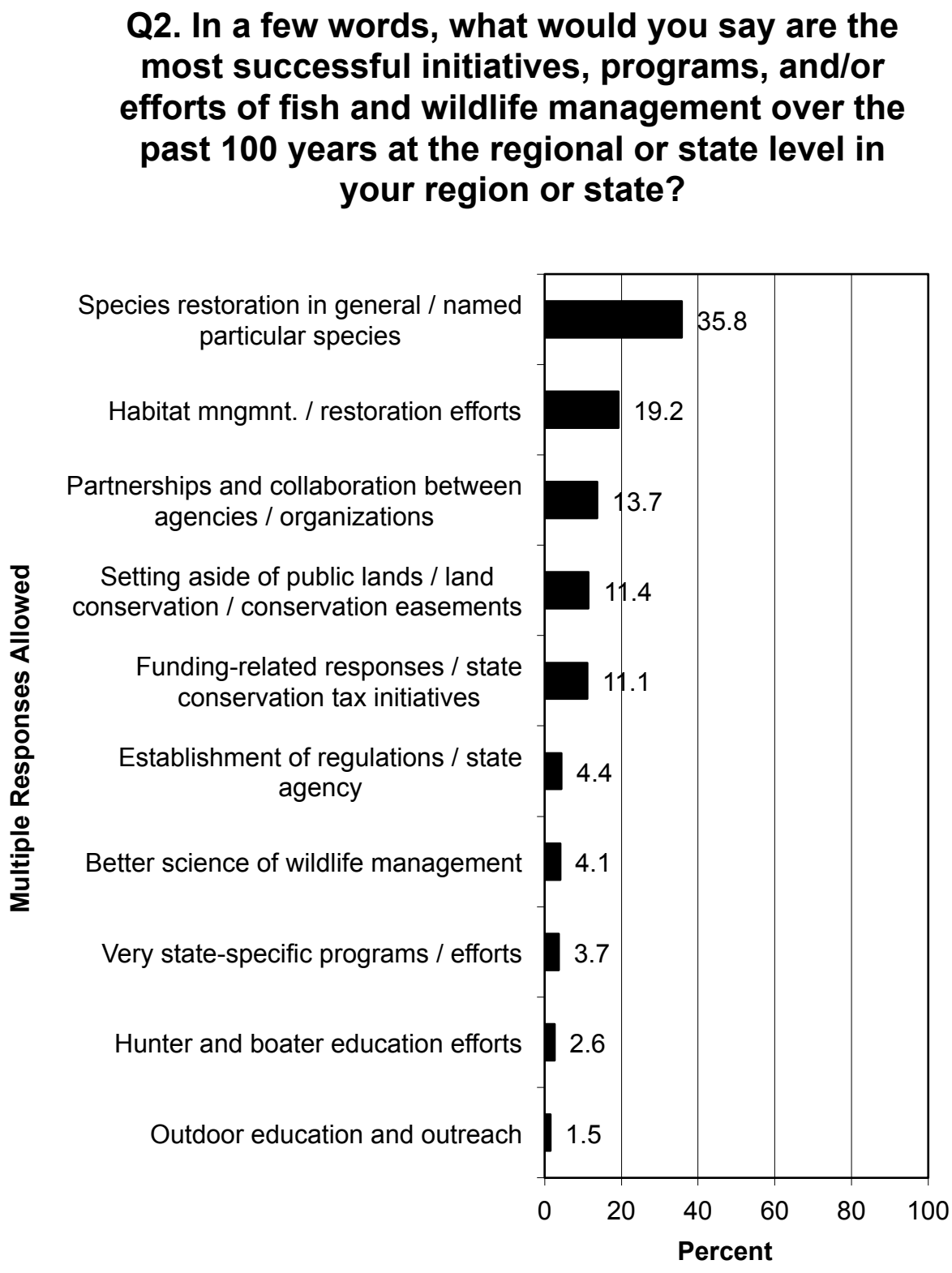


Figure 3. Least successful efforts at the national level.

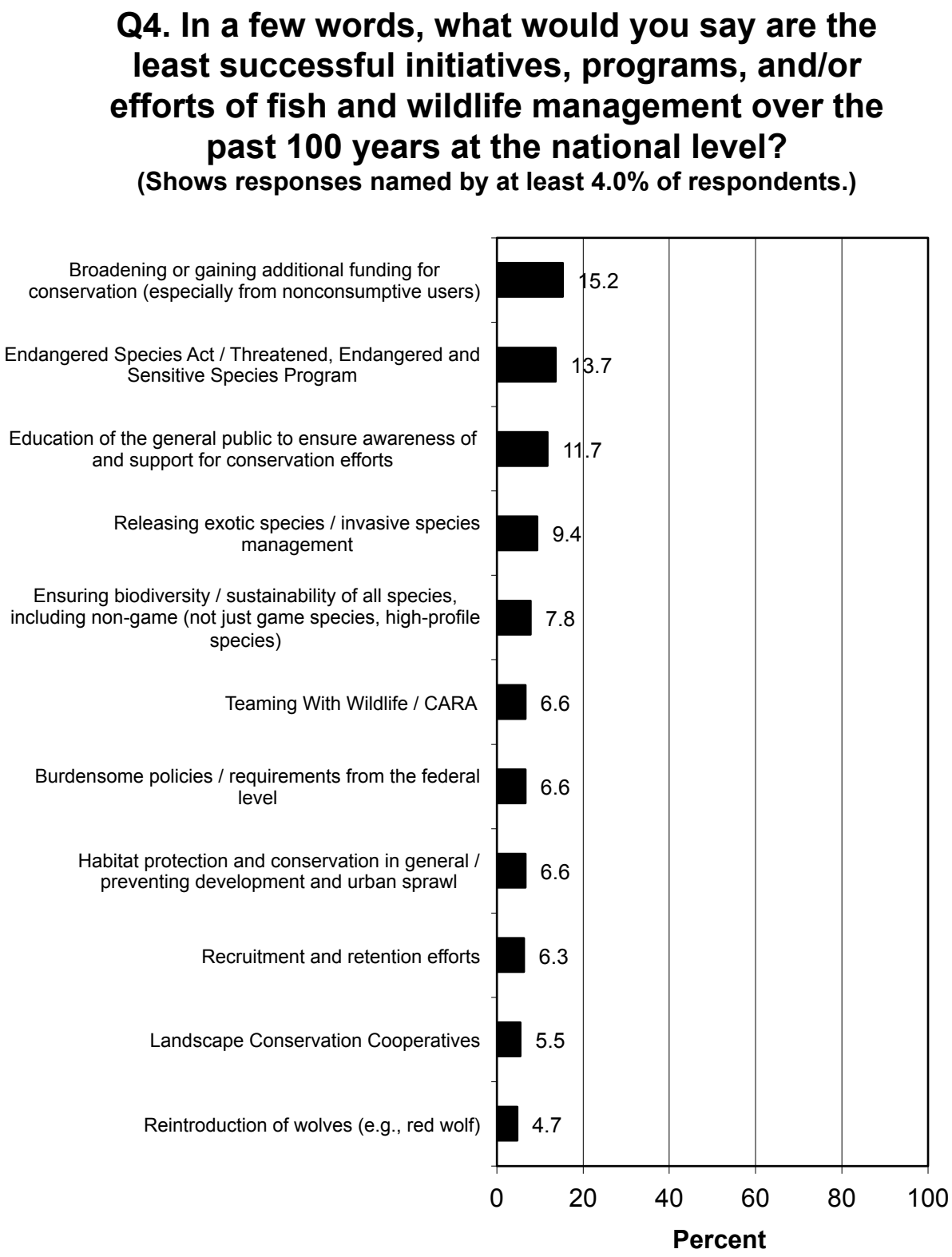


Figure 4. Least successful efforts at the regional/state level.

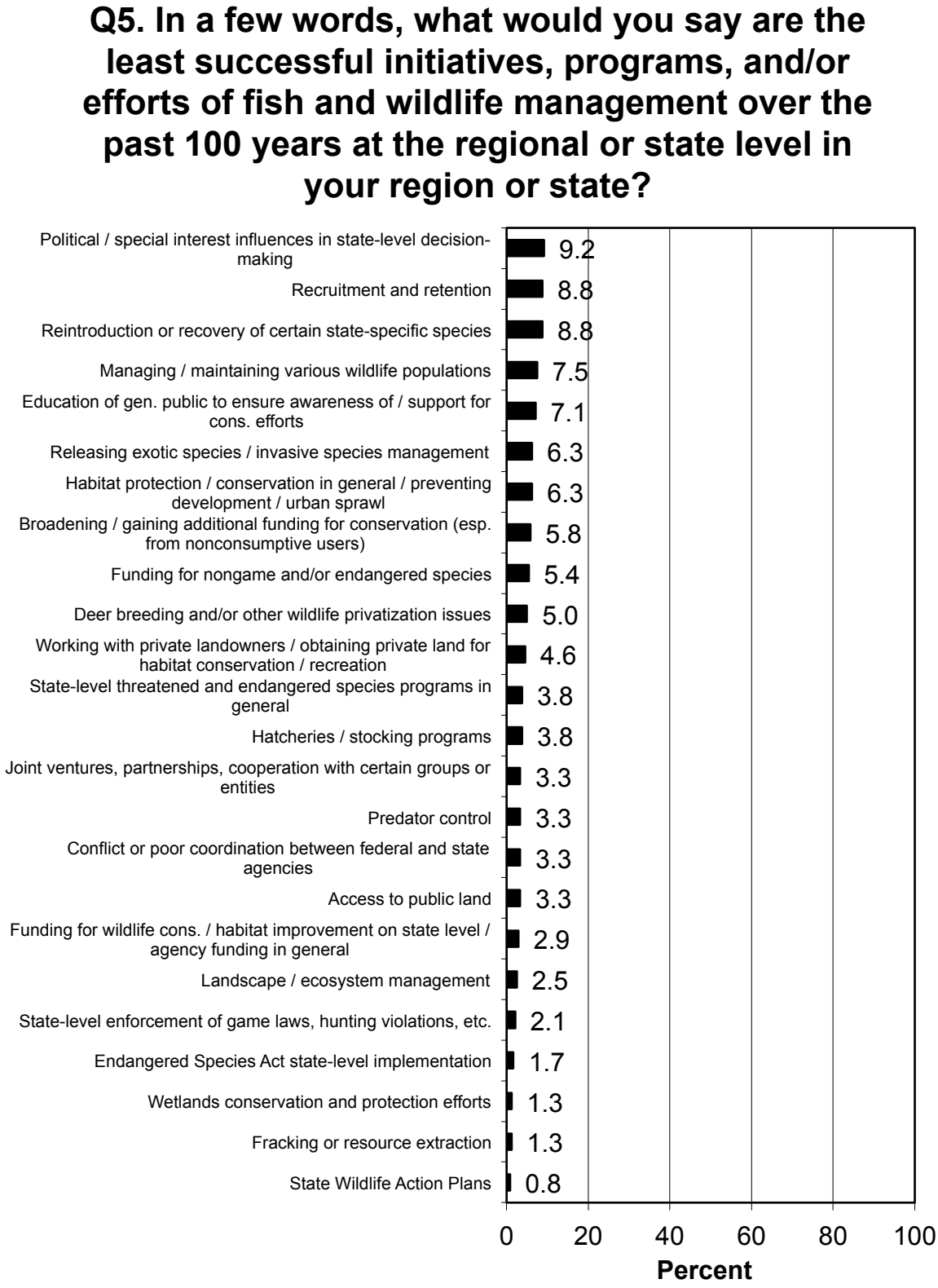


Figure 5. Mean ratings of importance of the tenets/principles of fish and wildlife conservation.

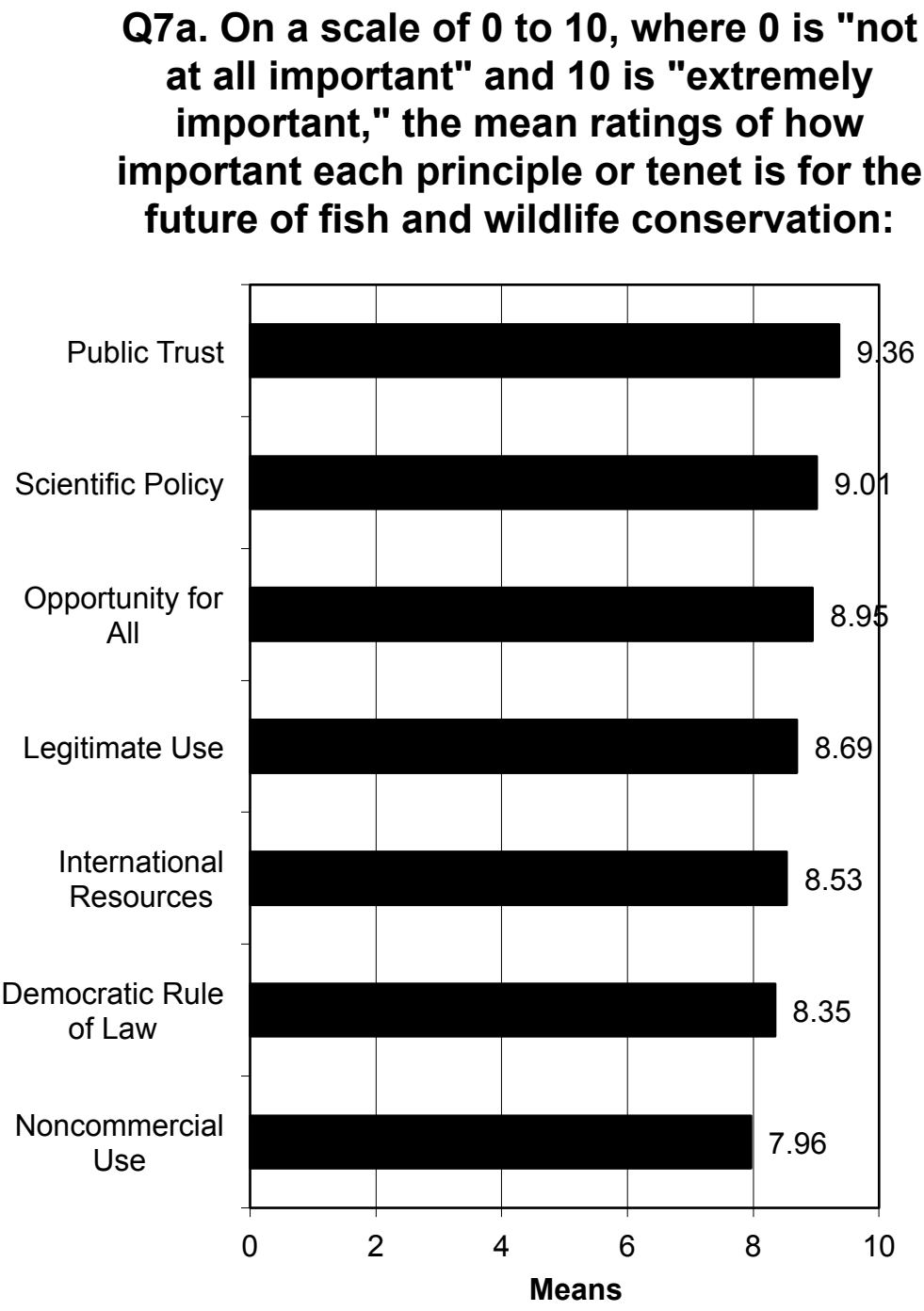


Figure 6. The percentage giving a high rating of importance to the tenets/principles of fish and wildlife conservation.

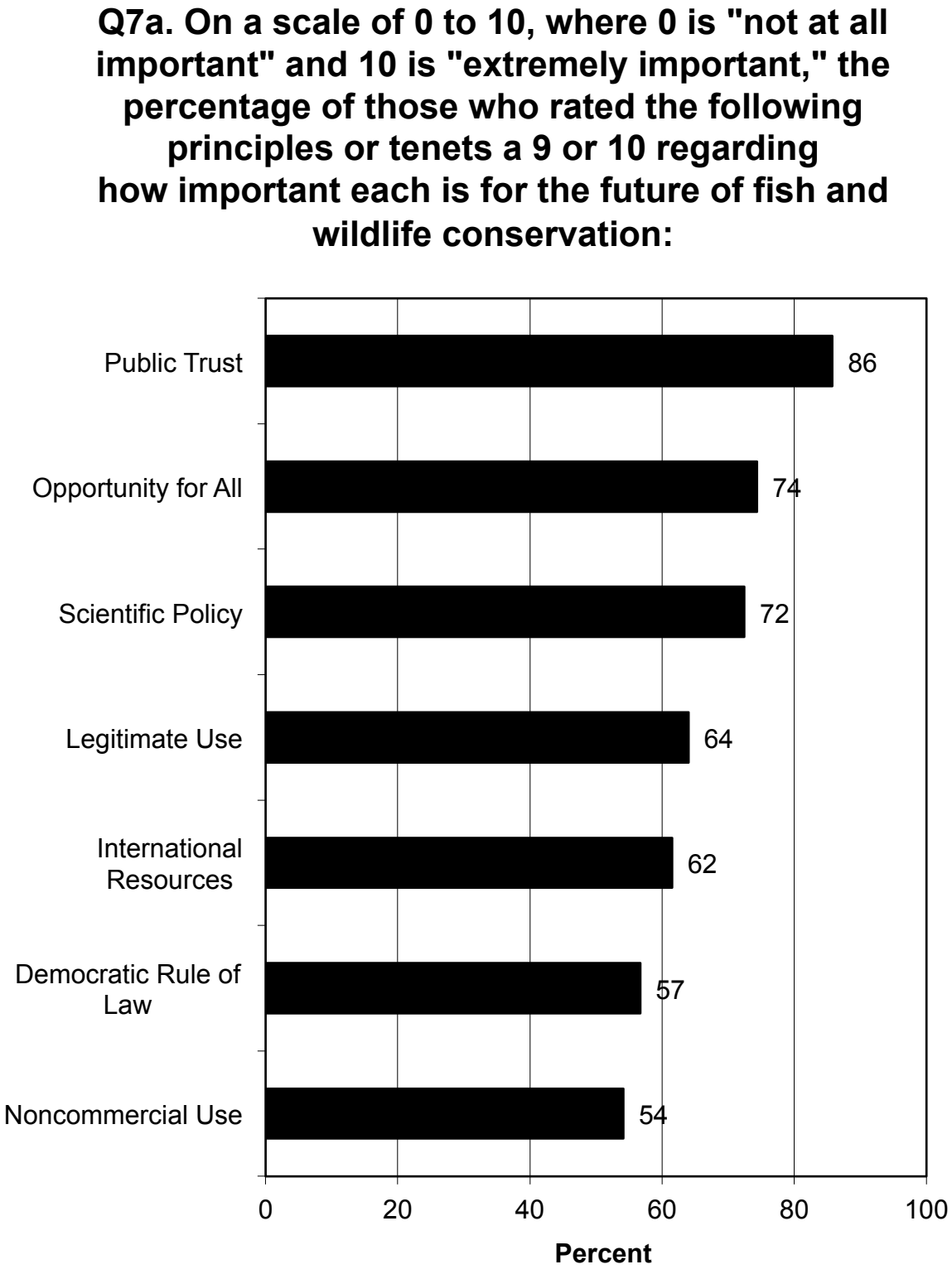


Figure 7. Mean ratings of how much the tenets/principles of fish and wildlife conservation should change.

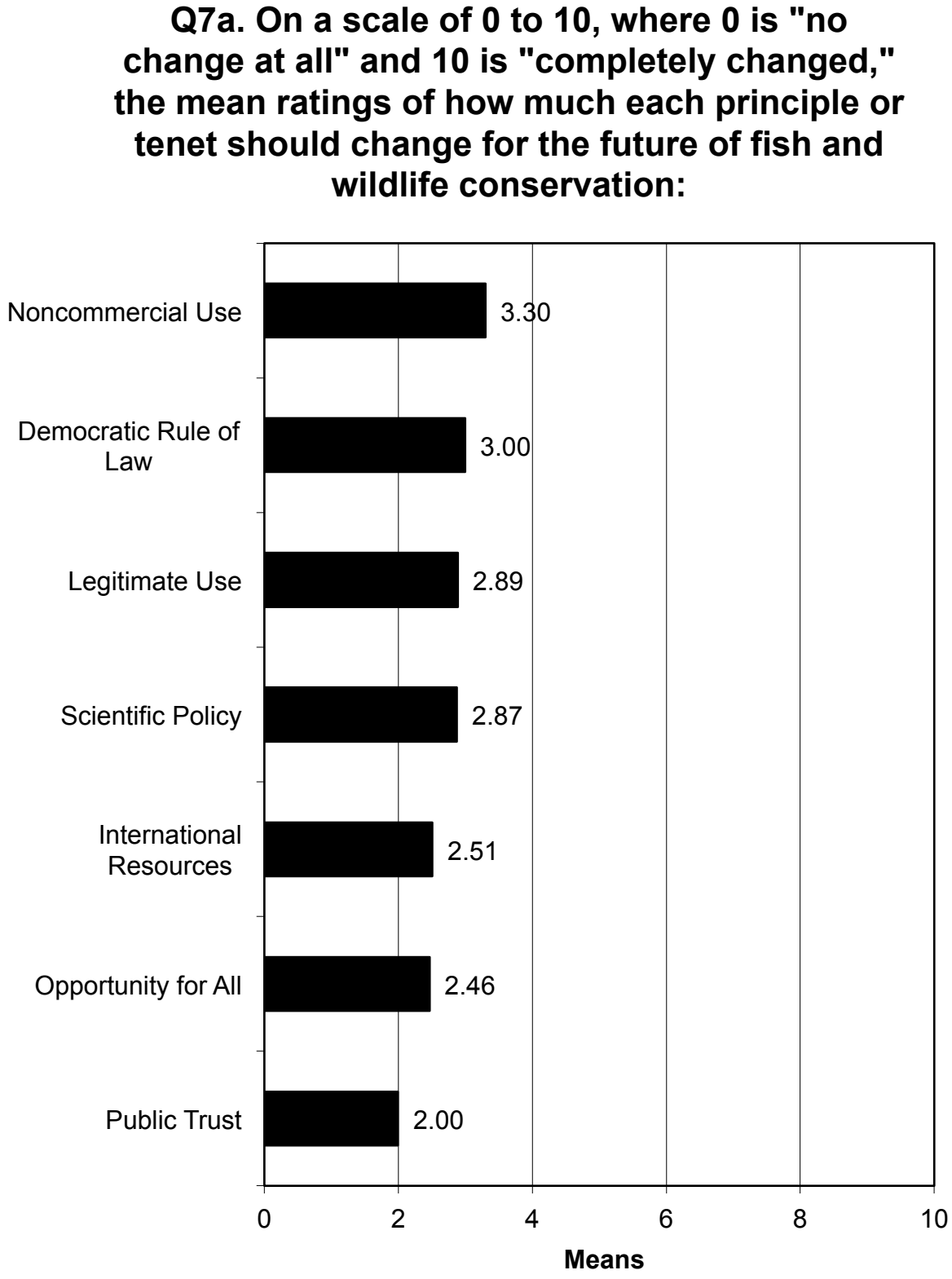


Figure 8. Mean ratings of components of successful fish and wildlife management.

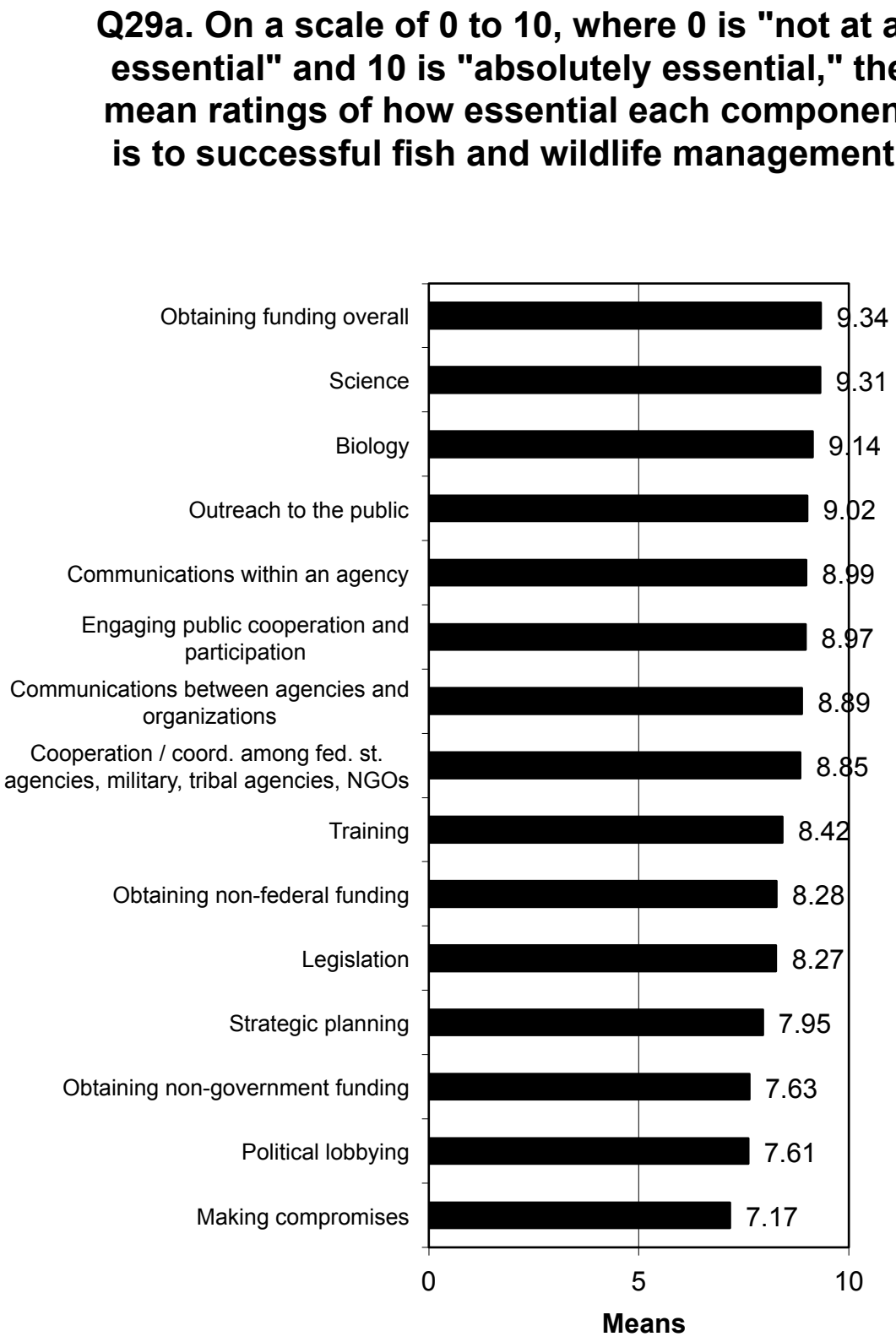


Figure 9. Mean ratings of how well components have been performed.

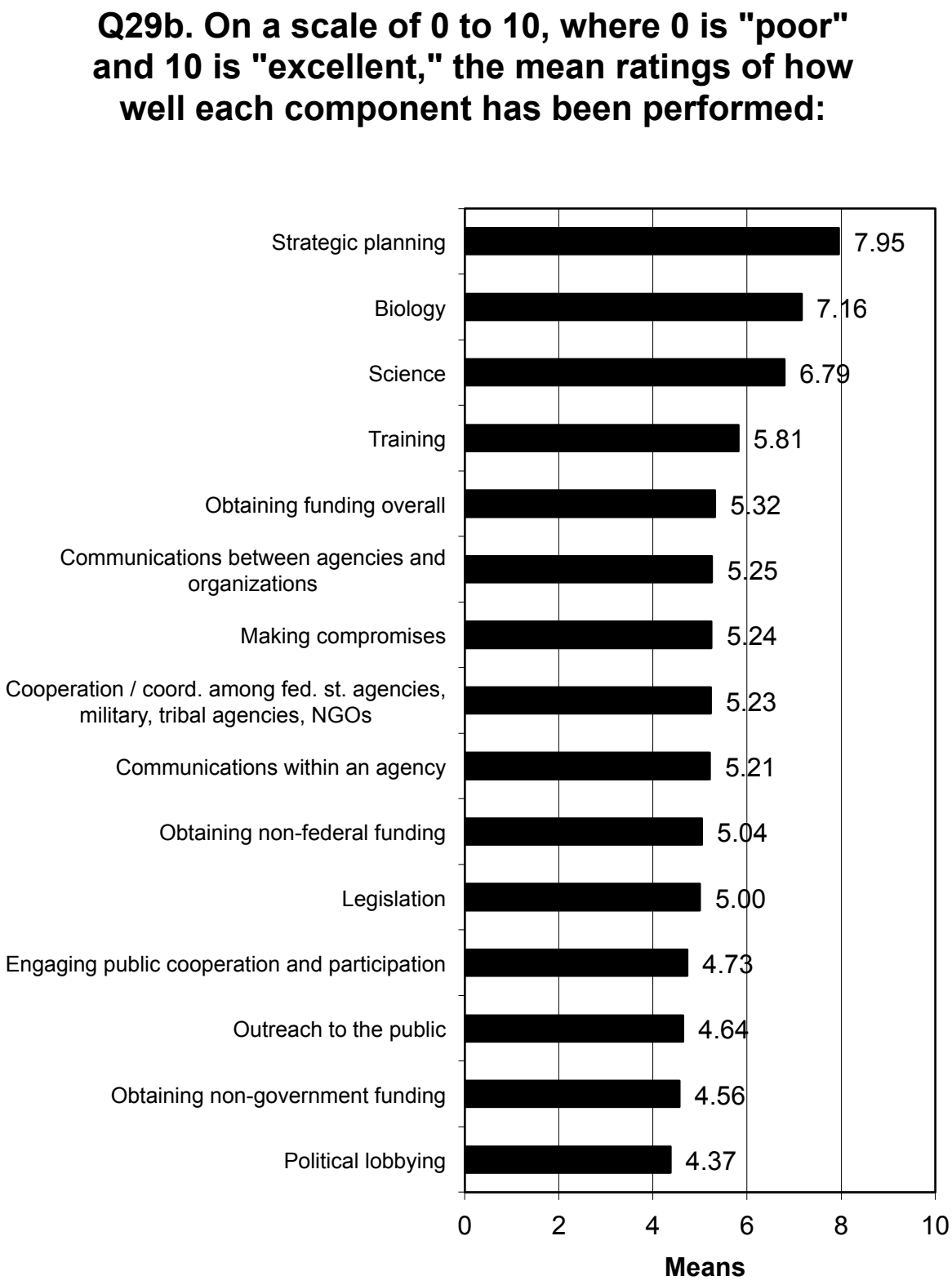


Figure 10. Scatterplot of essential ratings and performance ratings.

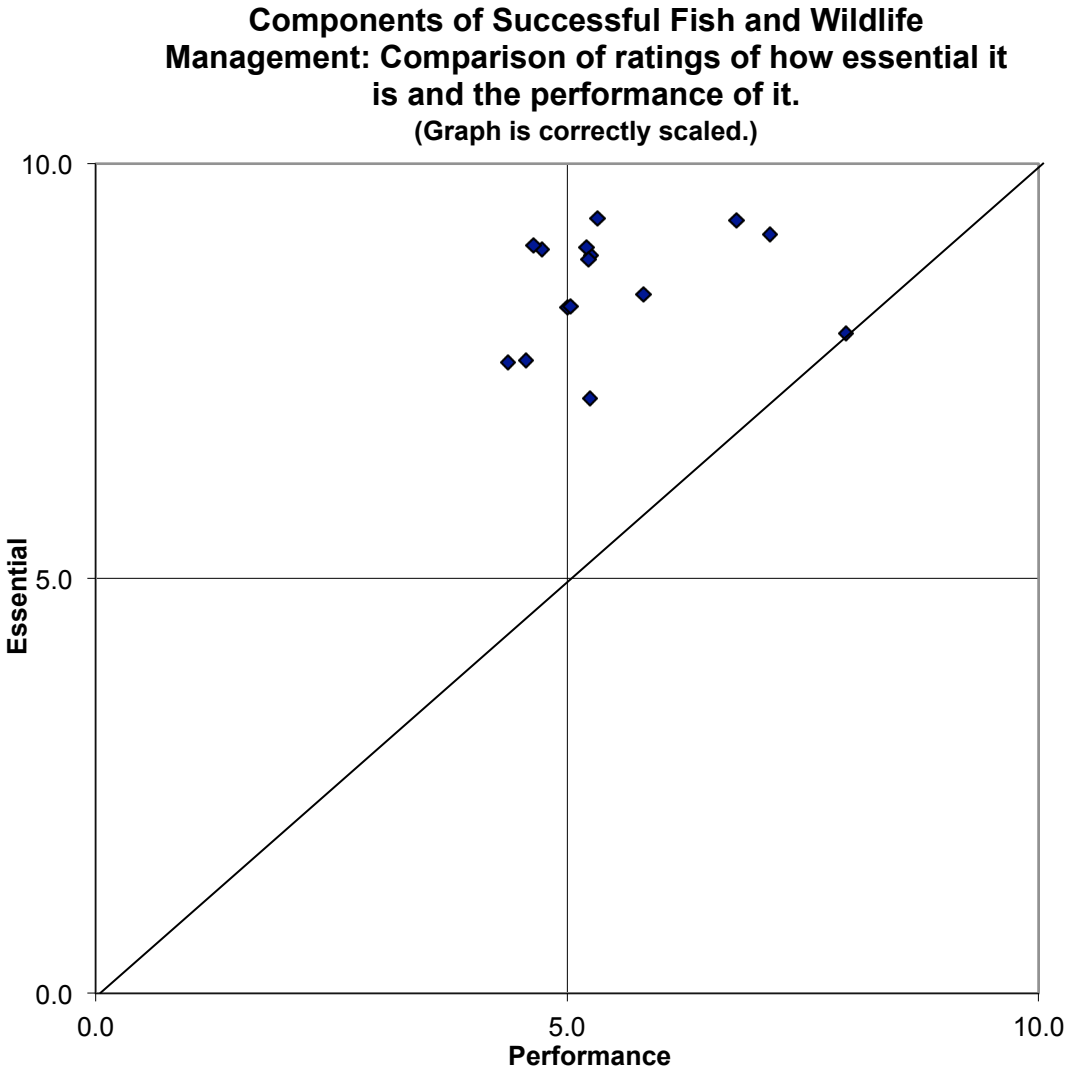
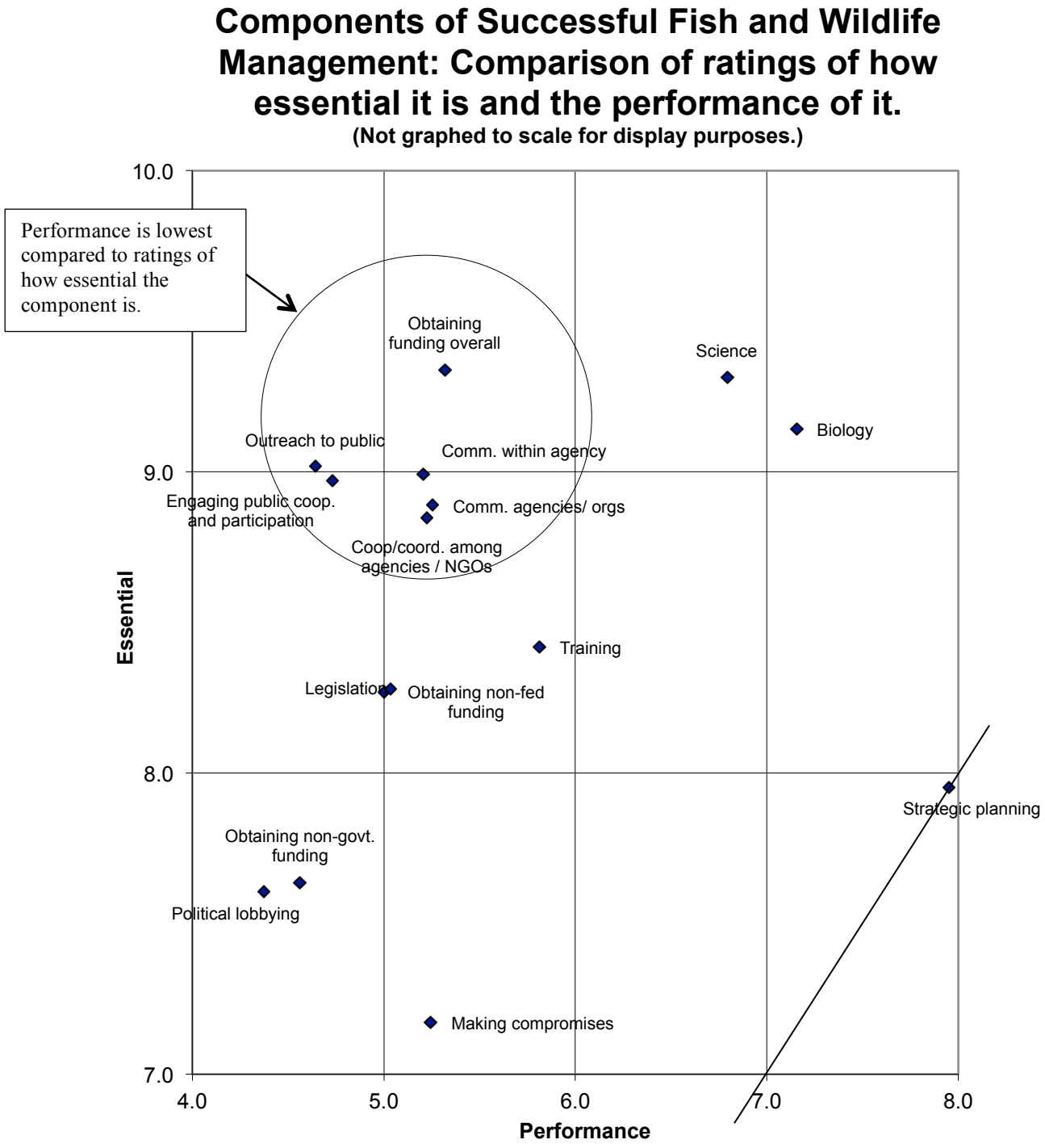


Figure 11. Close-up of scatterplot of essential ratings and performance ratings.



The Next 100 Years

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The attitudes expressed in the Elements of Success in Fish and Wildlife Management survey data came from past attendees at this conference who are largely employees of state and federal agencies and nongovernment organizations with responsibility for conserving fish and wildlife and their habitats. Some pursue goals and objectives more broadly expressed in terms of ecosystems and biological diversity, but habitat underlies it all. The same story of presumed success or failure may engender very different responses from individuals. Perhaps a simple, measurable definition of success for this discussion could be: "A program, movement, or activity that results in actions that conserve habitats and fish and wildlife for the future." The future may qualify the definition to express broader values but those simple needs will continue to be the basis for wildlife and fish conservation.

While a majority of the respondents' opinions were very positive regarding land protection, establishment of public lands, and species restoration, some concluded we hadn't done enough toward securing stable and adequate funding. As we look at the future, we need to ask ourselves how we define "enough"? We should have high expectations and hopes, but we also need to be realistic in our evaluation of what is possible.

Some brought up a desire to see more passion among practitioners in the field and administrators within state fish and wildlife agencies. Passion to achieve goals and do good things for fish and wildlife habitats can be a powerful, positive driver. However, less comfortable realities economically, socially, and politically will continue to affect all outcomes. Choices will have to be made about getting something done that moves us in the right direction versus achieving what we think is right. A long-term dilemma that will not change is that we are not the people who ultimately make those decisions; we are the ones who will try to provide the foundation of knowledge and express the need.

Considering the knowledge and experience of the survey respondents, it was not a surprise that dedicated funding through sources such as the Wildlife and Sport Fish Restoration program was given the primary credit for fostered conservation in the past century. The evidence is clear. But can we depend upon it in the future? If we ask the American public how much they value the conservation funding sources generated by sportsmen and women, what would they say? Current research shows the public isn't fully aware of these programs or their value. If we were to approach the current Congress with a similar dedicated funding proposal now, would they support it again?

The conservation community has been witness to some unfortunate history with long efforts like Teaming With Wildlife and the attempts to develop and pass the Conservation and Reinvestment Act (CARA) more than a decade ago. This expansive conservation coalition reached across the United States and included state and local governments, business leaders, hunting and fishing interests, state wildlife agencies, and a wide assortment of outdoor interests. Collectively, we shared a decade of trips to Washington, DC, fighting for passage of a law to capture a portion of the receipts of government gains from offshore drilling to support conservation and recreation. State wildlife agencies developed comprehensive wildlife plans to support the request and answer the questions: "How much do we need?" and "What would you do with the money?" This effort came close to success, but ultimately failed. A number of you didn't seem to know why such a good thing could have failed. The answer, from my personal observation, was that at the 11th hour it was not supported by the sitting administration and was also undercut by a small number of special interests who would not support it. We lost the opportunity to truly be able to manage all wildlife by investing an additional $1 billion into state wildlife agencies. Had we succeeded with CARA, it would have been one of the best possible ways to avoid the need for listing of species and could have funded all of the bird conservation efforts still in need of solid long-term funding.

There have been many other long-term efforts to achieve stable conservation funding at the state level, with only a few successes. The most outstanding of these identified in the Elements of Success in Fish and Wildlife Management survey was the Missouri Design for Conservation, a citizen-driven effort that secured one-eighth of one percent sales tax in the mid-1970s. Its success followed a simple formula—an evaluation of need by an outside panel of experts, clear expression of where funding would go from the department, and a process for transparent reporting and accountability to the legislature and people of the state. It pledged to expand programs to all of the states fauna, increase education outreach to the public, address the public's interest in fish and wildlife recreation, and serve the interests of all public stakeholders including hunters and anglers and urban centers and their populations. It was not just a major funding boost but a planned, transparent program that addresses new needs for fish and wildlife and the changing interests of the public. From the first year, it was challenged by individuals in the state legislature who wanted the money for something else they thought was a higher priority than conservation. To this day, those challenges have been fought with the help of continuously engaged citizenry. Unfortunately, there are constant challenges to that funding base with the same old song: "The job is done and we need to use the money somewhere else."

The Missouri program was not easy to pass and has not been easy to hold. A strong lesson for future programs is that constant engagement of the citizenry has been necessary to initiate as well as hold off special interest challenges. Reporting and outreach have demonstrated how the programs created and supported by this funding source are benefiting the citizens of the state. However, efforts like this are long-term and will probably never be "dedicated and permanent" in any easy sense of the words.

A program that combines an array of concepts that are useful for the future is the North American Waterfowl Management Plan. Now more than 30 years old, its success is rooted in the fact that it was not really a "plan" but a set of targets for populations and habitats that a whole array of government and nongovernment players could strive to achieve. It came in a time—the mid-1980s—when waterfowl populations were at an all-time low and waterfowl hunters and state and federal agencies were focusing on how to restore the resource.

The very size of the task laid out—millions of acres and billions of dollars—was both inspiring and intimidating. On a purely economic basis no single interest could do the whole job, so collaborative approaches evolved with many interests inside and outside of direct wildlife conservation. There have been national implementation bodies and federal and state coordinating committees, but it never became a top-down effort controlled by a government agency. That said, it would not have thrived had not states, provinces, and both Canadian and U.S. national governments worked together with nongovernmental groups to support it as it grew geographically.

The North American Wetlands Conservation Act (NAWCA) is a companion piece of legislation passed partly to implement the plan's habitat goals but with a clearly larger purpose of stemming the decline of wetlands and fostering broad conservation of wetlands and associated habitats. The way it was funded by Congress with partnership requirements, the development of matching contributions by the state and provincial wildlife agencies, NGOs, and other interests in the U.S. and Canada were essential steps. An early need was to be able to spend U.S. tax dollars in Canada to restore and secure habitats that directly affect what then was a declining resource of great interest to an energetic segment of the public. Doing business together across borders required establishing a lot of confidence with legislatures and commissions.

In one story associated with NAWCA and the plan, a close association with the fledgling National Fish and Wildlife Foundation (NFWF) broke new ground in achieving international conservation. Many of the various projects proposed had to occur in ways new to Congress—money was to be spent in another country on land not controlled by the U.S. and had to be accountable to the interests of the American public. NFWF could act as a private entity to pass money on to local project efforts, and all the partners ensured complete accountability in order to build the trust within Congress. This early action was vital to the work of the plan and NAWCA and helped the new foundation prove its value.

A vital development in the success of the NAWMP was the concept of Joint Ventures, geographically based partnerships in both Canada and the U.S. For landscape-scale conservation efforts in

areas like coastlines, the Mississippi River Delta, and the prairie potholes region, the U.S. and Canada adopted the goals set out in the plan and started trying to implement them. While at its core the plan had waterfowl and associated wetland habitats as its focus, its success was achieved by partnering with large-scale agricultural programs on the landscape, integrating with the Farm Bill and its many permutations, incorporating grazing systems and land protection efforts in both countries (often with a focus wider than waterfowl, municipal, and agricultural water supplies), and embracing virtually anything else that needed to be included to achieve the plan's goals. When respondents addressed the NAWMP in the Elements of Success in Fish and Wildlife Management survey, they frequently noted the passion and zeal of waterfowl hunters, agency biologists, constituents within the states, and the well-established nongovernmental organization Ducks Unlimited. The equal passion of citizens and organizations interested in land protection not necessarily associated with waterfowl was also noted as critical due to the need for resources well beyond those available through traditional fish and wildlife entities.

The concept of partnerships was mentioned prominently in the Elements of Success in Fish and Wildlife Management survey results. The Joint Ventures, the relationship between Canada and the U.S., relationships between natural resource agencies, agriculture, industry, and nongovernment organizations, were central to the success of the plan. A major contributor to the waterfowl plan and to the use of NAWCA to conserve habitats has been Ducks Unlimited and Ducks Unlimited Canada. The fact that large amounts of private funding could be provided up front to match state wildlife agency and federal funding to do projects on the ground continues to be a huge asset. Without these entities in the two countries, the scale of work achieved would be far less.

A long-standing attitude among many fish and wildlife biologists was expressed through this survey—that science should be the foundation for every decision in fish and wildlife management and that politics should be kept separate. We have a long history in wildlife and fish conservation of trying to keep politics out, beginning with attempts to separate state agencies and their commissions from the political process. Agencies in the early part of the last century were ruled as much by political patronage as by science. The development of science-based wildlife management that became visible in the 1930s was a major change for a more objective treatment of fish and wildlife resources. But politics did not disappear and they are not inconsequential or even inappropriate in wildlife and fish management. It felt good to see the public trust doctrine endorsed by the survey because it is intrinsically linked with the concerns about the impact of politics. Public agencies are funded by appropriations processes controlled by legislatures or Congress, the laws that protect fish and wildlife are made by those entities, and we live in democracies where fish and wildlife and habitats have to compete with other needs supported by the public as well. So how can politics stay out of fish and wildlife and habitat management?

I see no way in the future that they can. In fact, we as a community need to learn to play the game better. All of the successes we celebrate, and the failures we identify, have political roots. Conservation leaders were either able to convince legislative bodies in the U.S. and Canada that funds should be spent on programs, or they were not. The decisions may have help from the outside, as in the failure of CARA, but the political process played a major, and sometimes controlling, role and shows no sign of going anywhere. It is closely tied to our future and the future of fish and wildlife habitats.

The world has changed much during the worldwide economic downturn of the last decade. Thoughtful people are saying changes in the economy, the outlook for employment and retirement, funding by government for programs, and many other things have changed forever and the future will likely be different. What we have seen so far should warn us that some new thinking is needed for the next 100 years if we are to keep the fish and wildlife and habitats that we have.

Some are saying we need to find new ways for land conservation and agriculture because we have depended too much on short-term conservation agreements. Some think we should switch our strategy to permanent easement and fee title—a huge task. A reality is that about half the U.S. and a large part of Canada are utilized for agriculture. Future markets and demand for grain from growing countries already compete strongly with any of the conservation measures we have been able to count on. We struggle between providing incentives for landowners and wanting to regulate them. We need to find more ways to provide those incentives. One lesson from the NAWMP is that we have needs in conservation too big and

too costly for fish and wildlife entities to do by themselves. We have to continue to find ways to partner with other interests to shape how they spend their money so that more of our interests are served by what they do in their own interest.

A lot was said in the Elements of Success in Fish and Wildlife Management survey about the impact of education and science applied to fish and wildlife management. One of the bright lights is the Cooperative Fish and Wildlife Research Units (Units), now housed under the U.S. Geological Survey (USGS) within the U.S. Department of the Interior. This classic approach to partnership started in the 1930s and brought universities, the U.S. Fish & Wildlife Service, state fish and wildlife agencies, and the Wildlife Management Institute to the table in a partnership that conducts research to solve problems and train graduate-level students to pursue careers in the burgeoning agencies. It has been a huge success, going from separate fish and wildlife Units in many places to combined approaches and studies much broader than that of single fish or wildlife species. It now exists in most but not all states. Along with the growth of university programs, it provided the trained people who achieved a lot of the success of the last 100 years. Its partnership approach makes it an important contributor for many of the same functions in the future.

To illustrate the point, let me relate two personal experiences. I had both the privilege of being a student and later manager of the Units program. In late 1980, then-director of the U.S. Fish & Wildlife Service Lynn Greenwalt called several of us into his office to relate concerns from a meeting he had just had with the incoming Reagan administration. He looked pointedly at us in the Units and said, "Nothing may be a sacred cow in what is coming. Be forewarned."

Within a week he had lost his job and the Units were zeroed out in the administration's budget. A bitter fight ensued that lasted for four years, using huge political capital from the cooperators to work to save it. The Wildlife Management Institute played a pivotal role in the fight and the program was saved. Had we not played the political game fiercely and determinedly, that program would not exist. I also had the experience of standing at this podium with Secretary of Interior Bruce Babbit who was about to speak, and I spoke out against what we understood was his intent to move the large research function including the Units out of the Fish & Wildlife Service into a new biological survey unit within USGS. As you know, he did not listen.

The role of science, including the co-op Units, received a lot of attention in the survey results. We as a community strongly feel that science should be the basis for resource management decisions. We feel this in our hearts but also know from experience that Congress and the American public give that concept lip service but may not be willing to make sacrifices to implement it. It is the same old story: science and new information often come up with needs that require sacrifice. This is a situation that will persist for the next 100 years and we must find new ways to cope with it.

We all can see the polarization in our society and in Congress played out every day. Canada has its own problems with differing ideologies, particularly about spending money. Fish and wildlife programs have not thrived in Canada at the provincial nor national level. I think the evidence supports the concern that with the changes we've seen in our society in the last decade nothing will remain certain, including dedicated funding for fish and wildlife. So how can we cope with that and ensure a future for the things we value? One reasonable conclusion from the results of the survey is that we should learn from experiences that were successful and unsuccessful—moving ahead with demonstrated successful approaches and avoiding repeating mistakes of the past.

Partnerships between diverse entities committed to achieving clear goals for habitats and fish and wildlife, and real engagement by an informed public, have proven to be a force decision-makers have a harder time ignoring. Future needs include new funding from government and private sources that are as dedicated as possible as well as strengthened working relationships with private landowners. We will not be able to retain every program we have and we should focus on keeping successful programs that can be strongly justified. All this change suggests we need to be learning to make compromises that move us in the right direction but don't give up the farm. This is, and has been, an uncomfortable reality within fish and wildlife conservation, but the future depends on it.

The Challenge: Conservation in the Dynamic Environmental Context of The 21st Century

Lynn Scarlett
The Nature Conservancy
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As I contemplated my remarks today, knowing I'd be surrounded by so many mentors who have helped educate me and shape my thinking, I thought of a passage in *Alice in Wonderland*. Alice, you may recall, comes to a fork in the road. She looks up at the Cheshire cat and says to the cat, "Tell me please, which way ought I to go from here?" Grinning, the cat helpfully looks down and says, "That depends a good deal on where you want to get to."

Success does depend on goals and knowing where you want to get to, but success depends also on knowing the lay of the land. And so it is, I believe, with America's conservation journey as we look to the future.

Thinking of the Cheshire cat's quip, many conservation champions here in this room and around this country know their destination. That destination includes conserving wildlife and protecting and restoring their habitat, that our children and their children thereafter will know the sound of songbirds or experience a walk upon a trail, or that they might hunt and fish in the woods, on a lake, or at sea, as we and our grandparents before us did. The challenge is how to achieve these conservation goals in a context of political, social, economic, and environmental change. And I want to explore that lay of the land, the political, social, and economic tableau within which conservation goals are unfolding and the dynamic environmental context of this 21st century.

I want to begin with two political and social dimensions. First, national, state, and local levels of government face continued fiscal constraints. Concerns drive a clamor for belt tightening, bringing a challenge to one of the underpinnings of the North American Model of Wildlife Conservation public funding. But I want to turn to a second signal—conservation writ large does not rank as a top 10 concern of the American public.

But there's some good news. It does garner a broad general nod of approval. It's especially evident when it comes to particular challenges that directly touch the lives of people. Some 80 percent of Americans are concerned a great deal or a fair amount about river, lake, and reservoir pollution and water supply issues. Seventy-six percent are concerned a great deal or somewhat about air pollution. Even issues unrelated to human health pull fairly strongly. Plant and animal extinctions generate concerns among 65 percent of Americans.

Alas, these public values do not translate into votes for lawmakers. Folks are voting other issues. They're voting taxes, they're voting health care, they're voting education. But they do translate into votes to protect lands, water, and wildlife. The November 2014 ballot initiatives showed resounding support for conservation. The Nature Conservancy invested in seven such initiatives in 2014, and six of the seven were big winners. These initiatives garnered 60, even 75 percent of the popular vote. And they promised to deliver some $20 billion or more for conservation. What's the bottom line of this? The conservation picture holds some basis for a bit of optimism that Americans value environmental protection, restoration, and enhancement. They value wildlife and conservation. But let me paint into the tableau a few more elements.

First is the existing regulatory backdrop—the Endangered Species Act, the Clean Water Act, the Federal Land Policy Management Act, the Natural Resource Damage Assessment, and many, many others. The implementation of these laws presents a mixed verdict. Some of these laws in their implementation have rough edges—rough edges that antagonize states, communities, and landowners; that antagonize hunters and fishers, farmers, and others. The recent poll of the Fish and Wildlife Service professionals, those gathered here, reflects this mixed bag. Some see the Endangered Species Act as the most successful, or among the most successful, national efforts in wildlife conservation over the past 50 years, while others think it is the least successful. But I want to set aside those differences for a moment and look at the implication of those laws for funding conservation.

Many of these laws require mitigation for various environmental impacts, whether to species, wetlands, or public lands, waters, and resources. And these dollars are significant. The natural resource damage settlements net an average payout of about $100 million per year. Such funds often combine with other sources to achieve significant environmental benefits, especially when creatively implemented. Think, for example, of the $3 million in natural resource damage funds resulting from a settlement regarding harbor contamination in Rhode Island that were combined with private sector and nonprofit funds towards the purchase of 1.5 million acres of loon nesting habitat in Maine. There is no reason, of course, to think that we got the design of these programs perfectly right 50 years ago, but my point is a different one. They do yield nonfederal conservation dollars and they do motivate action. Beyond those monies these statutes triggered for conservation, the rough edges have different implications for our conservation future. Those rough edges continue to reinforce the search for ways to transcend conflict and enhance collaboration, those partnerships that ranked so high in the polling that this organization of wildlife professionals undertook. Throw a dart on the map and we see the efflorescence of collaborative endeavors. Whether the sage grouse initiative or at smaller scales the Blackfoot Challenge in Montana, the Ducktrap River in Maine, the list goes on and on.

You are the participants in those endeavors. Twenty-first century conservation hinges on these endeavors. Abraham Lincoln once wrote of the better angels or our nature, our capacity for civility, respect, and even good humor. Despite deep divides in Washington, DC, many of this nation's communities reflect those better angels of our nature. Folks are engaged in distinct yet increasingly linked social, environmental, and economic enterprises. These endeavors enhance, not merely sustain, wildlife, lands, waters, communities, and economies.

But I want to turn to another brushstroke—this nation's huge water and wastewater infrastructure backlogs. The American Society of Civil Engineers rates drinking water and wastewater infrastructure as poor. The ratings are reflected in the estimated $390 billion price tag to update or replace wastewater systems alone. Now what do those enormous price tags for wastewater treatment have to do with our conservation agendas?

Cities across the nation are looking for better, cheaper, smarter ways to meet their infrastructure needs, and sometimes perhaps increasingly, that means going natural. That means investing in floodplain restoration, open spaces, wetlands and watershed protection, and forest health. Increased risks associated with natural disasters are amplifying a second look at nature and natural solutions. Investments in the protection and restoration of floodplains, coastal dunes, and sea marshes can enhance resilience to severe storms. The Nature Conservancy's own science data on oyster reef restoration shows substantial wave attenuation. Can those investments link conservation with community resilience? Our work on watershed protection shows that investment in watersheds and forest health reduces water treatment costs. But let me offer one final brushstroke in the conservation tableau.

More than 100 years ago, scientist and explorer John Wesley Powell observed the intersection of people and nature with a systems lens. Observing interdependence and interconnections he concluded people must necessarily work together for common purposes within interconnected spaces and places. So let us fast-forward 120 years and see a growing embrace of Powell's vision. Large-scale conservation and restoration initiatives are broadening in scope, scale, extent, and ambition. We see large-scale conservation tableaus in the Gulf of Mexico, the Bay Delta in California, Puget Sound, Chesapeake Bay, the Crown of the Continent marine reserves—the list goes on and on. All require the sort of coordinated action that Powell envisioned. They require cooperation among federal, state, and local agencies working with industries, private landowners, and nonprofit organizations.

Large-scale conservation, of course, as we heard in the 100-year legacy is not new. Yosemite and Yellowstone were born from visions of sustaining millions of acres of their grandeur and the wildlife they support. And collaborative conservation, small and large, is not new either.

The coming together of collaboration and large-scale conservation is now an essential centerpiece of 21st century conservation. Many significant resource management and restoration issues transcend jurisdictional boundaries. Among these are climate change affects, water supply and quality issues, fire

management, invasive species management, and wildlife protection. Many restoration projects span time; they span geographic space, governing jurisdictions, land ownerships, and multiple agency authorities.

All involve looking at systems. What are the implications of this multi-dimensional tableau for the future of conservation? This is a tableau, as I noted, of fiscal constraints, infrastructure and community needs, the urge to transcend conflict, and the landscape scale dimensions of many challenges. What are the implications? Well first, with strong public concern about tangible environmental issues, linking conservation action to those tangible issues offers a focus that transcends party and ideology. Efforts that link people and nature have promise—promise for conservation funding, promise for transcendental support. Watershed protection protects drinking water supplies; coastal restoration reduces storm vulnerability; floodplain restoration protects communities; enhancing forest health protects water supplies. These themes present an opportunity to build conservation coalitions among cities and countryside. Hunters, fishers, farmers, and municipal water managers, disaster response agents and conservationists, they provide a potential new source of funds. These needs present an opportunity to press for shifting from gray to green investments in enhanced conservation. But let me consider another implication of the tableau I have painted.

We must operate at large scales. We simply cannot address hypoxia or invasives at small scales. And those relate to wildlife conservation. Success of larger-scale conservation though brings me to another element of the now and the future—that conservation at scale depends on scientific understanding of complex processes. It requires an understanding of the dynamics of intersecting human and ecological systems at regional scales. It requires the generation and use of interdisciplinary science and a systems lens and the application of planning and policy tools at scales commensurate with the challenges—fire, hypoxia, invasive mussel species, energy development, climate impacts. Tools, for example, like that recently released by the landscape conservation cooperative working in central Appalachia, a mapping tool that lets us see the big picture, where critical watersheds are, where critical species are, where wildlife quarters are, but where energy development might also unfold. How can we avoid the most sensitive wildlife areas, the high biodiversity hot spots, critical water, and watersheds?

Finally, success requires governing partnerships that facilitate coordination and sustained action. We are not operating in a conservation world of actions founded in time or place but indeed of enduring actions that must be sustained over decades, indeed, perhaps forever.

So as I contemplate the efflorescence of action this enhanced collaboration, an interconnected action within larger scales, I'm reminded, by way of conclusion, of the words of former U.S. Secretary of the Interior Stewart Udall, as he described himself: "I am a troubled optimist." As I contemplate communities, conservation and landscape scale, conservation and collaboration, I guess I too am a troubled optimist, troubled because the issues are great, they are increasingly complex, their scope, as I have said, transcends jurisdictional and property boundaries. The pace of change quickens, land fragmentation, invasive weeds, water quality and supply, the quest for energy, wildlife, fire (I have listed these before), the travails of succeeding in a global economy—these all challenge us. But as the Chinese proverb reminds us, our challenges are also our opportunities, and therein lies my optimism.

Special Session One.
Conservation Controversies: Avoiding a House Divided

Opening Remarks

Christian A. Smith
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Welcome and thank you for coming to this special session of the centennial North American Wildlife and Natural Resources Conference. I know you have a choice between four terrific sessions at this conference—I appreciate your decision to join us as we explore "Conservation Controversies: Avoiding a House Divided."

I also want to thank my co-chair Ron Regan, Executive Director of the Association of Fish and Wildlife Agencies, for his help in organizing this session; members of the conference planning committee for helping shape the content of the session; and the Wildlife Management Institute for continuing to organize and host the North American conference. Above all, I want to give special thanks to the presenters and authors you will hear from shortly for their willingness to step forward and address this important topic. Without them, none of this would be possible.

As we just heard from Rollie Sparrow, Paul Hansen, and Lynn Scarlett in the plenary session, the conservation community has accomplished numerous, significant achievements over the past century: restoring fish and wildlife species decimated by unregulated market and subsistence hunting in the 1800s; negotiating and implementing international treaties for conservation of migratory birds; establishing and sustaining a partnership among hunters, anglers, agencies, and industry that has provided a solid financial foundation for conservation; and reversing decades of use of our rivers and atmosphere as free dumping grounds for industrial pollution. None of these were "easy lifts." And while we can point to important champions who led the initiatives that culminated in these successes, none were the result of individual efforts. Indeed, many required a broad consensus and the combined effort of most—if not all—of the conservation community.

Looking ahead, I see challenges that are equally daunting to those addressed throughout the 20th century. Our reliance on carbon-based energy is driving changes in climate, habitats, and the pH and surface levels of the oceans that have the potential to dwarf the impact of the wave of exploitation that rolled across North America in the late 1800s and early 1900s. The world's human population continues to increase and is projected to reach nine billion within this century. Given the degree to which the people and economies of Earth have become inter-connected, the growing global demand for food, water, resources, and energy is not something to take lightly.

One has to ask, "Are we, as a conservation community, up to these challenges? Can we affect the sort of changes in direction that prevented the extirpation of deer and turkeys, or that led to passage of the Clean Air and Clean Water acts?" I, for one, am not certain. One thing I do know, though, is that if we allow our community to be divided, our chances of success are greatly diminished.

This leads me to ask, "Are we united, or is our community at risk of division?" Unfortunately, the potential for fractures among conservation interests is evident on many fronts.

Take, for example, the long-standing tension between state and federal jurisdiction. In the U.S., the responsibility and authority for conservation for resident species is generally held by the states. Jurisdiction over migratory and endangered species, as well as marine mammals and fish beyond state territorial waters, has been delegated by congress to the federal government. While this arrangement works reasonably smoothly for species such as white-tailed deer or mallard ducks, it can become problematic when, for example, the federal mandate to restore a species like the wolf impacts a state's ability to achieve ungulate harvest objectives or manage human-wildlife conflicts. Or consider the challenges involved in allocating harvest from fish stocks that range both far offshore where federal

managers are pressured by multinational corporate interests and in coastal or inland waters where states are focused on resident sport angler needs.

In addition to the jurisdictional "turf wars," there is an increasingly apparent divergence between those in the community whose work is based on the traditional, utilitarian concept of "conservation" and those in the community whose work is oriented toward conserving biological diversity on other grounds. The rise of organizations such as the Society for Conservation Biology is a positive development in terms of expanding the breadth and depth of the conservation community and literature, but can also set the stage to draw and defend artificial boundaries that alienate us from one another.

Because our community is larger than just agency personnel and academics for who conservation is a profession, we must also be aware of the potential divisions among the people we serve or the NGOs (non-governmental organizations) that are essential partners in this endeavor. In my home state of Montana, for years a dispute between warm-water and cold-water anglers diverted limited resources into separate hatchery systems that could not function with maximum efficiency. And more recently, an initiative to expand funding for conservation fell victim to fear and mistrust between hunters and nonhunters. Sadly, these are not isolated incidents. Left unmanaged—or worse yet, reinforced by our actions or inaction—the different ways people value fish and wildlife can become flashpoints for internecine battles that weaken us all.

Importantly, these divisions are not new. The arguments over states' rights and federalism have been with us since 1776. Theodore Roosevelt and John Muir, respective founders of the Boone and Crockett Club and the Sierra Club, held strongly divergent opinions about the proper course for conservation. Yet during the past century, when circumstances demanded that we focus on the values that unite us, rather than the issues that divide us, the conservation community found ways to come together to achieve great things.

During the next two hours, you will hear from speakers who come from a range of backgrounds and different branches of our community who believe we can, and must, mirror those who came before us, set aside their differences, and pulled together to advance conservation. These folks are not going to tell you it's easy or always successful—nothing worth doing ever is. But each has valuable ideas and experiences to share that you can take away from this conference to help build bridges, rather than walls.

Our first presentation is by Dan Forster and Cynthia Dohner. Dan is the director of the Georgia Wildlife Resources Division. Dan has been with the Wildlife Resources Division since 1990 where he started his career as a wildlife biologist in coastal Georgia. Dan also held the positions of assistant chief of the Game Management Section and assistant director before being appointed director in August 2004. Dan actively works at the state, regional, and national levels through the Association of Fish & Wildlife Agencies on a variety of wildlife management, fisheries management, and natural resource policy issues and is the immediate past-president of the association.

Cynthia is the southeast regional director for the U.S. Fish and Wildlife Service in Atlanta, Georgia. As regional director, Cynthia oversees service programs across 10 states, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands, including 128 National Wildlife Refuges and 14 National Fish Hatcheries. Cynthia is also the Department of Interior authorized official for the Deepwater Horizon Natural Resources Damage Assessment and Restoration. Before assuming her current position as regional director in 2009, Cynthia spent 16 years with the service, including six years as assistant director for ecological services—always an area ripe for conflict or controversy.

Dan and Cynthia are at the "tip of the spear" for their respective state and federal agencies on a host of conservation issues. But rather than allow their different responsibilities or jurisdictions to serve as grounds for dispute, they have forged an effective partnership that advances conservation for all parties. They "walk the walk" on a daily basis. It is my privilege and honor to introduce Dan and Cynthia to share their perspectives with you.

Following Dan and Cynthia, we will hear from Dr. Doug Austen. As the seventh executive director of the American Fisheries Society (AFS), Doug brings to the society more than 30 years of fisheries and conservation experience. Before heading up AFS, Doug served with the U.S. Fish & Wildlife Service as the national coordinator for the Landscape Conservation Cooperatives. Prior to that

Doug was executive director of the Pennsylvania Fish and Boat Commission. Doug also spent 20 years with the Illinois Department of Natural Resources and as a research biologist with the Illinois Natural History Survey. During the course of his career, Doug has had the benefit of seeing conservation issues from many different perspectives. He and his coauthors have agreed to share with us some of what they have learned about the common interests that can serve as a foundation for our conservation community.

Our third presentation will be by Dave Chadwick and Michele Beucler. Dave has served as the executive director of the Montana Wildlife Federation since 2013. During the preceding 20 years, Dave worked on Capitol Hill as staff to Senator Feinstein and for the Association of Fish & Wildlife Agencies, where he supported development of the state wildlife action plans and assisted with the Teaming With Wildlife campaign. Dave also worked for the Minnesota Citizens League, The Nature Conservancy, and spent four years with the Colorado Division of Parks and Wildlife. Dave has a strong commitment to involving citizens and voters in conservation.

Michele is the coordinator for strategic planning and human dimensions for the Idaho Department of Fish and Game. For the past several years, her work has focused on special projects including the Idaho Wildlife Summit, discussed at a previous North American conference by Idaho department director Virgil Moore, and a marketing effort to increase license sales and renewals. Earlier in her career, Michele held field positions in New York, Utah, and South Dakota. Like her coauthor, Michele is passionate about public involvement in wildlife conservation and committed to finding ways to lead divergent interests to common ground.

Our final speaker will be Becky Humphries. A longtime champion of conservation causes, Becky joined the National Wild Turkey Federation (NWTF) in October 2013 where she now serves as the Chief Conservation Officer. Prior to joining NWTF, Becky served as the director of conservation for Ducks Unlimited. Before Ducks Unlimited, much of Becky's career was spent with the Michigan Department of Natural Resources, where she rose from a field biologist through the ranks to become director of the Department of Natural Resources from 2004 to 2010. Based on her diverse background, Becky brings a unique perspective to the challenges and rewards of bridging the gaps between agencies, nongovernment organizations, and public interests.

Please join me in welcoming our speakers. Their insights should help us all address looming conservation controversies, while avoiding a house divided.

A Way of Working: How Partnerships Can Work in Real Life

Cynthia K. Dohner
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Dan L. Forster
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Samuel Pierpont Langley wanted to be the first man to successfully pilot an airplane.

Langley had everything he needed to succeed. A senior officer at the Smithsonian Institution, he was also a mathematics professor who had worked at Harvard. He counted among his friends Andrew Carnegie and Alexander Graham Bell. He had a $50,000 grant from the War Department to fund his project, an enormous amount of money in the early 1890s.

As author Simon Sinek recounts in his book *Start with Why*, Langley had pulled together some of that time's smartest minds. He had access to the finest materials. The media followed his work closely. People couldn't wait to read of Langley's success. It seemed guaranteed.

At the same time, Orville and Wilbur Wright were working on their own aircraft in Dayton, Ohio. Their passion to fly, Sinek wrote, was so intense it inspired the commitment of a group of friends. They had no funding. Not one of their team had an advanced degree or a college education. They had no connections.

Yet, they had one thing Langley and all of his connections didn't have. They wanted to fly in the worst way, and on December 17, 1903, they witnessed a man flying an aircraft for the first time ever.

It's not hard to guess how that story would end. What's important is why it ended that way.

The Wright brothers inspired people around them in a way that opened the door to a small group of committed citizens to change the world. The conservation movement in North America benefitted from the same kinds of folks—Theodore Roosevelt, Adolf Murie, John Audubon, and a few others who could inspire generations of future conservationists just as the Wright brothers inspired generations of aviation enthusiasts.

This conservation movement is poised, early in the 21st century, to achieve extraordinary conservation results that ensure a future of wild places for hunting, fishing, and other recreation; that support the economies of our local communities; that keep working lands working; and that protect a way of life.

However, one thing holds us back: relationships are not as strong as we need them to be to address the complex conservation challenges we face today.

This point is critical because the public entrusted the ultimate responsibility for America's fish and wildlife resources to the combined authorities, missions, and resources of state fish and wildlife agencies and the U.S. Fish & Wildlife Service (Service).

This state-federal model of managing fish and wildlife resources to meet public expectations requires robust interdependence and coordination between agencies; hence, partnerships are critical to securing the future of our natural resources. And this era of limited resources makes it even more critical

that we forge effective partnerships. To successfully work together, however, we need to include some social science along with our traditional dependence biological science.

Developing partnerships and maintaining relationships is hard work, especially for biologists whose style tends to be scientific, tactical, quantitative, strategic, and fact-driven. Partnership building focuses on the social science or psychology in a situation. The effort required is sustained over an extended time.

In the southeast, the benefits from this were crystalized about four years ago.

That's when the first of several legal petitions and subsequent settlement agreements required the Service to review the status of more than 450 species within five to 10 years. It amounted to historic workload increase that was unprecedented for the southeast and threatened to consume the Service's listing program and impact our relationships with state partners.

The states manage these species, and as much as possible, we wanted them to remain that way—under state management. We raised this problem to our state directors. We collectively realized a better process was needed to build on that foundation of trust. So the Service began a conversation with our state directors about how we could address the work ahead.

For us as partners, it amounted to building on a way of working many of us refer to as "conservation southern-style." It works for our region and it emphasizes trust and transparency that allows us to achieve more and take smart risks to get conservation on the ground.

Our goal was and is to deliver good conservation in the best places, minimize future regulatory burden, keep working lands working, protect a way of life, and conserve species. So far, the Service has precluded the need to nearly almost 40 species in the Southeast and built an even stronger foundation for our work with states and partners across the landscape moving forward. The point of this is to conserve species before they need the protection of the Endangered Species Act. It's to make sure we are working together to deliver the best conservation on the ground possible for the benefit of fish and wildlife.

Trust is required. Through extensive social science studies of partnerships in the business world, trust is the number one quality needed. A compatible communication style finishes a close second. Trust and communication make the foundation of a partnership strong and its success possible.

It is also vital to recognize that no agency has a monopoly on wisdom and virtue. That point actually plays to the strength of partnerships because we can benefit from others' expertise. We must recognize, too, that states and the U.S. Fish & Wildlife Service will not always agree on everything. Disagreements are to be expected. But they don't have to derail partnerships as a core value in the way we work.

When challenges and controversy arise between federal and state governments, they can manifest as "tension," complicating our ability to work together and achieve lasting conservation results. Causes include blurred lines of authority, competing priorities, a lack of communication, unwillingness to compromise, distribution or allocation of resources, politics, and unresponsiveness on the part of partners.

Tension can create a lack of trust and clarity and result in unclear or unrealistic expectations. In any collective endeavor, the impact of broken relationships can be far-reaching for fish and wildlife conservation and ultimately make results harder to achieve. We end up at a stalemate instead of building bridges.

How best to cope with this? Realize that many causes of inter-jurisdictional tension are out of our span of control. Be aware of the potential and move forward to eliminate tension. Use our "southern style" of partnering by working through these disagreements, focusing on areas of consensus, and allowing good communications to lead to conservation success.

The way to get the most out of partnerships is to leverage strengths to attain common goals. Partnerships take continued effort on both sides, much like a marriage, in order to maintain a healthy give and take.

If this seems like common sense, it is. You may think you are doing all of this already. And you may be. But if you're not, ask yourself: What results do you want out of your agency relationships and are you getting them? If not, maybe there is another way.

Historically, the greatest conservation success stories were products of balance in relationships and recognition of diverse interests. Think of the Pittman–Robertson Federal Aid in Wildlife Restoration Act, the Dingell-Johnson Federal Aid in Sport Fish Restoration Act, the Migratory Bird Treaty Act, and North American Waterfowl Management Plan—none of these emerged from the midst of polarizing controversy. All are products of partnerships that balanced common themes such as creative problem solving, common interests, and respect for everyone's viewpoint.

Wildlife conservation is too important for us to fail. As Will Rogers once encouraged, our objective is to get out on the limb as far as we can, "because that is, indeed, where the fruit is."

As part of this effort, we should explore foundational truths and methods for fostering optimal working relationships and provide examples of successful partnerships. The development and maintenance of a durable and cooperative relationship among state and federal conservation agencies requires a sustained level of commitment, understanding, honesty, transparency, compromise, and a willingness to actively listen. Individual partners involved in these strong relationships, especially agency leaders, must have a trusting rapport and give each other "the benefit of the doubt."

While state and federal partners will not always agree, a trusted commitment to common goals coupled with continuous and transparent dialogue will effectively enable partners to thoughtfully deliberate issues and work through challenges to create more positive opportunities for conserving America's fish and wildlife.

Lieutenant General George J. Flynn wrote in a foreword to Leaders Eat Last, "I know of no case study in history that describes an organization that (was) managed out of a crisis. Every single one of them was led." We believe we won't manage ourselves out of the struggles we face today. But we can lead our way out of them.

So, whom would you choose? The Wright brothers, who had passion and inspired those who followed them with extraordinary commitment in the face of great odds, or Langley, who had everything but the passion he needed most and ended up with accomplishments few of us remember.

As today's conservation leaders, the power to make the right choice is in our hands—all of our hands.

What We've Got Here is Failure to Communicate

Dave Chadwick
Montana Wildlife Federation
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A False Dichotomy

Wildlife management often is framed in terms that draw a line between people who hunt ("consumptive users") and people who do not ("nonconsumptive users"). Although useful in some contexts, such as administration of hunting and fishing license sales, this dichotomy can foster a divide that is unproductive in other wildlife management contexts (e.g., public involvement, political support for management actions, and agency funding).

The distinction between consumptive and nonconsumptive users of wildlife is familiar to the fish and wildlife profession. For decades, these labels have been used to describe two camps of wildlife enthusiasts. At first glance, these labels seem fairly intuitive: a wildlife-based recreational activity either involves the harvest of an animal (hunting or fishing) or the activity does not (bird-watching). However, the distinction becomes fuzzy when we take a look at the complexities of participation, attitudes, and motivations.

Hunters: How Many Are There?

The fuzziness of the distinction between these two groups appears when we start with one of the most basic and common questions in the wildlife management business: how many people are hunters? There are many ways to answer this superficially simple question, which all yield variable measures (Duda et al. 2010). Surveys of participation can produce one measure of the number of hunters, while data on hunting license sales can tell a different story. Both measures are likely to underestimate the extent to which people identify themselves as hunters, independent of how often or how recently they actually purchased a license and took to the field (Duda et al. 2010; Enck et al. 2000). While annual license sales and participation reports are often are used to define who is a hunter and who is not, many more people identify as hunters than are actually purchasing licenses and/or participating in the activity every year.

Nonconsumptive Users: Who Are They?

The term "nonconsumptive users" has been used in the wildlife management community for decades, but largely without clear definition. The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation first employed the term "nonconsumptive" in 1980 to refer to "observing, photographing, and feeding wildlife" (U.S. Fish and Wildlife Service and U.S. Census Bureau 1982). The survey switched in 1996 from "nonconsumptive" to "wildlife watching" (U.S. Fish and Wildlife Service and U.S. Census Bureau 1997).

Over the years, studies have looked at the impact that so-called nonconsumptive activities had on the economy and on the resources (e.g., Boyle and Samson 1985). Some have even argued that there was no such thing as "nonconsumptive use" since all recreational activities impact the resources (Wilkes 1977).

Overlapping Participation, Motivations, and Attitudes

The distinction between the labels "consumptive" and "nonconsumptive" further breaks down when considering the substantial overlap in user participation. National survey data indicated 52 percent of sportspersons (hunted and/or fished) also participated in wildlife watching (U.S. Fish and Wildlife Service and U.S. Census Bureau 2012). Likewise, 24 percent of wildlife watchers also fished and 11 percent also hunted (U.S. Fish and Wildlife Service and U.S. Census Bureau 2012).

In addition, the motivations, engagement, and recreational approach of hunters and nonconsumptive wildlife users are more alike than different. Vaske et al. (1982) and Vaske and Roemer

(2013) distinguish between consumptive users and nonconsumptive users based on the former's focus on obtaining a target and the latter's emphasis on experience, suggesting differing levels of satisfaction result from this difference in goal orientation. However, this framework's definition of nonconsumptive lumps wildlife-based activities like bird-watching in with kayaking and camping. Studies focused on consumptive and nonconsumptive *wildlife* users—such as waterfowl hunters and avid bird-watchers—have demonstrated what many of us have personally experienced: that bird-watchers and hunters are alike in their zealous pursuit of their quarry and their behaviors (Applegate et al. 1987; Adams et al. 1997). Considerable research has also shown that hunters often report substantial nonuse values in their participation, including their desire to connect with nature, experience the wild outdoors, and spend time with family and friends, all of which are nonconsumptive activities (Duda et al. 2010). A majority of hunters report that seeing an abundance of animals, even if they do not actually harvest one, is a key factor in a quality hunting experiences (Duda et al. 2010).

The dichotomy further blurs on consideration of wildlife enthusiasts' attitudes about wildlife management and conservation. Hunters and wildlife watchers strongly resemble each other in their support for conservation, particularly when contrasted with people who do not participate in either activity (Cooper 2015).

Communicating a Comprehensive Wildlife Vision

Simple labels can be useful for administrative, management, and marketing decisions. However, understanding both the differences and the similarities people have about wildlife is valuable in developing durable solutions in wildlife management.

In order to confront the challenges facing wildlife management, the wildlife profession needs to communicate thoughtfully, using language that recognizes shared wildlife values. Scientifically collected data on people's values, preferences, attitudes, and activities can inform our communications about programs, funding, and constituencies in a way that reinforces positive interactions rather than fuels divisions. Wildlife advocates should strive to develop and test messages that resonate with key audiences and promote a shared conservation vision. To that end, we offer three examples that highlight the effectiveness of language that moves beyond the hunter/nonconsumptive user divide.

Effective Communications in Practice: The Teaming With Wildlife Campaign

During the last 20 years, Teaming With Wildlife has been one of the most successful wildlife funding campaigns. While originating from the need to conserve nonhunted wildlife, the campaign has always been premised in a broad vision that brings sportsmen and nonhunters together in support of a comprehensive conservation agenda. The initiative has been led collaboratively by state fish and wildlife agencies, sportsmen's organizations, and nonhunting conservation groups. Over the years, the Teaming With Wildlife campaign's messaging has always explicitly focused on the need to fill the "gap" between the principles of the North American Model and the limitations of the user-pays funding system. Rather than talking about "changing," "transforming," or "refocusing" wildlife conservation efforts, the Teaming With Wildlife campaign has always been about "finishing the job" and "fully realizing" our wildlife conservation agenda (Duda 1991; Association of Fish and Wildlife Agencies 2005). The campaign has recognized the historic importance of sportsmen and called for broadening the burden to include more of the public.

The Teaming With Wildlife campaign's focus on building on the sportsmen's legacy and broadening support for wildlife conservation has proven essential to the campaign's success. Although the effort has not (yet) secured permanent funding for at-risk species conservation, it did lead to the creation of the State Wildlife Grants Program and the Wildlife Conservation and Restoration Program in 2000. During the last 15 years, appropriations to these programs have meant nearly $1 billion in new funding for state fish and wildlife agencies, helping build wildlife diversity programs and prevent species from becoming endangered.

Effective Communications in Practice: Building a Broad Coalition in Missouri

Enacted in 1976, Missouri's conservation sales tax has long been the gold standard for wildlife agency funding. The enactment of the conservation sales tax was the product of a hard-fought campaign that bridged hunters and nonhunting wildlife enthusiasts. The effort to expand funding for the Missouri Department of Conservation began in the late 1960s with discussions about how to provide funding for nongame species management. However, it quickly grew beyond the game-nongame frame and focused on the needs of all wildlife and all Missourians. The foundation for the campaign was the Design for Conservation, a comprehensive planning effort that outlined the habitat protection, research, and management needs for *all* of Missouri's fish and wildlife and *all* of the people who enjoy those resources (Keefe 1987). The coalition of support for the conservation sales tax included everyone from hunting clubs and garden clubs; the initiative was endorsed by organizations as diverse as the Conservation Federation of Missouri, the Audubon Society, the National Rifle Association, and the Sierra Club (Keefe 1987). Reflecting the broad base of support, it ultimately won by a large margin—with especially large turnout in urban areas (Keefe 1987).

Effective Communications in Practice: Engaging the Public to Broaden Wildlife Management

Following Missouri's lead, Arkansas enacted a conservation sales tax in 1996. This success followed two failed attempts over the preceding 15 years. Many involved in the experiences in Arkansas have pointed to the importance of professional campaign management and the use of solid, effective polling data as a key factor in the initiative's ultimate success (McKinney et al. 2005).

Like Missouri, Arkansas developed a plan for conservation to outline the need for funds. The Arkansas Game and Fish Commission developed this plan through extensive public engagement and surveys. As a result of this broad effort, the plan brought together the priorities of a spectrum of Arkansans' interests in wildlife. It included nature centers in Arkansas' urban areas and the hiring of more game wardens to enforce hunting and fishing laws.

Conclusion

Framing wildlife management in terms of only "consumptive users" and "nonconsumptive users" is an oversimplification. If the conservation community is to successfully address the daunting challenges facing wildlife, we need to move beyond this dichotomy. By honing our words and messages and learning from past successes the wildlife profession can celebrate our conservation legacy—without fueling the false divide—and set the stage for future success in wildlife conservation.

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Wrapping Up Partnerships With a Bow: Beautiful Packages or Rewrapped Castoffs?

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In today's environment where nongovernment organizations and state and federal agencies often share common goals, it is mutually beneficial to form partnerships, pooling resources to achieve common goals. The success of these partnerships hinges upon understanding and respecting the authorities under which all partners are operating and successfully coordinating state and federal agency authorities. It is imperative in these partnerships that we find creative ways to make what could be a contentious state/federal partnership work, and even work well.

You have heard how the changing philosophy of management can divide us. We know that many times we focus on the treatment (or lack thereof) rather than the desired future condition. Focusing on the goal rather than how we are going to get there helps us keep moving forward.

Communication is absolutely critical to success. The care and feeding of relationships takes a great deal of time and attention. It doesn't just happen with text or email notes. And for many of us, this isn't our strength. Trust is hard-earned and easily lost.

So, if we are going to be successful in the days ahead with more and more pressures on the landscape and a public (and possibly staff) that are less connected to natural systems, what do we need to do?

I will add a few of my observations as I walked through my career—first in agencies and now the world of nongovernment organizations. And then I'll be really presumptuous and give you my thoughts on where we need to go.

First, we need to recognize our roles have changed and will probably change again. When I started my career, my mentors in the agencies were crusty veterans who had served in World War II. They were visionaries (who sometimes I admired and sometimes I doubted), but they were bold and they were driven. They had returned from the war; gone to school in fisheries, wildlife, or forestry; and rolled up their sleeves and got to work. They developed game management programs, wildlife management areas, urban fishing programs, in-house research programs, and eventually laid the groundwork for our expansion into nongame programs.

They made mistakes and fought hard battles on issues like the harvesting of does, the creation of refuges, and building infrastructure. They also created scars with politicians and some publics.

As hunter numbers began to decline, we moved into an era of "extensive" management. We were being asked how much public land is enough? And we were facing real maintenance demands on the infrastructure we had built in the 1950s and '60s.

We also started to face changing dynamics of a public who questioned government and scientists. It wasn't enough to use sound science—you had to prove you were using the best science. And in some cases we used science as a shield on hot social issues.

The days of learning through hands-on management were waning and mistakes were not well tolerated. Our staff became less acquainted with the land and less comfortable making decisions that involved risk. Accountability took on a new meaning of "no tolerance for mistakes."

As people moved off the farm and ranch, we saw less understanding of habitat management and less tolerance for "messy management" from our publics and staff. Changing social values and competition created strain on our community and we saw deep divides on how we should fund wildlife management. What groups should have a seat at the table was another point of contention. We lost focus on who brought us to the dance and we drifted away from the outdoor industries.

It was at this same time we saw enormous membership growth in nonprofit conservation organizations. While Ducks Unlimited had been around for decades, new groups like National Wild Turkey Federation, Pheasants Forever, Rocky Mountain Elk Foundation, and Mule Deer Foundation were

all formed. All of these groups used variations on the same model to grow memberships and raise money for conservation. It became a competitive business.

As government agencies "right sized" and downsized, the nonprofit world grew. Constraints on hiring created an ideal environment to create alternative staffing models through partnership development. In many cases, the nonprofits have become the implementers of habitat work for the agencies. They became the "experts" in wetland construction, farm bill implementation, or forest stewardship work.

However, as this practice grew, the relationships changed and nonprofits that once were viewed as partners were now viewed more as contractors. Allowable overhead rates need to be justified and audits are common.

Dependence on government funding for staff and conservation delivery also has reduced the ability of conservation nonprofits to speak out on contentious issues. Issues that can cost donor/corporate revenue are weighed heavily. Nonprofits work on slim margins and are always looking to maintain members and revenue to deliver their mission.

And finally, just as our hunters are aging, so too is the membership of these groups. The pie is shrinking while competition is increasing.

So, how do we create an environment of cooperation between agencies, partners, nonprofits, and citizens? How do we stand united?

1. We need to develop shared visions. Efforts like the North American Waterfowl Management Plan and Joint Venture plans have been excellent tools to drive work and funding. However, we need to build these plans with a broader group. Agricultural groups and forestry groups are a natural next step, but we must also recognize and include rural and urban communities.
2. We need to clearly articulate our vision and goals for our nontraditional partners and our citizens. All too often we get lazy and use acronyms rather than words. The public does not have a secret decoder ring and we have no reason to be less than clear in our communications. That means we need to give up the acronyms that pepper our language.
3. We need to look for opportunities where there is forward movement and seize the moment. Political leaders think in terms of opportunity cycles and we need to get in rhythm with these political opportunities.
4. Many of us say we are nonpolitical, when in reality we are bipartisan. We have lost the moderate in both parties in America, and until it comes back, we need to figure out what groups are best to lead which issue. That means we need to develop the courage to give up a bit of our position to gain overall. We need leaders who are strong enough to work together.
5. We need to reduce duplication of effort. We need to find ways to learn from one another, share savings and lessons, and be willing to put aside our differences. I think the joint memorandum of understanding between Ducks Unlimited, National Wild Turkey Federation, and Pheasants Forever is a great start but it needs to be much deeper and much stronger.
6. We need to develop respect for different perspectives. We will be stronger and more sustainable if we are more diverse. Diversity isn't as simple as adding a few women, a few Hispanics, or a few African Americans to our groups, but rather significant diversity immediately—diversity in sex, race, age, education, religion, viewpoints, and use. We are an old white monoculture.
7. We need to set a goal of defined outcomes and be disciplined enough to measure our performance. When we fail, we need to try again and again until we get it right.
8. We need to publicly celebrate our successes. We tend to be the doom-and-gloom group. We get frustrated when others don't take us seriously, but we take ourselves a bit too seriously. Most people who enjoy outdoor recreation think it is fun. In our efforts to be serious, concerned, and professional, we sometimes lose the fun.
9. We must learn to disagree without being disagreeable. We need be mature enough to have the hard conservations behind closed doors. While it might make us feel better to chastise an agency

or another group, in doing so we all are the losers. There will always be groups who are disingenuous, untruthful, and ruthless. We need to separate ourselves from these groups.

10. Finally, we have to start letting the next generation of leaders sit at the table. This table is for adults, not just seniors. Yep, they'll have different ideas, just like we did. Maybe better ideas.

Avoiding a House Divided—Closing Remarks

Ronald J. Regan
Association of Fish & Wildlife Agencies
Washington, DC

I am starting my 35th year as a fish and wildlife professional. When I first began as a deer biologist with the Vermont Fish & Wildlife Department in the early 1980s the mission was pretty simple: "Here are the keys to the state truck. Go forth and do good."

Over the next couple of decades I watched complexity and conflict descend upon our agency and our staff—the easy stuff turned out to be setting antlerless harvest quotas. The hard stuff was *really hard* because it impacted core organizational values and basic, long-standing relationships with new customers *and* new fears from traditional constituents; new science *and* its integration into old management paradigms; new mission statements; new expectations; and new public involvement tools.

Things are not likely to get any easier. The pace of our world will not allow that to happen. Plus, given we are dealing with public trust resources, through evolving science, against a backdrop of democratic institutions—all principles of the North American Model—we should not be surprised. Should we?

One of the nice things about a long career is the maturation of long-standing professional relationships, of being able to look at everyone on the podium and being able to say I am among incredible friends. Indeed, our speakers have acquitted themselves well this morning.

I have to say: state-federal tensions, hiccups, or kerfuffles have shown up on my desk with some measure of frequency. But at the end of the day, more often than not, there is in fact acknowledgment that there is more to unite us than separate us, especially with our first cousins at the U.S Fish & Wildlife Service. Dan Forster and Cindy Dohner have certainly made it abundantly clear what can be done to manage through complexity with a commitment to communications and an investment of time, making the effort for one more phone call at the end of the day, caring enough to manage away surprise. Trust is the operative word of the day for their relationship.

Doug Austin probed divisions and differences, divides and wicked problems with due acknowledgement that he prefers to focus on commonalities, solutions, and success. He cited such positive outcomes on a number of state funding or bond issues for land conservation yet noted the apparent policy perplexities with climate science, climate adaptation modeling, and clean water. I fast-forward to questions like: how do we manage risk in the face of great uncertainty; how do agencies embrace new ideas that fly in the face of cherished assumptions; and how can we foster organizational environments that welcome or accommodate inquiry, debate, and adaptive approaches to managing fish, wildlife, and habitats?

Dave Chadwick and Michele Beucler have reminded us about the challenges of embracing change, knowing that new funding may drive new priorities, without forgetting those who brought you to the dance, in the words of former WMI President Rollie Sparrowe. Some of you in this room know that all too well. It was certainly at the back of our minds in thinking about the creation of a Blue Ribbon Panel on wildlife funding and the need for a broad spectrum of partners at the table from day one. Their remarks refocused anew on "Communications and Relationships 101."

Indeed, these are challenging times and who better to help offer food for thought to steer a path forward than Becky Humphries. Becky is an accomplished leader-collaborator and we would be well served to heed her advice. The stakes are high in our world of complexity and precious and limited organizational resources. The need for effective action demands partnerships. They are not an option. Becky encouraged a number of foundational principles in thinking about partnership success: constituent diversity, shared vision and goals, seizing opportunities, and plain talk.

Thanks to my co-chair, Chris Smith, for his able leadership in bringing this session to fruition. I hope it has proved to be provocative and thoughtful and that it will help each of us grow as adaptive leaders.

Special Session Two.
The Business of Conservation: Converting Consumers to Customers

Converting Consumers to Customers: Why We Should Consider a Different Approach

Ann Forstchen
Florida Fish and Wildlife Conservation Commission
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Nick Wiley
Florida Fish and Wildlife Conservation Commission
Tallahassee, Florida

The social and ecological landscape of the U.S. is rapidly changing, and state fish and wildlife management agencies are struggling to address the growing needs and concerns of increasing numbers of people and their desired interactions with wildlife. The broadening diversity of stakeholders has new and different interests in, and uses of, fish and wildlife. The combination of increasing numbers of people and expansion of where they live, work, and recreate with the loss or changes in fish and wildlife habitats is creating new challenges for agencies to address. Traditionally sourced revenue streams are flat or decreasing for many agencies as declines in traditional outdoor recreation activities continue. There is wide recognition that the traditional user-pay funding model for fish and wildlife conservation is inadequate.

Most in the conservation community would agree that all people benefit from or are "consumers" of the benefits of fish and wildlife and our management of these resources. For example, management of certain harvested species and the habitats they depend on contributes to the persistence and well-being of wildlife such as bees and insects that pollinate crops that benefit and are important to all people. Many people benefit through more direct interaction with wildlife, such as wildlife viewing or wildlife tourism activities. And an increasingly smaller number of people, those who gain benefits from the pursuit and harvest of certain species of fish and wildlife, directly contribute financially to the management of these species and their habitats through licenses, permits, and excise fees. A widely espoused sentiment is that most activities in fish and wildlife management are funded by this small group. The bottom-line contribution of the user-pay model varies from state to state and should be carefully examined and thoughtfully communicated. But regardless of who pays for what, as an "industry," we are struggling financially.

Some in the conservation community suggest part of the solution to wildlife management agency solvency is to convert the nonpaying consumers to paying customers. Attempts to broaden agency funding through this type of conversion generally have not been successful. Additionally, there has been external pressure for agencies to "run more like a business." Simply using for-profit business terminology is challenging. How do we define these terms for a public fish and wildlife management agency? What do they mean relative to our mission? This line of inquiry leads to a deeper dialogue and the surfacing of additional questions. What is our business? What is our business's purpose? Who does our business serve? What products and services do we provide? How do we know if we have a successful business model?

These questions are new to most state fish and wildlife agencies. During the federal government management challenges of the early 1990s, many people called for a movement to "reinvent government" but more recently have given way to more insistent cries to run government like a business—to harness the principles, practices, and infrastructure of the market economy to save money, increase efficiency, overhaul the bureaucracy, and reduce so-called red tape (Osborne and Gaebler 1992; Michaels 2015). Additionally, during the past decade, conservation agencies have been encouraged to transform (Jacobson and Decker 2008; Jacobson et al. 2010; Decker 2011). A series of workshops for agency leaders were

held at the North American Wildlife and Natural Resources conferences in 2009, 2010, and 2011 to explore why and how agencies could strategically adapt to meet the challenges of unprecedented social change coupled with global-scale environmental effects (Decker et al. 2011). Several articles about the "wildlife management institution" have pointed out that state wildlife agencies should avoid being constrained by the past so they can be relevant to contemporary social and ecological needs and effectively address 21st century challenges (Jacobson 2008; Jacobson and Decker 2006, 2008; Decker et al. 2009; Decker 2011; Forstchen and Decker 2014).

A look to the past is often a good start on how to move forward. Smith's (2011) commentary on the roles and responsibilities under the public trust doctrine prompted some wildlife management practitioners and scholars to revisit the historical underpinnings and legal foundations of state fish and wildlife agencies in the U.S. and explore the implications of public trust obligations for state agencies. Articulating the principles of the public trust doctrine provides an opportunity to look at our "industry" through a different lens—different from the traditional agency paradigm of focusing on stakeholders who pay for and directly benefit from the harvest of fish and wildlife. The public trust doctrine, a body of constitutional, statute, and case law that varies slightly from state to state, holds that certain natural resources such as water, fish, and wildlife are held in trust by the government for the benefit of people (Smith 2011). Managing fish and wildlife under a public trust framework means agencies manage the trust resources (fish and wildlife) on behalf of all people and provide benefits from those resources to all people, now and for future generations. This basic concept is captured in many state fish and wildlife management agency mission statements.

The public trust approach eliminates the need to distinguish between consumers and customers. We are not an economic or profit-based industry but a trust-based industry. The public trust framework defines roles, responsibilities, and relationships between trustees (elected or appointed decision-makers), trust managers (state fish and wildlife agency staff), and trust beneficiaries (citizens) (Smith 2011). It helps answer the questions we asked above. Our business model then becomes more defined as to its purpose: *providing benefits to all citizens from the trust resources (fish and wildlife), not just engaged stakeholders*. Who does our business serve? *All citizens, now as well as future generations*. What products and services do we provide? *Those that citizens request of the trustee and that the trust assets can sustain over time*. How do we know if we have a successful business model? *We can use metrics of sustainable fish and wildlife populations and the satisfaction of the beneficiaries of the trust*.

But if we revisit the idea of conservation agencies functioning like a for-profit business, we'll note there are some significant similarities. Products and services are defined: we provide opportunities for people to interact with fish and wildlife and in some cases, allow them to harvest certain species and numbers of them. We also provide services to help people reduce or avoid negative interactions with wildlife. Additionally, we generate less recognized benefits for all people—conservation and management of lands and waters to sustain fish and wildlife results in undeveloped landscapes that create opportunities and ecosystem-based services that all people depend on, benefit from, and enjoy.

Like a business, conservation agencies have a number of "business or product lines"; ours includes recreation, wildlife protection, mitigation, research, information and outreach, and law enforcement. We provide opportunities for outdoor recreation such as hunting on public lands, boat ramps to access fishing spots, and trails from which to view wildlife. Our wildlife protection business line provides the management structure that ensures fish and wildlife populations are healthy and sustainable. This line includes population monitoring, activities to halt and reverse declining species numbers, and the creation of rules and regulations that guide how people interact with fish and wildlife. A growing business line for most agencies is mitigation, which is focused on reducing negative impacts from fish and wildlife and provides benefits (or relief from) overabundant wildlife (e.g., deer depredation permits), assistance in reducing conflict with wildlife (e.g., bears in trash cans), and reduction or control of nonnative species (e.g., Asian carp, lionfish). The innovation and development business line or scientific research line provides data and insight on how to manage fish and wildlife more effectively through life history and population dynamics studies and the development of new methods and technologies to study and monitor fish, wildlife, and their habitats. A growing discipline in this research line provides social science

information about peoples' attitudes, opinions, and behaviors towards wildlife. This important research informs public trust managers and trustees in their decision-making processes. The marketing business line or information and outreach units in conservation agencies provide information to citizens about how to use and interact with fish and wildlife responsibly, the fish and wildlife related benefits and opportunities available to them, and how they can support conservation. The law enforcement line ensures that the trust assets (the fish and wildlife) and the benefits and opportunities we provide based on those assets are used responsibly and appropriately so all citizens can enjoy our fish and wildlife resources now and in the future. All of these "business lines" contribute to the creation and delivery of conservation related products and services or provision of benefits from the trust assets to the beneficiaries.

There is no doubt we can borrow and apply applications from the for-profit arena to improve operational efficiencies in the public sector, especially within areas like fleet management, technology, communications, financial administration, and human resource management, as well as in some of our more conservation focused areas. This is demonstrated by the increased recruitment and hiring of agency staff from for-profit industries. Adoption of procedures and standards designed for the for-profit sector has become an "early win" in conservation agency transformation efforts to become more relevant, valued, and supported by contemporary society.

Just as a business understands its customers, the products or services they want, and their ability and capacity to provide them, a trust-based organization needs to understand its beneficiaries, the benefits they want from the trust assets, and their ability and capacity to provide them. The public trust approach provides direction to better understand the needs and concerns of all citizens relative to fish and wildlife and our management of them. We need to understand who the beneficiaries are; where they live, work, and recreate; what opportunities they want relative to fish and wildlife; what positive and negative impacts they experience from fish and wildlife; and what their intentioned and actual behaviors towards fish and wildlife are. There are a number of good sources of information from the public and private sectors about citizens' attitudes, opinions, and behaviors toward wildlife. However, state agencies increasingly need information at the finer-scale of a county or community level to detect and address emerging trends. We also need to recognize that even long-engaged traditional stakeholder attitudes, opinions, and behaviors will change over time, so these research efforts will require long-term attention and resources. A growing number of conservation agencies are dedicating positions for in-house human dimensions research to complement larger scale external research projects.

Some agencies have turned to popular business literature such as Collins' *Good to Great* and Kotter's *Leading Change* for guidance on how to assess their strengths and weaknesses, be more modern, and explore private sector practices. A key element from *Good to Great* is the Hedgehog Concept—an exercise to articulate those things that the organization is deeply passionate about, can be the best in the world at, and what drives the organizations "engine." By applying the traits of a hedgehog—focused and being very good at one big thing—organizations can simplify a complex world into a single organizing idea, basic principle, or concept that guides everything (Collins 2001). Explicitly identifying these elements helps an organization focus on producing the best short- and long-term results and provides a framework to stay on course to achieve their goals. During the summer of 2005, in the midst of a major agency reorganization, the senior leadership team at the Florida Fish and Wildlife Conservation Commission (FWC) read Collins' book as a group exercise and used the accompanying diagnostic tool to assess where FWC was on its journey from good to great. This work generated broad and thoughtful discussion, resulted in activities that changed staff behaviors, and is still referenced today. Applying a public trust framework to this work reveals that our "engine" is sustainable fish and wildlife resources that provide benefits to current and future generations. Kotter's *Leading Change* helped FWC recognize that a catalytic event was important to create a sense of urgency and apply pressure to understand the current conditions and to implement actions to move towards our desired future conditions. FWC's catalytic event was the agency reorganization—an effort to refocus activities and resources on those things most important to our stakeholders and create a more integrative and collaborative workforce.

Although fish and wildlife agencies are not truly "profit based," they obviously cannot function without sufficient revenues to support operations, but they must be mindful and adaptive as they face

current and future societal changes that are eroding traditional revenue sources. Agencies must find innovative ways to generate a more stable and sustainable operational funding base for the entire line of "trust based" products they deliver. The "traditional" fish and wildlife management agency paradigm has focused on hunters, anglers, and trappers—the stakeholders who paid for and benefited directly from wildlife restoration successes of the 20th century. Revenue from these stakeholders is declining and the need to deliver a wider variety of benefits to all public trust beneficiaries is growing. Perhaps this is the catalytic event we, as a conservation community, need to help us focus attention on creating a stable, predictable, and equitable funding model. In a "no-fee increase" political environment, most states have picked the "low hanging fruit" (e.g., license plates, drivers' license check-off boxes, lottery or gaming revenues). There is considerable investment at the national level (e.g., Blue Ribbon Panel on Sustaining America's Fish and Wildlife Resources) to seek innovative ways to broaden and increase funding for all fish and wildlife management activities. We need to stay engaged with this group as they work. But we shouldn't assume they will come up with solutions to "solve it all." We need to work within our own socio-political arenas at the state and local levels to improve awareness of the wide variety of benefits that fish and wildlife resources provide citizens and seek support for conservation at all levels.

Internally we should examine our thinking, the words we use, and our behaviors as we shift from an economics-based focus on consumers, customers, clients, etc., to a more inclusive trust-based focus on "conservation beneficiaries." These beneficiaries should recognize the benefits they receive from fish and wildlife management, and they should value and support conservation even if they don't directly participate in outdoor wildlife-related activities. We need to examine our current recruitment, retention, and reengagement (R3) strategies with a public trust lens to reach all potential beneficiaries and garner their support. Many agencies have a strong youth-focused R3 effort, but we also need to engage with the baby boomer generation who experienced the environmental movement of the 1960s, have more leisure time and expendable income, and are likely to be politically active. We need to support our growing outdoor recreation programs at local, regional, and national levels that are reaching out to new audiences, such as the Recreational Boating and Fishing Foundation's "Vamos A Pescar"™ program. Engaging with their organization leaders will help us better understand their members and generate more value and support for conservation over the long term. We should increase and improve our engagement with local, state, and federal elected officials—and not just during budget decision-making sessions. We need to be explicit about how they can support conservation through their political actions and how those actions will result in direct and indirect benefits and services to their constituents. Additionally, as a conservation community, we are insular and isolated—we largely talk to ourselves and rarely engage with large industry, energy development, academia, tourism councils, transportation, healthcare, or economic development boards outside of a crisis. We need to partner with them and help them understand how healthy and abundant fish and wildlife contribute to the goals they want to achieve.

As we expand our engagement with a broader variety of public trust beneficiaries, we need to improve and expand our communications. Engagement with stakeholders needs to be a two-way dialogue, not just a push of information through the latest or least expensive communication tool. We need to use new technologies and "old fashioned" methods to engage and listen. We should critically assess the effectiveness of our communications. Who are we really reaching? Who are we missing? Are we just hearing from the "usual suspects" and do they all represent the same demographic? Who is not coming to our meetings or commenting on our activities or proposals? How are we capturing and responding to the desires and concerns expressed by the beneficiaries? Stakeholder engagement should come in many forms and happen at many levels and scales—topical internet-based polls, focus groups, listening sessions, social science inquiries, public meetings, workshops, summits, technical advisory groups, webinars, social media platforms, and one-on-one engagement with staff. And it's no longer just the public relations offices' responsibility to engage with stakeholders—it's everyone's job. We should try new ideas, such as allowing remote participation at our commission or board meetings from our regional offices so the beneficiaries don't have to travel far to engage with the trustees and trust managers. In addition, we should be exploring and using new communication technologies that will help us reach beneficiaries where they are, not where we are.

Few of us were trained to engage with the public and stakeholders; we were trained to work with deer, turkeys, and trout. Some would even argue many of us entered this profession because we didn't want to talk to people. But the importance of understanding and managing the "people part" of fish and wildlife conservation has never been more urgent. Engaging with stakeholders and gathering human dimensions information aids in identifying the needs and concerns of beneficiaries and considering them equitably; evaluating the distribution of costs and benefits of management in relation to different stakeholders; evaluating the outcomes of management actions; and incorporating information about stakeholder needs and interests, impacts experienced, etc., into decision-making and management practices (Forstchen and Smith 2014).

Reorienting an agency to focus on the people part of fish and wildlife management may be an uncomfortable shift, but changes in peoples' experiences, attitudes, opinions, and behaviors towards fish and wildlife during the past few decades leave us little choice. Expertise is needed in communications, social science inquiry, stakeholder engagement, conflict resolution, mediation, and facilitation in addition to our existing expertise on managing thousands of fish and wildlife species and their habitats. State agency staff no longer reflect the increasingly diverse population, and this may create a cultural barrier to understanding a changing stakeholder base. As we consider ways that state fish and wildlife agencies seek to fundamentally change and transform to deal with current and future conservation challenges, we must think much bigger and broader than ever. To continue to deliver on our public trust mission successfully, we need to think and act beyond traditional stakeholders and customers and our traditional comfort zone of fish and wildlife species. We can still celebrate our rich conservation history over the past century, but we must recognize that leaning on our history, particularly regarding outdated organizational structures and how we relate to traditional social and cultural interests, may be a barrier for change.

The 100-year-old wildlife conservation institution in the U.S. is based largely on the species management programs of state fish and wildlife agencies responding to a narrow set of special recreational-use interests (Jacobson et al. 2010). The social, political, and ecological environment in which we work has changed significantly over the century, but we are still largely organized and function much like we did 60 or 70 years ago. The number of people has increased and where these people live, work, and recreate has changed. As cities continue to grow and spread, more people are living on the suburban fringe and more wildlife species are adapting to a suburban lifestyle. Habitat is changing or being lost, and people and wildlife are interacting in new ways. The human population of the U.S. is diversifying and has new and different interests in, uses of, and concerns about fish and wildlife and their habitats. The scope of conservation issues are sometimes global; the complexity and interdependencies of conservation issues have vastly increased; the number and diversity of the public trust beneficiaries has dramatically expanded; and the procedures and practices agencies have used in the past don't always work like they used to. And generally, our conservation funding model is unstable, unpredictable, and inadequate. Conservation agencies are struggling to understand the implications of these pressures.

Pressures have increased for conservation agencies to act more like a business, "get back to their core mission," and yet also respond to increasing demands from the public trust beneficiaries with less resources. This has caused some of us in the conservation community to explore the foundations of why state fish and wildlife conservation agencies exist and how the "old" ideas of public trust might provide guidance to help us progress and persevere. The public trust doctrine provides a historical yet adaptable framework to understand and guide agency action as we work in an increasingly complex social, political, and ecological climate. While the primary function of a private-sector business is to make a profit, the primary function of government is to provide goods and services to its citizens. We are not an economic or profit-based industry; we are a trust-based industry. Under the public trust framework, the business of fish and wildlife agencies (the trustees and trust managers) is to provide benefits from the trust assets (the fish and wildlife) to all current citizens and future generations (the beneficiaries). Fully delivering the benefits of the public trust means conserving *all* fish and wildlife for *all* people, now and in the future. This broad inclusive definition emphasizes that wildlife resources are for the use and enjoyment of all citizens—not just those who choose to directly interact with or attempt to harvest wildlife (Forstchen and Wiley 2013). From a public trust resource perspective, all interests in wildlife should be considered, and

no interest should be privileged over another (Decker et al. 2013). This is not to suggest that agencies are abandoning traditional fish and wildlife uses and users who led the charge for conservation for over a century but to respectfully integrate their interests in a broader, more inclusive conservation community that values and supports fish and wildlife conservation.

Moving the wildlife management institution from a focus on wildlife uses and targeted species to conservation of the full suite of wildlife and habitat values is the great wildlife conservation challenge of our time (Decker 2011). Because of the socio-political changes during the past few decades, the past may not be the best predictor of the future. Let's think about conservation from a new perspective—where all citizens benefit from fish and wildlife resources or our management of them, whether they directly participate or not, or don't even recognize they are receiving those benefits. These benefits can be providing positive experiences such as opportunities to pursue and harvest game such as whitetail deer, quail, or red drum; management of habitats to view wildlife; or access to enjoy the scenic beauty of the outdoors. Benefits to citizens also include reduction of negative interactions with or impacts from wildlife such as managing problematic or nuisance species. Research, monitoring, and management of habitats that fish and wildlife depend on, such as forests, prairies, wetlands, and near and off-shore marine environments, provide indirect benefits and services such as clean air and water, which all citizens enjoy and depend on.

To provide these benefits, we need to provide easily accessible mechanisms for citizens to learn about why fish and wildlife and their habitats are relevant and important to them and to the other social issues they care about (e.g., economy, education, healthcare). The beneficiaries need to trust us to manage fish and wildlife on their behalf and should hold us accountable. This means the beneficiaries need to be informed and engaged partners in conservation. To provide access and information for the beneficiaries to be fully engaged, we need to know who they are and what they are concerned about relative to fish and wildlife. This social science information helps agencies demonstrate the connection between the presence of healthy fish and wildlife populations and the habitats they depend on and the ecosystem services (e.g., clean air and water, open space, scenic beauty) they provide that are valued by beneficiaries, as well as the agencies' role in providing these benefits to them.

Conservation agencies have the ability to transform into trust-based organizations that are attentive, responsive, and adaptive to changes in the social, political, and ecological landscape and to provide products and services that their beneficiaries seek. As we shift from a species-use focus to a focus based on benefits and values for all beneficiaries, let's concentrate on where we want to be in the long-term—20 years, 50 years, or even a century from now—not just next year's budget cycle or in our next five-year strategic planning cycle. Let's better understand and engage those beneficiaries who indirectly benefit from fish and wildlife and garner their support. Let's increase awareness in all citizens about how fish and wildlife conservation benefits their daily lives. Let's bring stakeholder groups together by leveraging their common interests rather than let differences of opinions on issues or personalities result in divisive dialogue. Let's be open to changing the products and services we provide and recognize that beneficiary needs and concerns will change over time. Let's find those intersections of fish and wildlife conservation to other socially important issues that our beneficiaries care about. Let's help our beneficiaries be knowledgeable and engaged partners in conservation. Let's embrace private sector practices where they help us provide improved conservation products and services to our public trust beneficiaries. Let's elevate the conversation from converting consumers into customers and focus on creating broad and diverse engagement with all citizens so they all value and support fish and wildlife conservation.

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Converting Consumers' Interest in Wildlife into Conservation Funding

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Whether it's a company buying supplies, a parent buying clothes, or a legislature appropriating funds, money is spent to fulfill people's needs and wants. This process of giving money to others in exchange for desired goods, services, or actions is commerce, which is a commercialization of the products and services people want.

Except for the rare occasion when regulatory action is needed to minimize abuse, commercialization is a good thing. Commercialization allows us to acquire things we otherwise cannot provide ourselves. How many homes have a dairy cow in their backyard? Fish and wildlife is not exempted, with people spending billions to engage in or purchase legal fish and wildlife related recreation or products.

This spending makes the fish and wildlife community not unlike other industrial sectors. Healthy habitat can be viewed as our factories. Recreation—the top source of fish and wildlife dollars in the United States—can be viewed as our factories' output, which then generates retail revenues through the sales of equipment, land access fees, licenses, and more. Like many industries, part of our industry's sales are re-invested back into maintaining and operating our factories via excise tax revenues, licenses, and direct donations from our customers. This funding, which amounted to more than $3 billion in 2011, is the lifeblood for conservation in the United States, providing the means to fund continued fish and wildlife improvements and maintenance.

Continuing with the industry analogy, managers of fish and wildlife agencies are our industry's executives. They are responsible for looking to the future and identifying potential threats and responses before it's too late. Currently, we see threats. During the past 20 years, the number of customers—hunters and anglers—has dropped roughly 6 percent (USFWS 1993, 2014). Increased spending per customer has offset these declines, but how much longer can we maintain revenues in the face of a declining customer base?

Past research shows about 90 percent of southeast United States residents think it is important wildlife exists (Responsive Management 2005). There's no reason to think other regions have significantly different opinions. However, only 16 percent of Americans currently enjoy fish and wildlife as hunters and anglers and can be viewed as active funders of conservation via their license and excise tax dollars (USFWS 2014).[1] The remaining 74 percent of the American public can be considered potential consumers.[2] Their interest—or value—in wildlife can be seen by entrepreneurial types as new business opportunities. It is our responsibility, as our industry's executives, to recognize this untapped value and determine how we can convert the public's values into new revenue sources. This process of monetization is one of the most important challenges in front of our community today.

While the new funding or business opportunities are many, we can categorize business opportunities into two general areas.

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[1] In 2011, 87.645 million Americans (or 36.5 percent) participated in some form of wildlife-associated recreation including wildlife viewing, hunting, and fishing. By removing those who only viewed wildlife, 37.397 million Americans (or 16 percent) over the age of 16 participated in hunting and/or fishing. Millions more under the age of 16 participated (USFWS 2014).

[2] Many of these actively donate millions of dollars to private conservation and sportsmen's organizations that then direct much

[2] Many of these actively donate millions of dollars to private conservation and sportsmen's organizations that then direct much of these funds to on-the-ground efforts and towards partnership efforts with state and federal agencies. The exclusion of these efforts is not meant to diminish their importance or downplay their contributions. This paper focuses on funding for state and federal fish and wildlife agencies and their related conservation activities.

Earn More From Current Customers

There's an axiom within the business community that it is easier to increase sales from existing customers than it is to recruit new customers. This makes sense considering your current customers are already familiar with you and understand the value of the products you offer. For the fish and wildlife community, this means:

1. *Offering improved licenses and value-added products.* Businesses are constantly testing new product ideas and introducing new products to keep customers interested. Think of General Mills Cheerios® cereal. Besides the traditional Cheerios® in the yellow box, to keep customers from switching to other brands and to attract new customers, consumers can now find Frosted Cheerios®, Apples & Cinnamon Cheerios®, and other flavors on the shelf. But state fish and wildlife agencies in most cases are still offering the same general selection of licenses now as they did 20 years ago. Though our customers' preferences continually change, we have not altered our products. States need to examine if customers would prefer options such as multiyear licenses, new combination licenses offering a wider range of outdoor options, value-added licenses that might allow access to fee-lands, or include vanity materials allowing the customer to communicate their love of the outdoor lifestyle (window decals, license plates, etc.).
2. *New seasons and outdoor opportunities.* License revenues grew in recent years along with the growth in turkey hunting, Great Lakes salmon, bow hunting, and more. States should always create new or special seasons when game populations, the public, and safety allow. For example, feral hogs are established in some areas and not likely to be hunted back to nonexistence. When some states allow pigs to be hunted without any licensing requirements, we lose the opportunity to capture revenue needed for pig damage management and general operations.
3. *Encourage existing hunters and anglers to participate more often.* Recent research shows that 25 to 50 percent of anglers and approximately 25 percent of hunters will not renew their license in the following year (American Sportfishing Association 2015; National Shooting Sports Foundation 2015). By reducing the churn rate, state agencies can receive increased funding. Notable efforts to boost renewal rates are already underway by the Recreational Boating and Fishing Foundation (RBFF) and the National Shooting Sports Foundation (NSSF). States are encouraged to remain actively involved in these efforts.

Earn Revenue From New Customers

Considering 74 percent of Americans have interest in wildlife but are not yet financially contributing to state or federal fish and wildlife management, the fish and wildlife community has considerable business opportunities in front of us:

4. *Voluntary.* We can think like an industry and find ways to entice people to willingly contribute to wildlife management. Two general approaches stand out:
    a. *Recruit new customers.* Until resource managers indicate additional participation pressure is not sustainable, efforts to recruit more anglers and hunters may generate greater revenue for conservation via license sales and excise taxes. Various state and private efforts such as the National Wild Turkey Federation's (NWTF) "Save the Habitat, Save the Hunt" initiative is an example, along with programs run by the RBFF, the NSSF, the Archery Trade Association, and the Council to Advance Hunting and the Shooting Sports (CAHSS).
    b. *Donations, foundations, and campaigns.* Many organizations actively raise funds for conservation of specific species, regions, or to maintain the hunting, fishing, and outdoor lifestyle. Considering the large proportion of the United States likely not contributing to conservation, additional fundraising efforts may prove profitable. At the state level, voluntary tax check-off programs are a good example, but professionally organized and

communicated donation campaigns may be worth pursuing, especially if done cooperatively with existing nonprofit sportsmen's and generalist wildlife organizations in a mutually beneficial way.

c. *Product sales.* Recognizing the state has a unique brand and access to wildlife, nonregulated products could be offered, such as plaster prints of grizzlies. Specialist conservation groups such as Save the Manatee Club has significantly raised funds selling "adoption" papers for specific animals. Considering the overhead required to operate retail businesses, states would likely earn more by partnering with existing retailers.

By thinking like a business, there are certainly many more product ideas for states to monetize their knowledge, abilities, and brand.

5. *Collective public action.* New taxes or dedicated funding programs are difficult to initiate in the current political climate but not impossible considering the value placed by the public on wildlife. Whether new initiatives are launched or current programs are enhanced, greater public funding remains an option. These could include:
    a. Expanding the current federal aid in sport fish and wildlife restoration excise taxes to include additional products;
    b. Appropriating greater funds to current programs like the Land and Water Conservation Fund and the State Wildlife Grants; or
    c. Initiating new funding programs.

Currently, the Association of Fish & Wildlife Agencies is organizing the Blue Ribbon Task Force (BRTF). The BRTF, comprised of conservation leaders and top conservation-minded U.S. business leaders, is tasked with identifying new funding opportunities for fish and wildlife conservation. This effort is critical and the remainder of the fish and wildlife community cannot watch on the sidelines. It is time for the rest of the fish and wildlife community to engage in discussions focused on either supporting ongoing efforts or developing new funding initiatives.

Monetizing the public's interest in fish and wildlife value requires thinking like a business. Defining how to incorporate entrepreneurial practices into everyday fish and wildlife management is a considerable topic and needs to be discussed at the state and national levels. To assist in funding discussions, here is a simple list of practices the fish and wildlife community can follow to start the process of developing new funding sources for fish and wildlife:

- DO think like a business! Even as public agencies, there's nothing stopping state agencies and the supporting community from taking an entrepreneurial look at the public's interest in wildlife and finding ways to monetize these interests.
- DON'T say, "No, we can't do that." Recent hunter and angler participation trends prohibit us from saying no. Nothing new ever began by saying no.
- DO business the customer's way. New ideas will not succeed if we require interested customers to visit our offices or walk-in stores to buy our products. We need to openly consider newer online-based funding techniques such as crowd sourcing, selling across multiple platforms, and social media-based campaigns. We must collect email addresses and maybe cell phone numbers for texting to enable successful marketing efforts. While we can maintain the traditional ways of transacting business with our customers, we will leave many dollars on the table if we fail to adopt newer methods, too. (For those who disagree, please read the previous "DON'T" bullet point.)
- DO work to better understand the 74 percent of the interested yet unengaged public. Any business would love a market representing 74 percent of the public! What do they want? Which services or products are they willing to purchase?

- DON'T try to do this alone. If we knew how to engage the 74 percent of the interested public not already contributing to state or federal fish and wildlife conservation, we would already have significant funding mechanisms in place. To succeed, the fish and wildlife community must work collaboratively with each other and especially with outside partners with expertise in the 74 percent of the unengaged public. Support efforts like the RBFF, CAHSS, and our highly successful partners such as the NWTF, Trout Unlimited, Rocky Mountain Elk Foundation, and many more.
- DO learn and build on past efforts! It took 80 years or more to bring the science of fisheries and wildlife management to its current status. Successful conservation marketing and fundraising efforts will require time to develop, too. Don't quit if initial efforts have minimal results. If the full community works closely with outside experts, we can significantly accelerate the learning process.
- DON'T forget who brought us to the dance! Sportsmen and women have been the foundation of conservation funding since the 1930s, they will be the foundation of future funding. It will take time to develop significant new funding sources. Opportunities to enhance funding voluntarily offered by sportsmen are present, as described earlier. They will remain our top partner for years to come. Recent boosts in wildlife restoration funding from the growth in target shooting are an excellent example showing how our traditional customers will remain our biggest customers.

It has taken years to bring the current funding models to their current record-high levels. It will take many more years to develop additional funding sources. We—the broader fish and wildlife conservation community including state and federal agencies, nonprofit sportsmen's and conservation organizations, industry partners, and our current customers—need to expand current discussions and start new ones now. If we don't, who will?

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The Future of Wildlife: It Starts with Non-Sportsmen

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About PILGRIM

PILGRIM is a full-service advertising and digital marketing agency based in Denver, Colorado, and founded in 2002. With a focus on Journey Brands, the company has experience working with organizations wanting to make a transformation in the way they are perceived by their audiences. PILGRIM has worked with the Colorado Wildlife Council since 2011 and is responsible for the state's well-known Hug a Hunter marketing campaign.

The Problem in Colorado

The problem faced in Colorado, and in many other states, is one of lack of awareness. Due to many factors, including increased urbanization and lower rates of hunting and fishing participation, most Colorado residents had little or no awareness of the existence of the North American Model of Wildlife Conservation. Even though research showed that most residents were proud of their state's natural beauty, diverse habitats, and wildlife abundance, they had no idea that hunting and fishing license fees were actually paying for most of the cost to protect and sustain those assets.

In the early 1990s, Colorado voters approved a ban on bear hunting, and trapping was banned soon after. Many wildlife managers felt the bans had passed without a full understanding of the issues and were supported by a public that was misinformed or had even been misled in some cases. The ultimate concern was that the Division of Wildlife might actually be losing its ability to scientifically manage wildlife populations.

The Creation of the Colorado Wildlife Council

In the late 1990s, an initial program was authorized by the Colorado state legislature, as a voluntary tax return check-off donation program. Permanent funding for the program was later secured in 2005, via a $0.75-per-license surcharge. That program continues today as The Wildlife Council in Colorado, and it generates between $800,000 and $1 million annually.

The council is managed separately from the Division of Wildlife by a nine-member volunteer board that meets bimonthly. The board includes a diverse group of participants who represent different sports, regions of the state, and interests. The board also includes one member from the Division of Wildlife. The board works with Division of Wildlife staff to manage the collection and spending of funds generated by the license surcharge.

The Mission of the Colorado Wildlife Council

The council's mission statement is as follows: "To oversee the design of a comprehensive media-based public information program to educate the general public about the benefits of wildlife, wildlife management, and wildlife-related recreational opportunities in Colorado, specifically hunting and fishing."

The following sections outline what we believe to be some of the major learnings from the annual marketing program conducted by The Wildlife Council, now in its ninth year of existence. We believe these learnings are applicable to any state wildlife agency, whether it currently has an established budget in place for this type of campaign or not.

State Wildlife Agencies Should be Worrying About Nonsportsmen

The Colorado Wildlife Council realized early on that hunters and anglers, though they have many shared interests and concerns, often don't share the same interests and concerns as the general public and that an increasingly urbanized public simply doesn't value hunting and fishing the way it might have 20 or 30 years ago.

The Colorado Wildlife Council understood that it needed to find ways to gain back this public support, if not increased understanding of the values of hunting and fishing, before changes in public opinion limited its ability to operate effectively. The council conducted research that helped it understand some basic, but often misunderstood, facts about nonsportsmen in the state. These included the realization that most nonsportsmen have very low interest in the subject of wildlife and wildlife management and that most nonsportsmen actually have no interest in ever becoming hunters or anglers.

Knowing that public opinion could drive big impacts to the state's wildlife management program, the council realized that it would be more efficient and effective to shift public opinion about sportsmen than to attempt to recruit the general public to become sportsmen.

Messages Need to be Crafted Carefully

Before attempting to change public opinion, the Colorado Wildlife Council wanted to ensure it was crafting the right message for its nonsportsmen audience. It suspected that merely talking about facts and figures associated with wildlife management would not be enough to connect emotionally with a disinterested and perhaps even skeptical public.

Message testing was one tool used by the council to gauge the effectiveness of different messages before investing in large-scale marketing campaigns. The council conducted focus groups with both sportsmen and nonsportsmen to review potential messages. In these groups, each set of participants was asked to rank a series of benefit statements according to what they thought was most important or would cause them to take notice.

While sportsmen and nonsportsmen clearly had interests that were specific and exclusive to each group, common interests did emerge. The two sides tended to agree on the protection and conservation of wildlife, the value of economic impacts of healthy wildlife habitat, and the pride they felt for their home state. This shared pride became one of the biggest drivers of the campaign and led directly to the creation of the well-known tagline "Hug a Hunter."

An Ongoing Engagement Plan Needs to be Put in Place

Once the most impactful messaging was developed, the importance of an ongoing engagement plan became evident. The Colorado Wildlife Council has a robust annual plan that understands the importance of not just establishing a message with its audience but repeating it over time. The council's engagement plan includes statewide television advertising, online display ads, radio advertising, and social media. In addition, the council maintains an informational website (hugahunter.com) and has even conducted promotions and publicity stunts to gain exposure and increase memorability.

Television, radio, and online advertising drive much of the emotional appeal of the campaign. For example, one TV spot shows a hiker on a wooded trail in the Colorado mountains. As we watch the hiker, we see alternate shots of a hunter also making his way through the woods on a different trail. Both are clearly enjoying their amazing surroundings. An announcer says, "We all love Colorado and want to take care of this amazing state." The hiker and hunter characters eventually come across each other, as the announcer continues, "So when you consider that the money from hunting and fishing licenses protects our wildlife and the beautiful places they live, you may want to hug a hunter." The spot ends with the surprised hunter actually receiving a friendly hug from the hiker.

Other aspects of the engagement plan help seed the rational justifications for the campaign—like the important facts and figures the council would like the general public to know and understand. For

example, the council's website focuses on the benefits hunting and fishing bring to the state's economy, its public lands, and the amount of jobs and revenues created. Infographics help communicate many of the facts and figures, and viewers are given links for making license or park pass purchases should they want to take the next step.

Social media has been another tool used to extend the conversation and attempt to engage audience members further. The council has even used publicity stunts to gain public exposure, such as having a hunter and fisherman character offer free hugs to pedestrians in busy downtown areas.

Tracking Results

To track the effectiveness of its efforts, the Colorado Wildlife Council conducts an annual awareness and attitude tracking survey. The survey polls a wide sampling of the general public, including both sportsmen and nonsportsmen. Participants are asked if they've seen the Hug a Hunter campaign and are asked to rank their support for hunting and fishing. The council has seen steady annual increases in most areas, most importantly among nonhunters and nonfishermen. In its most recent survey, the council was pleased to see that 72 percent of the general public said they support hunting, while 82 percent said they support fishing.

Technology Imperatives for the Future of Hunting, Fishing, and Shooting

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Introduction

Powderhook's mission is: "Access for all." That means access for new hunters, anglers, and shooters; for parents and their children; for neighbors who haven't been out in the field for years; and for you. Powderhook works with the nation's leading conservation organizations, retailers, and manufacturers, bringing our industry together to solve some of its most important problems. We're building a marketplace, like "Expedia for the Outdoors."

It could be said that Powderhook is the nerdiest outdoor company. Our team of seven technical individuals employs a skillset somewhat unique to the outdoor industry. We build software solutions to the challenges we believe are most integral to the future of our way of life. A little under 2 years old, we work hard every day to add value to the growing base of tools we've built, almost all of which are free to the consumer to use.

When we first started Powderhook we understood our mission to mean the average person needs a place to hunt, free or paid. Thus, we built one of the most complete data repositories for huntable and fishable lands information, both public and private, ever created. Our current sources of data come from upwards of 17 sources in each state, and in total we have more than 650,000 places to go. To our knowledge, almost no one has built a lands database as far-reaching and comprehensive. This data can be viewed, free of charge, by visiting powderhook.com/map.

What We've Learned

The way in which we understood the access problem grew and changed as we learned more about the challenges facing the industry and the individuals who hope to consume from it. Most days, people aren't looking for places to hunt or fish. One day, they might be looking for a tournament in which to fish; they may be interested in attending a National Wild Turkey Federation banquet; or they might just want to find a range to sight in their rifle. The access problem is bigger and more complicated than simply finding someone a spot. For that reason, we introduced group, event, and trip management functionality.

To present our user an accurate picture of what they could do outdoors in their area, we started to think of our business as "Expedia for the Outdoors." We began to build a one-stop place to find groups, events, spots, and trips for the hunter and angler.

In adopting this wider agenda, we have encountered several challenges we believe the industry must solve in order to propel itself forward. These problems are larger than what any company or single organization can change. They are as endemic and deeply rooted as their solutions are imperative. Challenging as they may be, they are also exacerbated by a generation of consumers, the future of our industry, who will almost exclusively purchase through their phone and who have a low tolerance for inconvenience.

The key steps the industry must take represent, in our view, a cultural shift in thinking. For the future of our way of life, we must collectively adopt a simpler, more open and transparent way of doing business. Open standards must become a way of life.

Key Examples

The Industry Must Create a Marketable Commodity Out of "Access"

Have you ever wondered why it's so easy to book a hotel room? You can book the same hotel room across dozens of websites. Knowing that, have you ever really asked yourself why it's so hard to find a duck blind to sit in, a place to hang your deer stand, or the upcoming 3-gun competitions in your area? The fundamental underlying issue is that our industry lacks a standard tradable good—an inventory, like a room-night. "Access" means several things and somehow nothing all at once. It could mean a lease; a trespass fee; a role on a shooting team; a seat in a blind or a spot in your friend's truck. We believe the industry, in the interest of creating a marketable commodity, will come to define "access" as a seat for a period of time—effectively, our version of a room-night. This is a natural conclusion given we buy and sell seats to all kinds of things, including movies, concerts, and classes. It is our belief that an industry-wide adoption of this "seat" or "inventory" creation approach is integral to the perpetuation of our way of life. In doing so, we can begin to create the opportunity and incentive for private industry, public/private partnerships, and individuals to get to work marketing, giving, trading, buying, and selling our collective access assets, regardless of who owns or creates them.

Powderhook has created the acronym G.U.E.S.T. to help serve as a moniker for this line of thinking. No matter what you do in this access or R3 (recruitment, retention, and reactivation) arena, you are in the business of helping people find and consume groups, users, events, spots, and trips. Because license buying is an imperative, we believe selling a license is a by-product of selling your audience on one or several of the components of G.U.E.S.T., examples of which include:

- Groups: hunting or fishing clubs, volunteer groups, or local chapters
- Users: mentors, volunteers, teachers, or hunting/fishing partners
- Events: fundraisers, R3 activities, fishing tournaments, and shooting competitions
- Spots: public/private land and water, free/paid places to go
- Trips: 4 seats in the truck, one day in a duck blind

Agencies and NGOs Should Think of Themselves as the Wholesaler of G.U.E.S.T.

The keyholders to the industry must push us forward by creating an economic incentive for others to help with access and R3 problems. Cabela's should be selling access at retail. I should be able to sign up for agency-run fishing tournaments on the Bass Pro Shops website. GunBroker.com should be selling Ducks Unlimited banquet tickets. Expedia should be booking campgrounds. Airbnb should be adding fishing licenses onto their lakefront home rental transactions.

While we've only been in the industry for a couple years, it has become our belief that our agency and NGO (nongovernmental organization) friends face nearly impossible odds in changing the tide in our industry. The agencies we've gotten to know are running, literally, 15 different lines of business. Because of this construct and the built-in inefficiency, resources become strapped, and effectiveness and innovation are swapped for status quo in the interest of just plain getting the work done each day. We believe a simplification of the agency and NGO business model through the adoption of the "wholesaler" mindset can have a drastic impact on the output of these organizations and the effectiveness of their role in the broader industry.

The Industry Needs a Common Repository of Geographic Information

Powderhook has invested several hundred thousand dollars in the creation of our map. No one should ever have to do it again. Our map, or one like ours with considerably more input from the industry, should exist as an open standard for hunting and fishing related geographic information. With an open standard, all public agencies, NGOs, private companies, and individuals could access a common tool and update a related data asset. Currently, geo information exists in hundreds of data silos. Several fish and wildlife agencies have invested heavily in their mapping infrastructure. Others have not. Each has done it in their own way, making for a significantly higher cost for an NGO, private company, or individual who

may be willing to invest in their own version of R3. When a park closes on a fish and wildlife website it should also reflect as closed on Powderhook, Google Maps, and any other place people might seek that information. When a new hunting land is added from a private access program, it should be visible across the entire industry. An open environment, welcoming of user contributions (such as openstreetmaps.com) is how we make it happen.

We Must Manage Our Collective Reputation

To do so, we need to commit to a national hunter, shooter, and angler registry. Each person in the registry should receive an identifier they can use to manage their reputation as they move throughout the industry. This common identifier would allow for simplification of the licensing and tag application process. It would enable people to register, sign up, purchase, and participate more efficiently. In addition, it would enable the R3 movement to measure the behaviors and outcomes of their programs. Strangely, this already exists under our noses. Facebook uses your common identity to allow you to login to countless websites. In doing so, they're able to track your behavior across your consumptive web behaviors in much the same manner our industry needs to do.

The idea of a national license program is an old one. It is not our belief that there will ever be a day when a person can purchase a license in one state and legally hunt another state. However, a common identifier will enable technology similar to Foursquare's "check-in" to make licensing across multiple states a more simple, open process.

Your common identifier would know you are an active member of Ducks Unlimited, which may gain you access to DU programs or hunts not available to the general public. It would know your Hunter's Safety Number, eliminating the frustration and pressure of materializing this form of identification for each new place a person hunts or fishes. Landowners cite wanting to know who is on their land and what they're doing as the number one reason they deny access. A common identifier could aid sportsmen and women in that communication process.

We Need a Marketplace

Have you ever thought about what makes eBay so special? There isn't another one like it. If you're looking to sell something used online, you go to eBay. Because of that, if you're looking to buy something used online, you go to eBay. People sell on eBay because people buy on eBay because people sell on eBay. This phenomenon is something referred to as the "network effect." Simply defined, the network effect refers to the notion that each additional buyer and seller in a market makes the marketplace better for each existing buyer and seller.

Our economy is in the early stages of a new type of revolution. Economists refer to it as the peer-to-peer or share-economy movement. Using a marketplace business model, companies such as Lyft, StubHub, Uber, GunBroker, Airbnb, Homeaway, Etsy, and hundreds of others are changing the way in which things are bought and sold. It can be said they're deconstructing fixed and mature industry one transparent, efficient, peer-to-peer transaction at a time. Last night, Airbnb was the second largest hotelier in the world, yet almost none of their sellers are even businesses. A marketplace, like those mentioned here, is part of the future of nearly all industries. We believe the adoption of a marketplace is a key component of the future of the hunting and shooting industry.

Why don't we have one already, if it's such a good idea? Dozens have tried. Powderhook is working on it. The outdoor industry is very different than others. The level of fragmentation, the desire for hunters and anglers to preserve their spots, the lack of a fundamental commodity, and the deep role of government, licensing, and regulation will require of the builder of a marketplace in the outdoor space to have immense staying power. Things that may move quickly in other industries simply cannot in the hunting, fishing, and shooting space. But, rest assured, if our industry is to make it into the next generation of hunters, anglers, and shooters, a marketplace will be a key component of how it all works. Our teenage children won't stand for the inefficiencies. They'll just play soccer or video games instead.

Conclusion

Will our children hunt? Will they care about the second amendment? Will they value our beloved North American model? Or will the race of an urbanized lifestyle, the relative torture it takes to earn a hunter-ed certificate, the traveling soccer teams, the two-income households, the need to make time, the hassle of finding a place to go, the pain it takes to figure out permits, the antihunting noise—will the pressure finally erode our base and crack our foundation?

Fixing these problems for the next generation is impossible for you to do, no matter who you are. Powderhook is no exception. None of us can add public access, we don't have the means to change policy, we can't train everyone on R3, and we can't educate the masses about the merits of what we do. But you can change the trend in your life and in the lives of those around you. As an industry, let's get busy empowering individuals to make that change by ensuring our every investment makes us more simple, open, and transparent.

Our way of life is just. It can and will sustain; we just need to people to bring a G.U.E.S.T.

Special Session 3.
Planning for Species Sustainability: Avoiding the Need to List Under the ESA

NRCS and the Sage Grouse Initiative: 21st Century Conservation that Works

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In March 2010, greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) were designated a candidate species for possible listing under the Endangered Species Act (ESA) with a final decision expected in September 2015. In an unprecedented collaboration to proactively conserve the species and preclude the need for listing, state experts teamed with the U.S. Fish & Wildlife Service (USFWS) and created a range wide conservation strategy that defines the extent to which threats need to be reduced to conserve the species (Conservation Objectives Team Report [COT]; FWS 2013). The overarching COT directive is twofold: modify policy to alleviate anthropogenic threats and actively manage habitats to restore ecosystem function (Boyd et al. 2014). To accomplish this, the COT spatially identifies threats and prioritizes their reduction inside high bird-abundance areas defined as Priority Areas for Conservation (PACs).

On the heels of the candidate designation in 2010, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) launched the Sage Grouse Initiative (SGI) as a highly targeted and science-based approach for alleviating nonregulatory threats on private land. Five years later, SGI has matured into a catalyst for sage-steppe conservation, providing win-win solutions for ranching, sage-grouse, and 350 other species. SGI has expanded exponentially the diversity of partners participating in voluntary conservation by focusing on the shared vision of achieving wildlife conservation through sustainable ranching. To date, 1,129 ranches participate in SGI, conserving 4.4 million acres (1.8 million hectares) across 11 western states—an area equivalent to two Yellowstone National Parks. To accelerate conservation, NRCS has invested $296.5 million, and partners and landowners have provided an additional $128 million, bringing total SGI investment to $424.5 million (NRCS 2015).

NRCS Targets SGI Conservation Inside of PACs

SGI matches its practices to reduce nonregulatory threats identified in the COT report and clusters implementation to achieve landscape benefits (Figure 1; Table 1). NRCS has applied 451,884 acres (182,871 hectares) of conservation easements to reduce the risk of urbanization or agricultural conversion; implemented 2,437,645 acres (986,480 ha) in grazing systems to enhance rangeland health; removed invasive conifer from 405,241 acres (163,995 ha) to restore otherwise suitable habitat; and marked or removed 350 miles (563 kilometers) of high-risk fence to reduce collisions. NRCS and partners have targeted approximately 75 percent of all SGI acres inside PACs (Table 1). The remaining 25 percent are in surrounding occupied habitat, expanding habitat opportunities and increasing connectivity.

NRCS Tallies 18-Fold Increase in Conservation Easements

Conservation easement acreage has increased 1,809 percent during SGI to combat subdivision and agricultural conversion threats. Now totaling 451,884 acres (182,871 hectares), easements are more than four times larger inside than outside of occupied habitats (934 acres [378 hectares] inside versus 205 acres [83 hectares] outside), and nearly all (94 percent) provide permanent protection. Resulting easements on vast tracts of working lands anchor sage-grouse conservation in perpetuity. SGI strategically locates easements inside PACs (79 percent) and clusters acquisition to achieve landscape benefits (Figure 1; Table 1). For example, oil and gas policy and conservation easements in Wyoming reduced by two-thirds the sage-grouse losses that would have occurred, and these protective measures also conserve 75 percent of habitats for migratory mule deer (Copeland et al. 2013; Copeland et al. 2014).

NRCS Reduces Conifer Invasion Threat

Conifer removal has emerged as a primary SGI conservation practice for maintaining extant sage-grouse populations through rapid restoration of degraded sage-steppe. Conifer encroachment today is largely an infill issue as most sites vulnerable to invasion became occupied by trees in the late 1800s and early 1900s (Miller et al. 2005, 2008). Roughly 80 percent of sagebrush sites invaded by conifers are still in the early phases of woodland succession, where native shrubs and bunchgrasses are common, making timely SGI's effort to scale up removal of early successional conifers (Miller et al. 2008).

SGI has greatly accelerated conifer removal, primarily through mechanical means, reclaiming 405,241 acres (163,995 hectares) of otherwise suitable habitat (Table 1). Overall, 81 percent of cuts are located inside PACs and within populations where conifer is a widespread threat. SGI-sponsored science documents the reduced capacity of a landscape to support sage-grouse when conifer canopy exceeds 4 percent (Baruch-Mordo et al. 2013). By focusing treatments on early successional sites, SGI helps prevent lek abandonment and conversion of sagebrush-steppe to conifer woodlands. A halving of fuel loads is an added benefit of tree removal that can increase the sagebrush ecosystem's resistance to catastrophic wildfire (Chambers 2008; Chambers et al. 2014). Private producers embrace conifer removal because maintaining, rather than shading out, deep-rooted perennials conserves rangeland health, increasing available forage by up to 60 percent (McLain 2012).

Conifer Removal in Oregon

Oregon NRCS is a pioneer in conifer threat reduction, and its leadership in SGI has resulted in roughly half of SGI's applied acreage (199,203 acres [80,615 hectares]). Conifer removal during SGI in Oregon increased 1,411 percent since 2010. New high-resolution tree cover mapping enables us to quantify threat reduction inside Oregon PACs by estimating extent of conifer threat (Nielsen and Noone 2014). In all four Oregon populations, SGI has helped ranchers reduce the threat of early succession conifer on private lands. In total, SGI has reduced conifer invasion by two-thirds and threat alleviation is nearly complete on private lands in central Oregon's population (Table 2). Alleviating this threat is well within reach and conifer mapping to further target future cuts across 102.5 million acres (41.5 million hectares) will be available September 2015.

NRCS Improves Rangeland Health and Resilience

Private working lands are the glue that maintains sage-grouse habitats across the West, and sustainable ranching is preferred over the fragmenting effects of agricultural conversion and subdivision. SGI enhances rangeland health with rotational grazing systems, sagebrush and perennial grass plantings, and control of invasive weeds. Prescribed grazing maintains key plant species such as deep-rooted perennial grasses that provide continued ecological function of sagebrush-steppe (NRCS Conservation Practice Standard 528). Ecological site descriptions and comprehensive rangeland inventories, coupled with prescribed grazing standards, provide the biological basis for sustainable grazing plans.

In central Idaho and eastern Montana, grazing systems help maintain existing habitats that support large and intact populations. In the western Dakotas, partners are restoring fringe habitats through native seeding, prescribed grazing, and weed management. In Washington state, the Columbia DPS reversed its decline following maturation of 1.5 million acres (0.6 million hectares) of Conservation Reserve Program (CRP) lands, planted through USDA's Farm Service Agency, to restore cropland to perennial grasses and sagebrush (Schroeder and Vander Haegan 2011). Today, SGI is helping maintain these habitats by turning expiring CRP lands into working lands where sustainable grazing is the predominant land use.

NRCS Reduces Impacts from Range Management Infrastructure

Despite habitat benefits of sustainable ranching, poorly designed or improperly placed range management infrastructure (i.e., fencing, water tanks, seeps at spring developments, corrals) may threaten grouse with increased mortality risk. Since 2010, NRCS has been placing new infrastructure to reduce impacts and now retrofits existing structures. For example, SGI has catalyzed fence-marking by first quantifying its benefit and then targeting its application. Fence-marking reduces grouse collisions by 83 percent without eliminating those that facilitate sustainable grazing (Stevens et al. 2013). Most collisions (93 percent) occur within one mile of breeding grounds in flat to rolling terrain. Utilizing this knowledge, SGI developed a mapping tool to prioritize where grouse are most at risk of collision across 10 of 11 states. Only 6 to 14 percent of sage-grouse range poses a high risk for collisions necessitating markers or other modification if fences are present (Stevens et al. 2013). This tool helps managers avoid building new fences in problematic high-risk areas and focuses limited resources where collisions are most efficiently reduced. Fence-marking is now a widespread practice applied by landowners and volunteers. Reduced risk resulting from fence-marking to date may be preventing 2,600 fence collisions annually, which is more than twice the number of males counted annually on leks in Washington, North and South Dakota, and Canada combined (NRCS 2015).

SGI Capacity Doubles Implementation

Human capacity needed to initiate conservation and then sustain its implementation is a vital yet often overlooked component of successful partnerships (Beever et al. 2014). Anticipating this need, NRCS launched the Strategic Watershed Action Team (SWAT) in 2011, as its primary vehicle for increasing capacity. Instead of going at it alone, NRCS asked that SWAT be managed by the Intermountain West Joint Venture (IWJV), an established and respected public-private partnership governed by a western-based management board. This model teams 40-plus paying partners with NRCS and places 27 (nonfederal) partner conservationists in NRCS field offices to provide technical assistance to private landowners and facilitate conservation projects. SWAT has matured over the years and is now regarded by partners as an effective mechanism for enhancing field capacity, funding outcome-based science, and sharing the SGI story. The primary SWAT outcome is 11,149 field visits with landowners that ultimately resulted in a doubling of SGI conservation (4.4 million acres [1.8 million hectares]). SGI continues to grow, and in January 2015, ConocoPhillips provided the IWJV a $1 million contribution that is being used to extend the partnership through 2018.

NRCS Extends SGI Through 2018

In unprecedented fashion, NRCS has committed an additional $200 million to extend SGI through 2018, the life of the current Farm Bill. This additional commitment, combined with partner contributions, will bring the total SGI investment to an estimated $750 million. Already underway in 2015, additional resources are enabling SGI to nearly redouble past achievements, resulting in an estimated 8 million acres (3.2 million hectares) conserved by 2018 (NRCS 2015). It is an exciting time

for sage grouse conservation and NRCS is proud to make certain the additional conservation provided through the life of this Farm Bill.

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Figure 1. Circles represent Sage Grouse Initiative contract locations for restoration and enhancement projects (closed) and conservation easements (open; as modified from Natural Resources Conservation Service 2015). Shading demarks occupied sage-grouse range (light) and Priority Areas for Conservation (dark; as modified from U.S. Fish & Wildlife Service 2013).

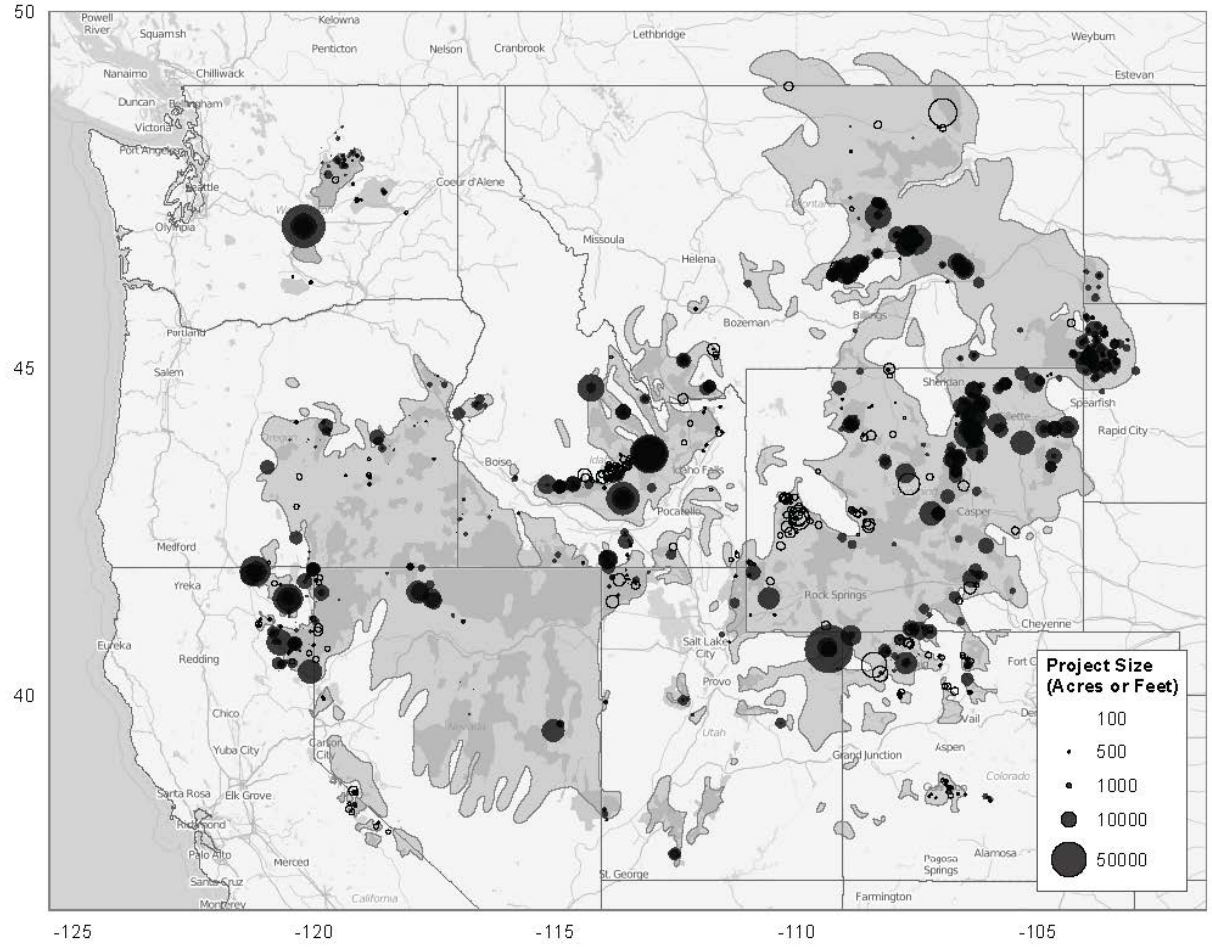

Table 1. Sage Grouse Initiative acreage by state and conservation action and percent of total acres within Priority Areas for Conservation (fiscal years 2010–2014).

State	Grazing Systems		Easements		Conifer Removal		Seeding		Fences Marked or Removed	
	acres	percent	acres	percent	acres	percent	acres	percent	acres	percent
California	64,204	56	15,187	71	63,299	65	987	96	65	72
Colorado	79,077	56	68,988	86	1,185	19	3,483	72	11	85
Idaho	249,653	87	69,609	94	47,830	77	5,235	43	79	94
Montana	409,594	85	70,111	75	168	0	5,442	14	104	96
Nevada	26,173	90	18,272	100	22,266	75	1,855	62	21	66
North Dakota	20,173	100					2,475	88	< 1	100
Oregon	26,571	100	6,701	1	199,203	81	296	93	11	82
South Dakota	312,295	85							5	83
Utah	173,733	95	17,229	100	70,011	99	27,666	96	11	100
Washington	83,073	86	4,369	100			677	41	29	10
Wyoming	993,100	63	181,418	71	1,280	80	4	100	14	36
Total	2,437,645	75	451,884	79	405,241	81	48,120	76	350	79

Table 2. Proportion of conifer threat reduced inside of Priority Areas for Conservation for four sage-grouse populations in southeast Oregon.

Population	Acres Early Successional Conifer	Acres Cut Inside PACs	Percent Threat Reduced in PACs
Central Oregon	80,387	67,955	85
Northern Great Basin	97,367	65,052	67
Western Great Basin	39,085	20,412	52
Baker, Oregon	19,005	7,864	41
Total	235,845	161,283	68

Focusing on Effectiveness: Credit Systems as an Approach to Driving Conservation Outcomes

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Introduction

Environmental Incentives, in partnership with Environmental Defense Fund and state, agriculture, and industry stakeholders, are working to improve the way conservation is achieved through the development of Conservation Credit Systems and Habitat Exchanges (collectively called "credit exchanges" in this paper). Credit exchanges are proactive, collaborative, and rigorous conservation and mitigation programs that create incentives for durable conservation. Credit exchanges are being implemented for greater sage-grouse in Nevada, Colorado and Wyoming to ensure that state or third-party administered programs protect the greater sage-grouse in advance of the upcoming listing decision. Credit exchanges for other species, ecosystems and water quality are also in development in California and other western states.

Linking Project Success to Meaningful Regional Goals

Credit exchanges link on-the-ground project success to the overall stabilization and recovery of species throughout a region. Credit exchanges leverage regional conservation plans that define species and ecosystem goals, and identify critical habitat areas for protection. Theories of change are developed to understand how conservation interventions influence the specific threats to species and ecosystems of concern. While many indicators and environmental attributes are measured at multiple scales to determine project success, the results are typically combined into an index that determines overall habitat quality, and allows the credit exchange to track and report results in consistent terms of functional acres or credits. The single functional acre metric and its use on all projects acts as a decision-support tool for project selection and design.

Credit exchanges are operated by an administrator responsible for reviewing projects, approving project plans and credit releases, and coordinating adaptive management of the program, including collecting input from expert scientists and program participants. Once the program has accumulated information about functional acre changes from individual projects, species response at the local and regional scales can be analyzed to test the hypotheses in the theory of change and evaluate if the definition of habitat quality can be improved. Using the single functional acre metric as a decision support tool focuses attention in a manner that ensures improved science changes management decisions.

Elements of Credit Exchanges

The elements of a credit exchange described below include 1) a habitat quantification tool, 2) a set of policies to ensure durability, additionality and net benefit, and 3) standard protocols for projects and program management.

Habitat Quantification Tool Differentiates Between High and Low Quality Habitat Function

A habitat quantification tool is essentially a habitat suitability index with clear guidelines for data collection and analysis, and a defined interface that enables users to document inputs and calculate habitat function. Habitat quantification tools include both landscape and site-level quality attributes in the definition of function.

The area of analysis for a project depends on the sensitivity of the species to effects from disturbances. Greater sage grouse are sensitive to the effects of anthropogenic disturbances at distances of several miles. Figure 1 and Table 1 show how the same footprint of impact - in this case, a 775 acre

impact from a hypothetical mine - can result in significantly different losses of habitat function. By locating the impact in an area with low habitat quality the loss is 1,110 functional acres, including partial loss of function to the 35,000 acres surrounding the site that are not directly part of the project footprint, but are within the affected area of the mine. Locating the mine within high quality habitat increases the impact by some 14 times.

The consistent definition of habitat function enables different types of projects to be compared for their relative contribution to supporting species needs. Yet, regional variation requires that habitat quantification tools are unique to each specific ecoregion. By creating an index, tailored definitions of habitat function can be summarized into a percent function that is comparable across projects and regions, considering local needs and priorities for the species.

Policies Practically Ensure Durability, Additionality and Net Benefit

Policies documented in a manual define how the information provided by a habitat quantification tool are interpreted and used to create incentives for restoration, enhancement and maintenance of habitat that is consistent with ecosystem and community needs. Certain policies, such as the definition of preferred conservation areas and project eligibility requirements, are applicable to publicly-funded conservation programs. Additional policies must be defined when credit exchanges are used to govern specific requirements related to compensatory mitigation.

When developing a credit exchange designers must consider both practicality and the expected behavioral ramifications of different policies. For example, the definition of baseline is critical to ensure that the credit exchange creates additionality, or benefits beyond those that would be achieved if the actions had not taken place. Baseline establishes the amount of functional acres, above which, projects are awarded credit. Many stakeholders assume baseline should be set at pre-project conditions, or the level of function that exists before new conservation actions that increase the habitat function are implemented. This pre-project definition of baseline creates strong incentives for habitat restoration. However, it does not provide incentives for landowners and managers who have traditionally maintained high quality habitat out of a strong land ethic. If these landowners have the right to degrade habitat or if active management is required to maintain habitat quality, then the pre-project definition of baseline for conservation sites provides no incentive for landowners and sends the signal that maintaining high quality habitat may not be in landowner's best interest. Alternatively, setting baseline at zero may result in landowners receiving credit and potential payment for maintaining habitat that is simply status quo for landowners in the region, which does not meet the definition of additionality.

The Nevada Conservation Credit System established baseline consistent with the median habitat quality within a region (Nevada Natural Heritage Program and the Sagebrush Ecosystem Technical Team, 2014). This reinforces the social norm that some level of habitat function is expected from working lands, yet honors the benefits derived from landowners who create and maintain high quality habitat that is better than that required or expected within the region. This definition of baseline provides incentives for landowners to enhance and actively maintain high quality habitat even when it requires costly tradeoffs or measures to reduce the risk of uncharacteristic wildfires.

Credit exchanges governing mitigation typically include mitigation ratios and credit reserve accounts that result in net conservation benefits above the impacts being offset. Mitigation ratios ensure that more habitat value is enhanced and maintained above baseline than is degraded. Reserve accounts create an insurance pool of upfront mitigation credits that cover any losses of habitat function from conservation sites (often called *reversals*). The reserve account is generated and maintained by dedicating a portion of the credit generated from each conservation site into the reserve account, which is then managed by the exchange administrator. Contract terms may include financial penalties for intentional reversals to prevent or quickly remediate any losses of habitat.

Operating Protocols Enable Consistent, Efficient Operations and Adaptive Management

Credit exchanges define clear protocols for project review and program operations. These protocols and supporting tools ensure the program operates efficiently, following quality assurance

practices, and provides transparency to stakeholders. The operational protocols developed by Environmental Incentives and the Willamette Partnership are highly consistent for credit exchanges across more than 10 regions.

Project enrollment protocols clearly define expectations for documentation and timely project review. Verification protocols define the need for self-reporting and third-party review of project quality to ensure reported habitat quality is accurate and consistently maintained. Credit transfer protocols ensure that any one credit is owned by only one party.

Credit exchanges maintain project registries and report the number of functional acres enrolled in the program annually. Clear reporting enables stakeholders to understand the benefits generated from publicly-funded programs and ensure that offsets are resulting in net benefit.

Credit exchange protocols clearly define program governance procedures, including requirements for information sharing and the relationship between the exchange administrator and all relevant authorities and stakeholders. Formally defining the communication structure between the administrator and interested stakeholders ensures that stakeholders have access to the rationale supporting programmatic adaptive management decisions.

Using Performance-Driven Credit Exchanges

Credit exchanges establish a performance framework that can be used to engage communities, target conservation investments and enable performance contracts. These uses of credit exchanges can increase the participation and effectiveness of conservation programs. Credit exchanges can also provide the framework for rigorous compensatory mitigation.

Reporting Accomplishments for Community Engagement

Communities of stakeholders may have common concerns for wildlife and other ecosystem services, but different assumptions about how land management practices effect ecosystem. By linking regional goals to on-the-ground conditions and reporting results with a single unit of performance, such as functional acres, credit exchanges enable communication and understanding between stakeholders and neighbors.

Credit exchanges can take advantage of the growth of analytical systems that use increasingly available remote sensing data to report regional results from different land management activities. Reporting habitat quality based on an agreed-upon definitions of successful habitat outcomes, can create a common factual basis for discussions between ranchers and environmental advocates who frequently disagree on the influence of ranching related to maintaining healthy sage brush ecosystems. By tracking the functional acres lost due to wildfires, anthropogenic disturbances and other significant impacts, the credit exchanges provides a valuable tool to understand the drivers influencing population changes. Reporting of results can allow community members to check progress toward meeting regional goals in a manner similar to checking the score of the local baseball team.

Targeting Conservation Investments

Credit exchanges provide the decision support framework to understand potential outcomes from funding conservation projects. Regional targeting, project selection and project design alternatives can be evaluated using the habitat quantification tool. Program managers can estimate and report on the functional acres enhanced and protected by state and federal conservation actions.

Performance Contracting

The traditional project funding model allocated funds to projects based on planned actions and assumed outcomes. As shown in Figure 2, the funding is provided before the project is implemented, leaving the risk of project failure or cost overruns solely on the funder.

Performance contracts, such as pay-for-success models are characterized by paying for performance-based results after an intervention has been executed, rather than paying for an intervention

upfront. Pay for success models typically involve contractual arrangements where the funder pays an agreed upon amount if performance targets are met, as specified in the investment contract (Nicola, 2013). As shown in Figure 3, pay-for-success models applied to the environmental sector enable public funders and private investors to purchase verified conservation outcomes. This model creates an opportunity for private impact investors to fund project implementation with the ability to realize a return on capital for producing conservation outcomes. It also allows risk to be shared among those best positioned to manage the risk: the project implementer and their investors.

Mitigation

Credit exchanges establish the necessary underpinnings for rigorous mitigation programs that ensure offsets of residual impacts from development projects after avoidance and minimization policies are followed according to the mitigation hierarchy. Policies define how habitat performance relates to the calculation of debits, resulting from the loss of habitat value from anthropogenic impacts, and credits, resulting from the enhancement and protection of high quality habitat. Credit exchanges verify habitat performance on credit sites and ensure appropriate site-specific and programmatic assurances are secured. Assurances include a reserve account of available credits, and the contractual requirements with associated financing to replace habitat lost from intentional reversals. Credit exchanges also produce annual reports of net change from anthropogenic disturbances and conservation actions, providing the necessary information for regulators to ensure accountability and assess how well the program is resulting in net conservation gains for the species of concern.

Benefits of Performance-Driven Approaches

Engaging Working Lands to Provide Solutions

Credit exchanges can define the value of habitat provided by working lands. This value may not be as high as it would be in a reserve that is dedicated and managed solely for the conservation of a species, but with a vast majority of the land area in the United States used for working lands, leveraging and protecting the habitat value provided by working lands is essential for species survival and landscape-scale ecosystem function. Further, integrating the maintenance costs of enhancing and protecting habitat into current working lands operations can significantly reduce costs when compared to sending crews to a site for the single purpose of maintaining habitat performance.

Most importantly, credit exchanges have the potential to change the relationship between the landowners and the Endangered Species Act. Listing a species as threatened or endangered has been seen as a threat to landowner's way of life, restricting economic activity. Credit exchanges enable habitat to become part of the working lands business model by being compensated for enhancing and maintaining high quality habitat on both private and public lands.

Increasing Environmental Return on Investment

By defining meaningful units of environmental outcomes that can be used for project selection, management and ongoing tracking, credit exchanges maximize the environmental return on investments to deliver the most value for available funding. Most public funding programs struggle with limited resources and the true cost of achieving and maintaining meaningful environmental outcomes is often not included in the budgets for environmental programs. Yet, without a clear definition of quality, the focus is instead on implementing specific activities and spending money on schedule.

Environmental effectiveness can vary greatly from project to project depending on a number of success factors, such as timing, scale and geographic location. Fuller et al. (2010), demonstrates why understanding environmental return on investment can significantly increase program success. By estimating the benefits and costs of approximately 7,000 potential environmental projects under a particular environmental program, the highest performing 5% of projects is 330 times greater than the median performing projects. Therefore, failure to select the highest performing projects under this program represents a significant opportunity cost for program managers (Pannel 2013).

The consistent, outcome-based metric provided by credit exchanges enables program managers to solicit projects based on clear performance criteria and private actors to submit competitive proposals for the most cost-effective conservation opportunities.

Ensuring Long-term Durability

Credit exchanges ensure the long-term durability of habitat value that species need to survive. Land protection instruments, such as easements on private land and rights of way on public lands, are required to ensure that a project will continue to provide credits for the entire term of its contract. Contract requirements and increased reserve account contributions are required for sites with less secure land protection or risks resulting from split estates (surface rights and subsurface rights, such as the rights to develop minerals, for a parcel of land are owned by different parties). Project stewardship funds ensure that resources are available to perform maintenance and monitoring for the full life of the project. Programmatic reserve accounts of credits ensure a sufficient amount of credits are available to replace credits that are solid to offset debits and later invalidated through unintentional reversals, such as force majeure events. The reserve account also can cover the loss of credits from intentional reversals until the time that financial contract penalties are secured and the credits are replaced through a new conservation site.

Engaging Private Capital

Private investors are increasingly interested in conservation impact investments, with a projected $5.6 billion in capital expected globally between 2014 and 2018 for investments that generate conservation outcomes (NatureVest 2014). The participation of these return-oriented investors brings an opportunity to substantially increase the environmental return on investment from conservation spending, as private impact investors select projects that optimize conservation outcomes at the lowest cost, and actively manage project execution risk. However, the conservation impact investment market is constrained by the lack of willing buyers for conservation outcomes. By creating a standard unit of performance, credit exchanges can underpin performance contracts, as described in the section above, enabling government, philanthropic and mitigation buyers to purchase outcomes generated by impact investor-sponsored projects.

Providing Regulatory Certainty

Credit exchanges are designed to qualify as pre-listing mitigation. Agreements with regulators can ensure that the credits generated pre-listing can be used to offset impacts if the species is later listed as threatened or endangered under the Endangered Species Act. This provides regulatory certainty to both buyers and credit developers that mitigation actions taken before the listing decision will count in a post-listing environment. The credit exchanges developed for greater sage grouse in Nevada, Colorado and Wyoming meet all criteria outlined in the Greater Sage-Grouse Range-Wide Mitigation Framework (US Fish and Wildlife Service 2014) with the intent of gaining agreement for use of credits if the greater sage grouse is listed.

Neither conservation banks nor credit exchanges authorize, in and of themselves, incidental take of listed species. However, credit exchanges are designed to be integrated with other regulatory mechanisms that provide additional regulatory assurances for incidental take protection for credit developers and buyers. Additional regulatory mechanisms include Candidate Conservation Agreements (CCAs) or Candidate Conservation Agreements with Assurances (CCAAs) before a species is listed, or a Safe Harbor Agreement or incidental take permit, such as those issued under an approved Habitat Conservation Plan (HCP), once a species is listed. HCPs developed after the adoption of a credit exchange should be able to reduce the cost and time for development by using the credit exchange as the mechanism for evaluating impacts, conservation improvements and ensuring net benefit is achieved in advance of impacts.

Conclusion

Credit exchanges provide the framework to improve project selection, reduce the execution risk of project implementation to government and private conservation buyers, and ensure ongoing durability of habitat function. The cost of developing credit exchanges is rapidly decreasing as program design experts leverage existing templates that can be tailored to the unique physical, political and legal needs for new species and regions. Any region that expects to spend or receive public or private funds in excess of $3,000,000 over three or more years should consider developing a credit exchange, or similar performance-driven program, to ensure those investments produce efficient and durable results that meet species conservation needs.

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Figure 1. Hypothetical mine and road impacting 775 acres of surface area place in high-, medium-, and low-quality habitat area. Also shown, the area of habitat enhanced and conserved to offset the impacts depending on the location of the impact. Conserved areas are of equivalently high-quality habitat.

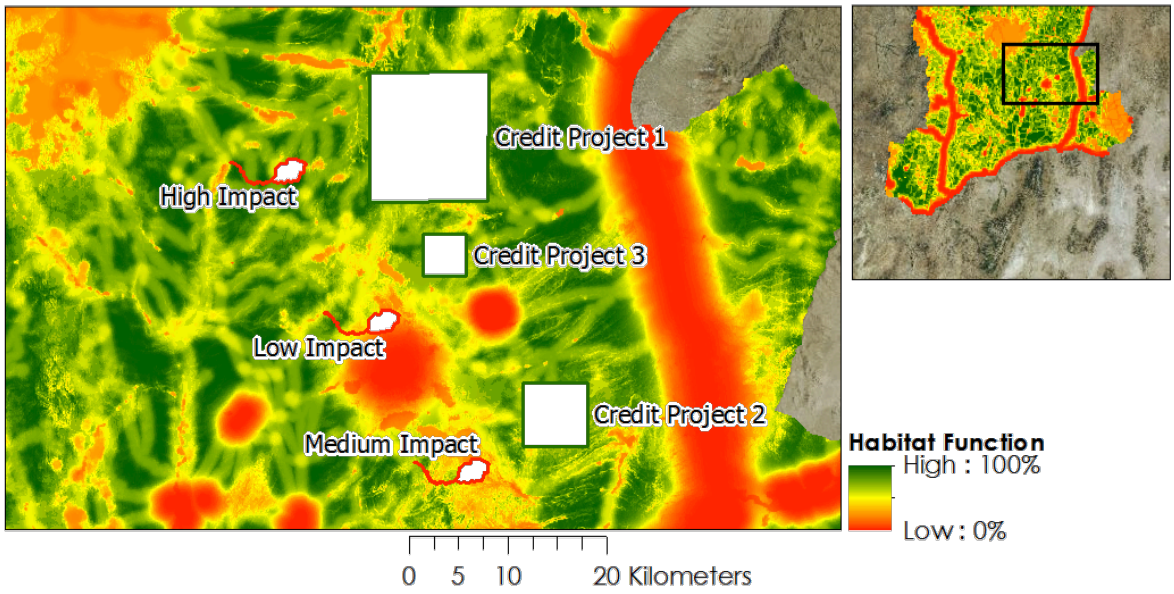

Figure 2. Traditional project-funding model with government funds committed to a project based on a limited understanding of the project design, site constraints, and the outcomes that the project will ultimately produce. In this investment model, the funder is left with the risk of the project underperforming and cost overruns. Further, there are limited requirements to ensure ongoing maintenance beyond the period of initial implementation, which is typically three to five years.

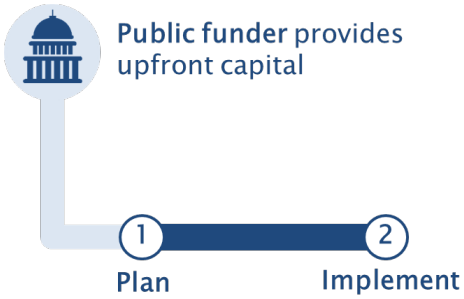

Figure 3. Performance-based funding model shifts the commitment of government funds to the point at which verified performance is reported to the funder. This provides the opportunity for private investors to provide upfront capital to plan, implement, and maintain the project over time. The private investor takes on the execution risk for the project and thus has a strong incentive to deliver the desired conservation outcomes.

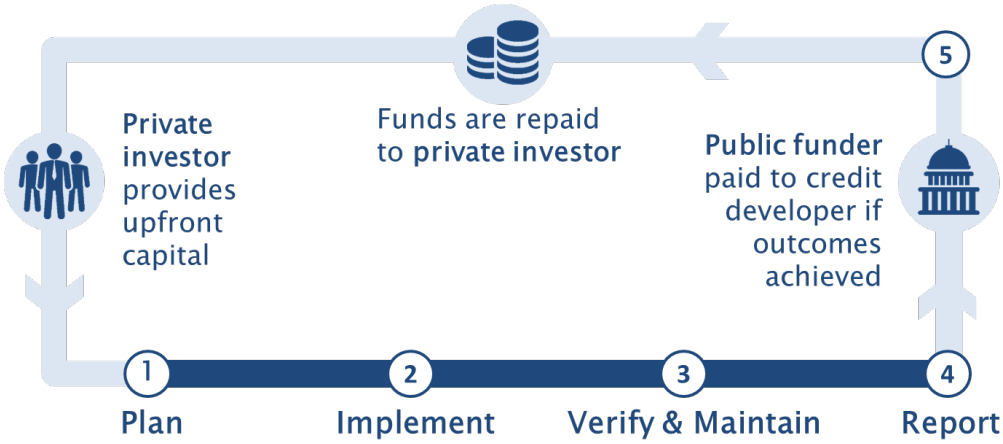

Table 1. Summary table showing the numeric results associated with the hypothetical impact from developing a mine and road impacting 775 acres of surface area in the different locations shown in Figure 1. The acres of conserved land necessary to offset the impacts are determined using the rules in the Nevada Conservation Credit System.

Debit Scenarios	Debits	Credit Project	Acres Conserved
High Impact	15,312	Project 1	25,506
Medium Impact	3,730	Project 2	6,214
Low Impact	1,110	Project 3	1,850

The Lesser Prairie-Chicken Range-Wide Conservation Plan: A New Paradigm in Wildlife Management

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Background

Since the 19th century, lesser prairie-chickens (*Tympanuchus pallidicinctus*; hereafter LPC) and their associated habitats have diminished across their historical range, which included parts of Texas, Oklahoma, Colorado, Kansas, and New Mexico (Crawford and Bolen 1976, Taylor and Guthery 1980a). Recent estimates of currently occupied range total approximately 80,000 square kilometers (30,900 square miles), or about 17 percent of the estimated area of their historical range (Figure 1), although boundaries of this estimated range include many areas that are unlikely to be occupied, including riparian corridors, forests, and desert. This reduction in occupied range is attributed primarily to habitat loss and fragmentation (U.S. Fish & Wildlife Service 2012). Habitat losses have been caused by conversion of native prairie to cropland in the western portion of the range and long-term fire suppression leading to tree invasion in the eastern portion of the range (Bent 1932; Copelin 1963; Jackson and DeArment 1963; Crawford and Bolen 1976; Taylor and Guthery 1980b; Woodward et al. 2001; Fuhlendorf et al. 2002). Degradation of remaining habitat is due to fire suppression, grazing management practices, and herbicide spraying for shrub control, all of which can reduce the quality of LPC habitat (Woodward et al. 2001, Jones 2009; Jackson and DeArment 1963; Taylor and Guthery 1980a; Riley et al. 1992; Jackson and DeArment 1963; Peterson and Boyd 1998; Thacker et al. 2012). In addition to habitat loss and degradation factors, existing habitat has been fragmented by oil and gas development and possibly by effects of wind-energy development (Hunt 2004; Pruett et al. 2009). In addition, LPC populations have been influenced by fences and utility lines, prolonged drought, and climate change (Wolfe et al. 2007, Hagen 2010; Merchant 1982; Lyons et al. 2011; Grisham 2012; U.S. Department of Agriculture Natural Resources Conservation Service 2012; U.S. Fish & Wildlife Service 2012).

In April 2012, the five state wildlife agencies found within LPC range met with the U.S. Fish & Wildlife Service (USFWS) to discuss the feasibility of developing a comprehensive conservation plan with enough effort for implementation to influence a not-warranted listing decision under the Endangered Species Act of 1973 (ESA). After this meeting, the states tasked the LPC Interstate Working Group (IWG) to draft a scientifically-based conservation plan, initially without state boundaries, that would meet the USFWS's Policy for Evaluation of Conservation Efforts.

An initial stakeholder-scoping meeting on the revision of the Crucial Habitat Assessment Tool (CHAT) and the development of the range-wide conservation plan (RWP) was held in in Edmond, Oklahoma, on June 11, 2012. More than 90 stakeholders representing oil and gas, wind energy, transmission, agriculture associations, Farm Bureau representatives, departments of transportation, public utilities and public utilities commissions, oil and gas permitting agencies, agricultural and natural resource agencies, conservation bankers, and conservation organizations attended from across the five-state region. A first draft of the RWP titled "Range-Wide Conservation Plan for the Lesser Prairie-Chicken" was provided for public review and comment in January 2013. Input was received at a public meeting held in Edmond, Oklahoma, on January 23 and 24, 2013, and also was received through both email and written inputs. A second draft of the RWP was provided for public comment in February with a third draft provided to the USFWS and placed on the Western Association of Fish and Wildlife Agencies' (WAFWA) website for public review and comment on April 1, 2013. The IWG solicited comments on the third draft of the RWP until May 15, 2013, and the USFWS closed their comments on June 21. Comments were reviewed by the IWG and the current RWP titled "The Lesser Prairie-Chicken Range-Wide Conservation Plan" was drafted in October 2013. Finalization and endorsement of the RWP from the USFWS was completed in late 2013.

A critical component of the RWP development was coordination among the various agencies, organizations, industries, landowners, and other stakeholders interested in LPC and its conservation strategy. Coordination was needed at multiple levels, including interagency coordination for federal agencies, interagency coordination within and among states, interagency coordination between states and federal agencies, coordination with regional organizations and industries, intrastate agency and organization coordination, and general outreach and engagement of landowners and the public. Sequencing of planning components involved establishment of various committees to accomplish specific tasks and then engaging broader involvement as various components of the RWP were available for review and comment.

A significant focus of the RWP is the improvement of habitat for LPC on private lands as well as integration of the limited amounts of public land that can contribute to LPC habitat needs. A variety of conservation initiatives focused on improving LPC habitats have been initiated by numerous agencies and organizations. Most of these initiatives are administered at state levels, either through staffing of federal programs at state levels, state agency programs, or organizations that either operate within a state or align with state-level initiatives. For this reason, coordination of LPC programs was woven into the RWP enhancing conservation efforts.

Biological Goals and Objectives

The USFWS defines biological goals as the broad, guiding principles that clarify the purpose and direction of the conservation components for conservation tools (65 CFR 35241). The biological goals and objectives are designed to address the potential impacts of the proposed activities while taking into account the overall conservation needs of the LPC and its habitat. In general, the biological goals will be accomplished by: (1) conserving LPC and their habitat in the service areas, and (2) mitigating the impacts of take contemplated by the RWP by conserving and managing certain known LPC habitat areas throughout the service areas. In addition to these general objectives, the RWP will include a conservation strategy that will strive for the implementation of activities, providing the blueprint toward a speedy recovery and delisting.

Conservation Strategy

The RWP describes a conservation strategy which, when implemented, will provide the population and habitat needed to sustain and expand and the LPC population. The strategy identifies a desired population goal deemed adequate to provide for a well-distributed LPC population dispersed throughout each of four ecoregions within a 10-year period. To meet the population goal, the RWP identifies habitat goals that provide for good representation of adequately-sized habitat patches to provide for resiliency in populations and with enough patches to provide for redundancy to support populations that persist in the long term. The RWP also identifies needed connectivity among habitat patches that will allow for genetic and demographic support among populations and will allow for potential movement of the species given uncertainties from climate change. The RWP provides for coordination and enhancement of programs to improve habitat on private lands through landowner incentive programs and promotes the avoidance and minimization of impacts to important habitat patches. Where avoidance and minimization is not possible, the RWP identifies processes to mitigate impacts from developments. Finally, the RWP requires monitoring and adaptive management actions.

A key component of the conservation strategy is applying the concept of focal (core) areas. This concept as applied to LPC is based on identifying the areas of greatest importance to the species and focusing habitat enhancement, maintenance, conservation, and protection in these areas. In addition, a subset of lands within focal areas will be identified as "strongholds." These are areas meeting the definition described by the USFWS (2012b) and are a much smaller component of focal areas but have the ability to provide permanent LPC conservation areas. This accomplishes two objectives:

1. It concentrates limited resources for species conservation in the most important areas, allowing for the restoration, enhancement, and maintenance of large blocks of habitat needed by LPC.
2. It identifies areas where development should be avoided, which also helps identify areas where development is of less concern for the LPC. This provides developers with the guidance they typically seek for their development planning purposes and helps avoid conflicts over impacts to the species.

The conservation strategy employs various tools to achieve its management objectives with an emphasis on focal areas and connectivity zones. With the exception of New Mexico, more than 95 percent of the current LPC range is on private lands. To be successful, the conservation strategy must emphasize delivery of habitat improvement in focal areas and connectivity zones by maximizing incentives that will encourage landowners to engage in LPC habitat improvements. This has to be either economically neutral or economically advantageous to the landowner. The strategy identified existing programs available to help provide these improvements and then worked with implementation teams and others to identify how to coordinate and maximize the delivery of these programs, particularly in focal areas. Another important component of the strategy is identifying approaches and tools to avoid, minimize, and compensate through off-site mitigation the potential threats to LPC. This is accomplished through a mitigation framework that offers assurances for continued development operations in the future following identified guidelines and standards. This mitigation framework includes a metric system to quantify impact units and mitigation units.

WAFWA Mitigation and Metrics System

The WAFWA Mitigation Framework incentivizes avoidance and minimization of impacts to LPC habitat from development. The metrics system within this framework provides a pathway to mitigate for impacts to habitat through a biologically-based system that incorporates space, time, and habitat quality to define both habitat impact units and habitat-offset units. A habitat impact is defined as: potential LPC habitat that has been rendered unusable by LPCs based on direct or indirect habitat loss related to development. A habitat offset is defined as: an area of potential LPC habitat that is conserved and managed or restored to compensate for impacted habitat. Impacts are considered permanent, unless remediation occurs back to baseline. The mitigation system also utilizes a 2-to-1 mitigation ratio to ensure that offsets are greater than impacts, resulting in a net conservation benefit for the LPC.

The WAFWA Mitigation Framework functions as a platform to balance impact and habitat-offset units in that a portion of the offset units are allocated at the sign-up based on current acreage and habitat quality. Additional offset units are generated annually and the quantity is reflective of potentially usable acreage and habitat quality. The landowner is incentivized to manage for quality habitat because their annual payment is based on the acreage and Habitat Evaluation Guide (HEG) score of the enrolled property. If the participant does not follow the recommended management plan for the property, the offset units will be reduced, as will the annual payment to the participant. This performance-based system ensures that participants are not paid in advance for un-generated offset units.

Offset units will be generated by enrolling a property into an agreement with WAFWA or one of its technical service providers. Participants may enroll in short-term (five- to 10-year) agreements or in long-term agreements requiring an easement. The value of 25 percent of the habitat-offset units will be targeted towards permanent conservation to support long-term or dynamic conservation and population strongholds. The remaining 75 percent of the conservation efforts will be targeted towards short-term or static contracts (five- to 10-years), which represent permanent conservation that may shift around on the landscape within the targeting goals of the RWP and the CHAT. Finally, the WAFWA mitigation system incentivizes the remediation of impacts that are not permanent on the landscape by providing the opportunity to generate offset units that can count toward new developments elsewhere. The 25-to-75 percent ratio of long- and short-term offset units will be evaluated through the adaptive management process and may need to be adjusted in the future.

RWP Conservation Program

The RWP establishes a mechanism to enroll private or state lands to produce conservation benefits to the LPC by implementing management practices that will improve habitat quality and quantity. Offset units will be generated by enrolling a property into an agreement with WAFWA or one of its technical service providers. A property must be at least 160 acres in one block to be eligible to produce offset unit. This eligibility requirement is to ensure that habitat is being managed at a sufficient size to provide a meaningful benefit to the species. Multiple landowners may cooperate to produce a management area meeting the size requirement. The property must be managed in compliance with a WAFWA-approved management plan to generate offset units. Each year a property is in an agreement, it will generate offset units based on the LPC habitat quality and the acreage un-impacted by development. This system is performance-based, which means higher-quality habitat generates more offset units per acre. This will result in higher payments for landowners who manage their property well. The maximum rate that offset units may be generated is 1.25 units per acre per year, where the HEG score is equal to one and the property falls within a focal area.

Adaptive Management

Adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resource management, using the experience of management and the results of research as an ongoing feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers often is unavailable. Adaptive management also includes, by definition, a commitment to change management practices when deemed appropriate within the guidelines of the RWP.

Adaptive management is a dynamic process that helps reduce uncertainty in natural resource management by incorporating into flexible conservation plans new information as it becomes available. Adaptive management strategies allow for mutually agreed upon changes to the conservation measures to occur in response to changing conditions or new information, including those identified during monitoring. The primary reason for using adaptive management in the RWP is to allow for changes in the conservation measures that may be necessary to reach the stated long-term goals. Under adaptive management, the mitigation and conservation activities implemented under the RWP will be monitored to identify whether or not they are producing the required results. Additionally, adaptive management activities affecting the implementation of the RWP will be influenced by emerging science that fills existing knowledge gaps. Those two types of information will be used to guide adjustments in implementation of the RWP.

While impact acreage is important, it is only part of the mitigation framework under the RWP. This framework utilizes habitat units, which include both acreage and a proportional habitat quality such that one acre of the highest quality habitat equals one unit. If the habitat quality on that acre falls to 0.5, then the acre accounts for half of a habitat unit. For impacts, the habitat quality is assessed prior to impacts, and a company can significantly reduce mitigation costs by avoiding high-quality habitat for development in favor of lower-quality habitat. Those impacts must be offset with iterative short-term conservation contracts or permanent easements at an average 2-to-1 mitigation ratio, and those offsets use the same system of habitat units based on acreage and habitat quality.

The first landowner application for a term contract was received by WAFWA on November 14, 2013. From that date until the end of this reporting period, a total of 48 applications were submitted. Through those applications, landowners offered 309,154 acres with the greatest amount coming from the mixed-grass service area. Prior to the end of the reporting period, 11 contracts had been offered to landowners across the LPC range. Those offered contracts contained 68,874 acres with the majority located in the mixed-grass service area.

Conclusion

Overall, the RWP allowed for economic development to continue in a seamless manner by providing an efficient mechanism to voluntarily conserve the LPC and/or comply with the ESA. Without the RWP, there could have been significant regulatory delays in obtaining take permits, disruption to economic activity in an area vital to state and national interests, and little incentive to conserve LPC habitat on private lands. The RWP encourages participants to enact proactive and voluntary conservation activities promoting LPC conservation. Implementation was tracked through a committee structure using adaptive management. Goals and objectives associated with population levels, habitat conservation objectives, and funding streams were conducted by the adaptive management process.

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I would like to thank the Lesser Prairie-Chicken Interstate Working Group for being committed to conserving the species under their charge by looking outside the box and developing a new paradigm for conserving wildlife by state wildlife agencies. I would also like to thank the directors from the five wildlife agencies for their leadership and stalwart support for drafting a scientifically-driven conservation plan. Finally, I would like to thank the U.S. Fish & Wildlife Service for its willingness to use the inherent flexibility built into the Endangered Species Act to conserve a species and for maintaining the role of the state wildlife agency in managing wildlife under its trust.

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Figure 1. Estimated historical range and current occupied range of lesser prairie-chickens.

5 Attributes of a Successful Partnership: Evaluating Conservation Efforts for the New England Cottontail

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The U.S. Fish & Wildlife Service (Service) is one of two federal agencies primarily responsible for implementing the federal Endangered Species Act (ESA), yet it lacks the financial and personnel resources to fully carry out that task on its own. The Service appreciates the special relationship it has with the states to conserve imperiled species and relies on the states and many other partners in implementing conservation actions that benefit federally-listed threatened and endangered species or those species that are candidates for listing. The New England cottontail rabbit (*Sylvilagus transitionalis*) (NEC or cottontail) is one of those candidate species. The Service's northeast region is part of a successful federal-state-private partnership working to conserve the NEC. The partnership's success can be characterized by five attributes: clear goals, willing partners, proactive planning, prior and ongoing commitment to implementation, and the use of a business model approach for achieving established goals.

Before elaborating on those five attributes, we provide a brief background on the cottontail's history with the ESA. In 2000, the Service received a petition from four conservation organizations to list the NEC (Biodiversity Legal Foundation *et al*. 2000). In 2004, we published a 90-day substantial finding indicating that listing the species may be warranted (Service 2004). The finding also requested additional information about the NEC and initiated an in-depth status review. At that time, some states within the NEC's range requested that the Service engage with them in conservation actions in lieu of listing. The status review progressed while the dialogue about conservation continued with all of the states within the species' current range (Connecticut, Maine, Massachusetts, New Hampshire, New York, and Rhode Island). The best available information in 2006 indicated that the NEC's range had contracted significantly and that much of its young forest habitat had been lost or fragmented, such that listing the cottontail under the ESA was warranted. However, the northeast region was precluded from listing the NEC due to the national workload required to list other more imperiled species. In 2006, the NEC was added to the candidate list, but our conversation with the states, and the cottontail's story didn't end there (Service 2006).

In 2008, the first formal meeting was held between the states, Service, and academic partners to work on conservation planning for the New England cottontail. Our formal efforts were further catalyzed by the 2009 Memorandum of Understanding (MOU) between the Service, Natural Resources Conservation Service (NRCS), and the Association of Fish & Wildlife Agencies that was drafted for the express purpose of working together to help preempt the need to list additional species (Lancaster et al. 2007). In addition to the MOU framework, funding from competitive state wildlife grants provided momentum to build the partnership by facilitating the states' participation in regional conservation planning meetings and in implementing high priority conservation projects.

In 2011, the partnership started to excel when the coordinating staff biologists working on designing the NEC conservation effort requested their managers' support and the managers responded. The six state wildlife agencies, the Service, and NRCS, with coordination support provided by the

Wildlife Management Institute (WMI), formed an executive committee with established by-laws to "promote recovery, restoration, and conservation of NEC so that listing is not necessary." The executive committee's first action was to form a technical committee composed of state and federal biologists and task the group to develop a conservation strategy (Weber in litt. 2011). In 2012, the "Conservation Strategy for the New England Cottontail" (Conservation Strategy) was completed (Fuller and Tur 2012).

At this point, the partnership had three of the five successful attributes—clear goals, willing partners, and proactive planning. In addition, the NEC Conservation Strategy planning was occurring parallel with national ESA listing and litigation actions. For example, a Multi District Litigation (MDL) settlement agreement between the Service and two environmental organizations established listing determination deadlines for all candidate species appearing on the 2010 candidate list. The MDL specified that the Service make a listing determination for NEC by September 2015. The listing determination process considers information about the species' population estimates and trends, threats to the species, as well as previous, current, and future conservation actions to address the species' threats. Ongoing conservation actions yet to show an effect and planned conservation actions yet to be implemented are evaluated according to the Service's 2003 Policy for the Evaluation of Conservation Efforts (PECE policy) (Service 2003). For the NEC, the review of the implementation and effectiveness of the conservation actions is guided by criteria in the PECE policy.

The NEC partnership used a business model approach, the fourth attribute of success, to target conservation delivery. A business model approach entails establishing goals and measureable objectives and using monitoring and adaptive management practices to target conservation delivery at rangewide and local scales to generate NEC population response in the most efficient manner. The Service counseled the technical committee to use the PECE policy criteria to structure the NEC planning effort and to develop the species' Conservation Strategy. The peer reviewed Conservation Strategy also identified goals and measurable objectives to explicitly address the NEC's threats. To ensure the strategy stays current, the executive and technical committees hold annual performance review meetings and use new information from ongoing monitoring efforts to inform any needed changes (e.g., adaptive management).

The preceding paragraph discusses how the Conservation Strategy is applied at the broadest scale, but there is additional information on how it is implemented on the ground. The Conservation Strategy is tailored to address the rangewide issues facing the NEC. However, conservation efforts are targeted to 41 separate focus areas, each possessing unique biological, sociological and landownership differences, opportunities, and challenges. Among the focus areas, the NEC's status varies from abundant to absent, as do the threats, conservation actions, land ownership patterns, and sociological circumstances. The priority for implementation also varies from focus area to focus area. To address these differences, the technical committee developed focus area-specific plans that serve to step-down the application of the Conservation Strategy and to generate the highest value propositions for conserving local NEC populations. The focus area variability is intentional and is accommodated by the strategy: the 41 focus areas represent built-in redundancy—there are more focus areas than what are needed from both an NEC conservation biology and an ESA perspective.

Along with the states, the Service, NRCS, and WMI, there are about 100 different organizations involved with implementing and funding the NEC conservation effort. The full partnership consists of five universities (University of Rhode Island, University of New Hampshire, State University of New York College of Environmental Science and Forestry, University of Connecticut, and Brown University), four tribes (Mashpee Wampanoag, Narragansetts, Wampanoag Tribe of Gay Head, and Mashantucket Pequot), two zoos (Roger Williams Zoo and Queens Zoo), the Department of Defense (Massachusetts Army National Guard), additional federal agencies (National Park Service, the U.S. Geological Survey, and the National Ocean and Atmospheric Administration), numerous land trusts, and multiple nongovernmental organizations (e.g., Audubon state chapters, The Nature Conservancy, Environmental Defense Fund, National Fish and Wildlife Foundation, and the Wildlife Conservation Society), as well as many private landowners. The Service greatly appreciates the special relationship it has with the states to conserve imperiled species and relies on the states and many other partners, like those mentioned above, in implementing conservation actions that benefit federally-listed and candidate species. The breadth of

skills and resources these organizations bring to the table strengthens the robust partnership. But in addition to these partners, the Service has also utilized the full suite of planning and implementation tools available within its own programs. For example, Service staff has assisted with funding, habitat management, surveys, captive breeding, land protection, grant management, policy application, and public relations.

The NEC has benefitted greatly from the past and current implementation efforts of this diverse, robust, and successful partnership. However, looking ahead to our obligation of making a listing determination for the NEC by September 30, 2015, the Service must evaluate the certainty of implementation and certainty of effectiveness of the conservation actions under the PECE policy, including the commitment to continue the conservation actions into the future. In October 2014, the Service convened a meeting with state, NRCS, and WMI partners to review conservation information that would facilitate the Service's evaluation of the conservation effort. The group assessed: the species' current and anticipated population levels for each focus area; threats and conservation actions planned within each focus area; and the performance levels achieved through implementation of the Conservation Strategy. The Service also documented the state and federal partners' commitment to continue conservation at both the focus area and rangewide scales.

Based on the information provided at the meeting, the Service is encouraged to see that the conservation effort appears to provide sufficient certainty that it will be both effective and implemented. However, whether the NEC warrants ESA listing or not, we know our partnership is a success and will continue to implement conservation for the NEC.

And the NEC is not the only beneficiary of this successful partnership because the conservation implemented for NEC will also benefit other species. The NEC is a surrogate species for shrubland habitats. By conserving it, many other animals are conserved, such as the woodcock, ruffed grouse, eastern towhee, prairie warblers, and other various species, many of which the states have identified as Species of Greatest Conservation Needs in their State Wildlife Action Plans. The conservation partnership is also successful because of its ability to market NEC conservation tools to other landowners and groups as a mechanism to benefit other species that they care about. The ability to affect conservation for a whole suite of species is an efficient and effective way to successfully meet our goal of working together to conserve the NEC.

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Special Session Four.
The Evolution of Cooperative Fish and Wildlife Research

Opening Comments

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The Cooperative Fish and Wildlife Research Units (Co-op Units) emerged 80 years ago as one of the pivotal forces that catapulted fish and wildlife conservation into the domain of a professional, scientific institution. Along with the Duck Stamp Act (1935), the Pittman-Robertson Wildlife Restoration Act (1937), and the establishment of The Wildlife Society (1937), Ducks Unlimited (1937), and other private enterprises, the Co-op Units helped define the 1930s as a turning point for conservation. The Co-op Units were created by "Ding" Darling to meet the needs articulated by Aldo Leopold and other leading conservationists for a research program to find solutions to the problems affecting wildlife and to provide a cadre of trained professionals to conduct the work of restoring wildlife and habitats (Leopold 1930).

The Co-op Units originally were part of the Bureau of Biological Survey in the Department of Agriculture, and in 1940 became part of the newly created Fish and Wildlife Service in the Department of the Interior (DOI). During the 1990s the Co-op Units became part of another newly created DOI agency, the National Biological Survey, and ultimately came to reside within the U.S. Geological Survey, along with all DOI biological science functions. During the course of this journey, Cooperative Fishery Research Units were established and the mission of the Co-op Units was broadened to include training and technical assistance to cooperating agency biologists in interpretation and application of new and emerging science (1960; Goforth 2006). Today, the majority of the 40 Co-op Units are combined Cooperative Fish and Wildlife Research Units.

This session is not a retrospective celebration of 80 years of accomplishments. Rather, it explores the Co-op Unit model in terms of its functionality and role in meeting current and future challenges in fish, wildlife, and natural resources conservation. The challenges of the 1930s were daunting, as our nation was in the midst of its worst economic depression and the Dust Bowl ravaged the heartland (Egan 2006). While many of the same kinds of challenges confront us today, our landscape has changed, our public has changed, and we face conservation challenges of a different order and magnitude.

Our presenters today will approach the question of the relevancy of the Co-op Unit model today in a stepwise fashion. The first presentation will outline the Co-op Unit model describing the unique nature of its cooperator framework and how priorities are determined. The model provides for federal scientists to be embedded within the graduate faculty of major universities nationwide; what advantages does that relationship yield? While the Co-op Units are part of a university, their direction comes from state and federal natural resource management agencies. How does this dynamic operate? Is this model nimble enough to address the kinds of science needs we have today?

The second presentation takes a case study look at a Co-op Unit in terms of how it addresses cooperator needs. Within a given Co-op Unit, a diversity of expertise exists and access to regular university faculty by cooperators is streamlined. Are there advantages that result from a synergy of diverse scientists and cooperators? Does this enhance the opportunity for innovation and advancement of applied science?

The third presentation takes a case study look at a landscape scale effort spearheaded by three Co-op Units collaborating with multiple state and federal agencies and nongovernmental organizations. Will

the conservation outcomes of such an approach exceed the sum of its research components? Is this representative of the way forward for addressing our greatest conservation challenges?

The fourth presentation takes a look at the future of cooperative fish and wildlife research. The authors represent the leadership of the cooperator network, and they establish a vision for the future of the Co-op Units.

It is appropriate that this session be held as part of the 100th assembly of conservationists brought together by the Wildlife Management Institute (WMI) and its predecessor. WMI, as an original cooperator, was essential to establishment of the Co-op Units as a national state, federal, university, and nongovernmental cooperative. My co-chair Jim Martin and myself are both products of the Co-op Units, having received our graduate degrees from the Oregon Cooperative Fish and Wildlife Research Unit and the Louisiana Cooperative Fish and Wildlife Research Unit respectively. We have held leadership positions in natural resource management agencies at the state and federal levels, as well as being leaders in nongovernment natural resource organizations. We are vested in the Co-op Units and believe their role in the success of the fish and wildlife conservation institution in this country in addressing the challenges that face us will be critical.

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The Cooperative Research Units Model: Enabling Past and Future Science-Based Conservation

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Introduction

Science-based natural resources management has been a primary philosophy driving the evolution of modern fish and wildlife management. First codified as one of the seven founding principles of the North American Model of Wildlife Conservation, science-based wildlife management was also the driving force for the conception and establishment of the Cooperative Research Units Program (CRU) in 1935. The CRU was envisioned to be a formal cooperation between federal, state, and university entities, enhanced and enabled by the Wildlife Management Institute (WMI), a key industry-supported force in game management policy. The CRU science-based conservation model has been delivering results for 80 years. The basic premise that fish and wildlife conservation and management should be based on the best available science is as relevant today as it was at the time the CRU was formalized. This science-based management agenda is shared by nearly all federal and state conservation and management programs.

In its present form, the CRU continues to draw from its deep roots in the historical North American game management agenda. The CRU has expanded and evolved since 1935, but the program purpose, core cooperative arrangements, and products have shown strong fidelity to the founding principles. The goal of this special session at the 2015 North American Wildlife and Natural Resources Conference is to both showcase the capacity of the CRU and use this as a springboard for discussing the program's future. For the CRU to evolve to meet the strategic science and management challenges of the future, it is important to understand the factors—cooperative intention, operational relationships, framing legislation, and administrative arrangements—which have guided the program to its present day form.

Since the inception of the CRU, there have been both legislative actions and internal management changes that have established and refined the administrative architecture of the program. This structural evolution has enabled the CRU to significantly extend its reach and influence. The basic governance model of the program has remained unchanged over time, illustrating the tremendous foresight of program founders. We believe the shared governance model remains CRU's greatest strength and is key to its continued success and ultimate sustainability. In this paper we review several elements of the CRU that enable its present-day delivery of science-based, cooperative fish and wildlife conservation. We also provide basic overview information on the CRU to set the stage for the larger strategic discussion to follow.

The Cooperative "Unit Model"

Cooperative Intent and Provisions of the Cooperative Research Units Act

The concept of cooperative intent is the foremost guiding principle for CRU and was applied in the 1930s to establish the earliest units (e.g., Iowa). To achieve science-based management, the federal government would provide resources to hire scientists who would enjoy rights as graduate faculty at host universities and work on research funded and directed by state fish and wildlife agencies. The CRU model recognized that no one entity alone could deliver the science needed to support wildlife management; thus, CRU was distinguished as a cooperative relationship—much more than a simple partnership—where founding entities would mutually commit, share, and leverage resources.

The construct of cooperative intent was codified and legislatively authorized under Public Law 86-686 or the Cooperative Research Units Act in1960. The Act authorizes the Secretary of the Interior to form cooperative relationships with states and universities for purposes of providing research, graduate education and training, and technical assistance to states on fish and wildlife resources. This specific language, while highly parsimonious, established several important spoken and unspoken principles for the CRU that collectively form what we identify as the "Unit Model":

I. The act codified three mission goals for the CRU: (1) to conduct research; (2) train and educate graduate students; and (3) provide technical assistance to cooperators. *All three mission goals are of equal importance imparting an imperative to weave together the goals in all, or as many unit matters, as possible.*
II. The resources of the federal government were to be purposefully limited to the provision of salaries of the federal scientists appointed to the units. *The point is that although federal resources were needed to establish a unit, the units were not to be federalized but were to serve the needs of states and cooperating universities.*
III. As part of a formal cooperative arrangement, each of the specified entities would have one equal voice in all matters of the unit. *The units were foremost to be guided by shared governance where no one entity irrespective of the contribution of resources had a greater voice in unit matters than others*.
IV. The cooperative intent envisioned is a living arrangement amongst parties that, while updated periodically, has no specific end date. *The units established through the act were not simply time- or issue-based transient partnerships. The cooperation was to be a long-term endeavor and commitment, with the stability enabling substantial value-added investments and outcomes*.

Evolution of the Act and Structural Additions

CRU's authorizing legislation of 1960 provided the important structural arrangement to formally establish and grow the program into the present day. However, several other key pieces of legislative action and language had a significant effect on the operation and administration of the program. The first was language added to the 1978 Fish and Wildlife Coordination Act, whereby the federal investment to the units, which was previously limited to the payment of salaries of the federal scientists appointed to the unit, was enhanced to allow the U.S. Fish & Wildlife Service (USFWS)—the federal sponsor of the CRU at the time—to also fund research projects. For the first time, federal funds were available to unit scientists for research and graduate education and training. A new mechanism called the Research Work Order (RWO) was developed to allow the transfer of federal funding from the USFWS to university accounts to fund research at the units. An important condition was placed in the RWOs that each was to support graduate student research and training. This administrative condition promulgates the mission goals of the program, and to this day, the RWO remains the primary administrative mechanism to transfer federal funding to university accounts for research.

The 1978 legislative modification, while enabling the infusion of federal funding to the units, was limited to Department of Interior (DOI)-only sources. Subsequent legislative changes in the early 1990s allowed federal funding for unit research to extend to non-DOI sources. Collectively, federal funding for unit research has had a profound effect on the scale and scope of the program. All federal funding uses the RWO process and thus requires support of research involving a graduate education and training component. The strict adherence to requirements of the RWO process has allowed the infusion of federal funding for research to add value to the unit mission.

Organizational Structure

The basic relationships defining the units are straightforward. The federal government through the DOI—presently the U.S. Geological Survey (USGS)—provides the salaries for the two to five scientists located on a host university campus who enjoy full rights and privileges as graduate faculty to mentor graduate students. The host university treats unit scientists (federal staff) as embedded faculty.

The university provides a substantially reduced overhead rate for unit projects, dedicated administrative support staff, avails to the unit support for processing research grants and contracts, and provides offices, laboratories, and space to house field equipment. State fish and wildlife agencies provide operating funds to the unit and typically fund research on issues of priority to their management needs. The WMI, the nongovernmental organization specified in the legislative language establishing the CRU, may provide direct support, serve as a go-between among cooperators for funding or other needs, and provides significant support to the unit program in large scale congressional matters. In addition to the USGS, the USFWS is also a federal cooperator to nearly all of the currently 40 units located in 38 states. The USFWS traditionally has provided significant funding to unit scientists to address priority research-management needs of the DOI, which are often closely linked to the priorities of state fish and wildlife agencies.

Shared Governance

The unit model facilitates the concept of shared governance, which implies that no one unit cooperator irrespective of the specific financial or resource contribution wields any greater influence than any other. The unit model purposefully limits the influence of the federal government establishing the premise that the unit itself was to be a fully cooperative venture. Importantly, the federal government does not dictate a specific research focus to federal scientists at the units. A unit level focus on shared governance allows the CRU to stay nimble and be adaptive to local, regional, and national cooperator needs.

Shared governance is achieved at each unit through a governing board of cooperators called the Coordinating Committee (CC). The formal CC is comprised of one representative from each of the formal cooperators. The CC ensures that the unit is responsive to the needs of the cooperating state fish and wildlife agency in a collaborative manner with local, federal influences and, naturally, the host university. The agreements on cooperator responsibilities and resource commitments are captured in a formal cooperative agreement signed by all parties.

Cooperator-Focused Research Agenda

One of the most important foundational principles of the unit model is that the units, in their cooperative mission, were intended to be organically connected to the cooperator's priority research agenda. Since prior to the late 1970s no federal funding was provided for research projects, unit scientists' research focused solely on states' research priorities. In turn, states were expected to provide the funding for the unit scientists to meet their challenges. This organic connection among cooperators means that the highest research priority of the cooperating state becomes that of the unit scientists. In practice, unit scientists will first and foremost ensure that the cooperating state's research needs will be addressed as the highest priority and that cooperating states will first and foremost focus their research agenda on the unit. State research needs may exceed the capacity of federal scientists in the local unit and so it is common for states to engage the larger university community to satisfy research needs. It is the historical and present day intention for this science-management relationship of the units to be special in the sense of assumed commitment among unit researchers and cooperating state resource managers.

The administrative arrangement of the unit enables cooperators access to university expertise and science support in a manner that exceeds traditional calls for proposals for reimbursable funding. Since each unit is locally directed by the CC, accountability to the mission goals is shared amongst all cooperators at the unit level. Within the general framework of this governance model, the units may collectively exhibit a wide degree of diversity in how they implement their research agenda in order to keep units highly responsive to cooperator needs.

Legislative changes that provided the opportunity for federal agencies to fund research through the units greatly expanded the federal scope and influence on the units. The addition of federal funding for research has had a significant effect on the units, and currently, federal funding for science at the units is similar to or slightly greater than state funding. Federal funding to the units for research could potentially present a challenge to the shared governance concept and create a constructive tension within

the unit model. This tension is alleviated, however, through the operation of the CC, which exerts significant influence over the research agenda of the unit. Given the interjurisdictional nature of many fish and wildlife resource issues, most if not all federal funding for research at units closely matches the priorities of state agencies. Additionally, it is the role of the unit CC to ensure that state and federal research priorities mesh.

Unit Model Outcomes

The unit model provides several unique and tangible outcomes, which are a strong testament to the vision of program founders and the dedication of past and present cooperators, unit scientists, and program administrators.

Resource Leveraging

Leveraging cooperator contributions is a key component of the unit model. In-kind and monetary support provided by state and university cooperators combined with allocated federal funding provides the operating capital needed for unit operations. Research costs and student stipends do not come from direct federal appropriations but are funded primarily by reimbursable dollars obtained by cooperating scientists from a wide variety of research sponsoring agencies and other organizations. When all of these sources are combined, the annual contribution of any one cooperator is leveraged three- to four-fold above any single cooperator's investment. The net result is that each cooperator receives the benefit of the entire program, which is much greater than its original contribution. For example, unit scientists annually obtain more than $25 million in reimbursable funding brought directly into host universities. The lower cost of supporting student research (versus professional, full-time researchers), combined with reduced university indirect cost rates on state and federally funded projects, provides a substantial return-on-investment for program cooperators.

Graduate Education

The unit model for training graduate students and postdoctoral associates (collectively called students) provides an unparalleled platform for training the next generation of natural resource managers, policymakers, and scientists. Students conduct research addressing issues of key importance to state, federal, and NGO natural resource managers and decision-makers. Students gain skill sets relative to the application of science to management needs in a manner that stimulates service and technical assistance to the natural resource management community. Further, due to the unique model of cooperative partnership between federal and state governments, universities, and NGOs, students gain familiarity with management agencies that make them uniquely prepared to join the workforce of the future for natural resource conservation. Near the turn of the latest century, nearly half of the professionals who have and are serving fish and wildlife conservation agencies in the U.S. were educated through the CRU (Goforth 1997).

Technical Assistance

Technical assistance to the users of unit science is a key component of the unit model because it encourages the close relationship between science and decision-making. Unit scientists and students provide assistance to state and federal natural resource managers and decision-makers on the interpretation of research findings. Such assistance takes varied forms including direct consultation, workshops, trainings, and structured decision-making/adaptive management projects and applications.

For example, research conducted at the Alabama unit on water flow management and native fish in the Tallapoosa River led to the implementation of an adaptive flow management plan for operation of Harris Dam. Unit wildlife scientists have worked with USFWS, the Atlantic States Marine Fisheries Commission, and the states of Delaware and New Jersey to develop an adaptive management plan for horseshoe crab harvest in the Delaware Bay region. These are just two examples of many technical assistance activities across the country enabled by the CRU model.

Transboundary Research

The unit model also facilitates unparalleled opportunities for working across state lines or what may be called transboundary or large landscape research. Some resource challenges cannot be solved in one state alone or require a broad understanding of the true population-level effects to appropriately manage at the local scale. The management community, led by the USFWS and the states, has long recognized the necessity of state-independent approaches to regional conservation for fish and wildlife populations. Prominent examples include the Flyway Management Councils for the continental management of waterfowl, Joint Ventures, and most recently, the Landscape Conservation Cooperatives that focus on science for conservation over a large geographical area.

One highly successful example of transboundary research is the Western Elk Research Collaborative (WERC). With the initial impetus from the Idaho Department of Fish and Game, unit scientists from the Wyoming and Montana units took on the role of facilitating the effort to collate elk data across seven states. The multistate collaborative has been fruitful and scientifically, the group is accomplishing far more than any one elk research project could have. Inferences about elk ecology and management impacts are now available that were previously impossible. The temporal and spatial span of the data set even allows researchers to ask meaningful questions about climate change. Several papers from this work are already published, with a grand unifying theory of elk demography and life history in development. The unit model facilitated the participation of multiple states, which was essential to the success of the WERC.

Opportunities for Cooperative Conservation – The Units as a Network

The WERC is an excellent example of how the CRU can support a broad-scale research project that is still consistent with the state focus of the unit model. In the WERC, one unit (Montana Wildlife) served as the focal point for collating information and used its natural CRU connection to western states to broaden the scope of the data. There are also several examples where multiple units have worked as a network to address species or habitat conservation issues affecting multiple states (e.g., woodrats, warblers).

Considering units as a network is directly in line with these species and ecosystem- or landscape-based management initiatives. The unit model, which links federal and state priorities and science-based conservation goals, is a natural vehicle for achieving cooperative conservation at regional and landscape scales. Because each unit is locally governed and supported, a balance must be struck between enabling full unit discretion for research directions and the potential needs of national programs including USGS when considering the units potential as a "research network."

Challenges to the Model

The goal of this special session is to begin the work of developing a strategic vision for the future of the CRU. To do so requires us to acknowledge several challenges to the unit model that have affected the program including: 1) fluctuations in available resources that affect cooperator contributions to each unit; 2) changes to cooperator organizational structure or mission; and 3) the vigor and commitment of cooperators to the health of each unit.

Because the basic unit cooperative agreement consists of federal, state, and university sources, cyclical funding deficiencies that may arise can be correlated among cooperators. Federal funds are the sole source of unit scientist salaries and a fluctuation in appropriations creates a deficit in the number of scientists a unit is able to support. This presents a significant challenge to universities who rely on unit scientists to teach classes, conduct research, and mentor graduate students, and for the state cooperators who have research needs that may go unmet.

Changes in traditional fish and wildlife programs at some universities is an issue larger than CRU but has affected the program due to its relation with mostly land-grant universities. Causes for a shift away from traditional fish and wildlife programs have not been fully quantified, but an evolving business

model for universities that reflects changes in students' interests, funding models (legislated vs. tuition driven), and administrative necessities (extramural funding and overhead generation) are likely contributing factors. The role of the unit within the university department is to add value, not serve as the sole source of expertise in a given discipline. Difficulties could arise in delivering the core fish and wildlife science and graduate education and training mission if there are too few (or no) non-unit fish and wildlife university faculty present to form graduate committees. The business strategy of cluster hiring—where one faculty position serves the interests of multiple programs or departments—also may serve to dilute the pool of traditional fish and wildlife faculty expertise at host universities.

Finally, the health and vigor of cooperator investment for each unit has not been previously explored but is an important part of identifying a strategic vision for the future. The emphasis here is not about resource contributions but the foundational idea of the unit being a mutual shared commitment. Certainly, an underlying tension in the unit model is created if insufficient resources are available to maintain full unit science capacity. For the unit model to achieve its tremendous shared potential, all cooperators must strive to achieve it no matter what the specific state of resources and related contributions may be at present. The challenge here is for the leaders of the unit cooperators and the CRU to lead local units through difficult times for the greater good of the program as a whole.

Conclusion

The CRU was conceived in the mid-1930s and the elements of the program's construct are both artifacts and living tenants. The investments that have allowed the CRU to be strong and maintain its relevance and effectiveness are far more enduring than the specific resources each cooperator brings to the table. The units, whose mission is drawn from authorizing legislation and structural adaptations, are built upon a spirit of cooperative intent that creates a "Unit Model." The unit model is one of shared governance that places commitments and accountability in the hands of each local cooperator. The notion of shared local control, administration, and support of units then propels a cooperator-focused research agenda, which supports graduate education and training on priority state and federal issues. By connecting individual units into a research network, the unit model can address region-wide, boundary-independent issues for which a solution is not found in any one state. The following papers in this volume provide excellent examples of unit-level state and federal coordination on large-scale, cross-state resource management issues that illustrate the power of this approach. In the end, a strategic vision for the future of the CRU must acknowledge very real challenges to the model that are both quantifiable (e.g., resource fluctuations) and conceptual (e.g., mutual commitment).

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Meeting Cooperator Needs: Examples from the Oregon Cooperative Fish and Wildlife Research Unit

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The Cooperative Fish and Wildlife Research Units are perfectly positioned to conduct cutting-edge, paradigm-shifting research that addresses critical scientific unknowns for the Units' cooperating agencies. Operating within the framework of one of the federal government's premier science agencies, the U.S. Geological Survey, scientists have the distinct advantage of conducting research within the cerebral climate fostered by academia that constantly exposes Unit science to the challenging peer review of our nation's top faculty. The exceptionally close working relationship of Unit scientists with state natural resource management agencies and the U.S. Fish & Wildlife Service (USFWS), typically on a daily basis, with insights provided by the Wildlife Management Institute, provides timely and firsthand awareness of the immediate research needs by these organizations. In fact, because of the synergistic atmosphere provided by the Units' mission of serving multiple cooperators, Unit scientists can often anticipate such needs before they have been fully recognized by their respective cooperators.

This essay uses research by the four scientists at the Oregon Unit to illustrate the contentions made above. These contributions represent widely differing scientific disciplines spanning a broad range in expertise from molecular, physiological, and genetic on the one hand to community ecology, bioenergetics, statistical, mathematical, and other methods to reach decisions strategically within an adaptive framework on the other. They also span widely differing scales from the molecular to the landscape. Of many, we draw on just a few representative fields of scientific enquiry that have successfully informed management decisions. These include but are not limited to significant contributions to:

(1) recovery and conservation of Endangered Species Act (ESA)-listed salmon and trout in the Pacific Northwest stemming from development of a mathematical means for constructing rigorously defensible family trees of fishes, development of the first molecular approach to identify Distinct Population Segments (DPS) of listed coastal coho salmon (*Oncorhynchus kisutch*) and Oregon's trout, and use of environmental physiological analyses to identify threats to populations in the wild and suggest management actions for better recovery planning and enhancement of fish fitness;

(2) conservation and management of the Northern Spotted Owl (*Strix occidentalis caurina*), a federally threatened species, and the recovery of the Bald Eagle (*Haliaeetus leucocephalus*), recently removed from federal endangered species list;
(3) contributions to the restoration of ESA-listed salmonids through investigations into the magnitude and extent of predation on juvenile salmonids by piscivorous colonial waterbirds (including Caspian terns [*Hydroprogne caspia*] and double-crested cormorants [*Phalacrocorax auritus*]) and management approaches for reducing smolt mortality while conserving protected migratory birds;
(4) development of a scientifically based decision framework that informs development of recovery plans for all species of anadromous Pacific salmonids.

Fish Management

The Oregon Unit has been using genetic and physiological approaches to solve fishery management questions. The genetic work was mainly directed at stock characterization. Physiological approaches were used to help develop techniques to alleviate stress and identify sources of mortality for fish in the wild and in the hatchery as well as provide understanding of life history patterns of fishes needed for recovery planning.

The ESA defines a "species" for vertebrates as being any "distinct population segment" of a biological species. The National Marine Fisheries Service refers to this level of taxonomic classification as an Evolutionarily Significant Unit (ESU). The dilemma becomes being able to know which populations belong to a particular DPS. While a student with the Colorado Unit, the leader fish helped develop the first methodology for fish (based on western U.S. trouts)—taximetric analysis that mathematically allowed for classification of individuals and populations into various taxa. It is the root for all current methods that construct fish "family trees" based on relationships and provides for classification at various taxonomic scales, including the DPS.

For both conservation and recovery planning, it is critical that DPSs/ESUs can be genetically distinguished. Coho salmon are particularly problematic in this regard. We were the first researchers to use multiple types of characters (morphological, biochemical, and life history) to distinguish coho salmon stocks in Oregon. More recently, we were the first to use molecular genetics for this purpose. The DPSs/ESUs used to list coastal populations of coho salmon in Oregon under the ESA were originally based on our work. Even given all of the refinements to this methodology over the years, our classifications still stand today. We have provided similar information regarding the rainbow-redband trout complex throughout Oregon, recognizing more than 200 distinct genetic populations representing several DPSs/ESUs.

Many situations that fish encounter in both the wild and in hatcheries are stressful. Recovery of populations at risk requires that stress be minimized. Minimizing stress in hatchery fish raised by the USFWS and by the Oregon Department of Fish and Wildlife is important for meeting hatchery objectives. There is a massive amount of stress imposed on salmonid juveniles as they migrate seaward over or through dams throughout the Columbia and Snake river basins. Many of the salmon and trout concerned are listed under the ESA. We discovered that the physiological stress response (e.g., elaboration of hormones such as cortisol) in salmonids would be greatly reduced if fish did not immediately recognize the gravity of a stressful experience. For example, we found that fish such as downstream migrating salmon at dams that were very briefly anesthetized before experiencing a lethal stressor experienced very little stress and mortality compared to those migrants that had initial perceptions of the stressful situation. This led to the use of "pre-anesthetic baths" into which seaward migrants at Snake and Columbia river dams moved before they were captured by the millions for marking experiments. It is also the basis for the anesthetic treatment tanks designed into the new adult salmon and steelhead trapping facilities that are part of the recovery.

Our studies on wild and hatchery-reared juvenile salmonids in the Columbia and Snake river basins, and in small coastal systems with listed species, led to the discovery that there were surprisingly high levels of mortality as they migrated to the ocean through estuaries. In the Columbia River system we

found that avian predation was significant upon out-migrant fish, a finding that led to successful management tactics that will be described. Very importantly for fish out-migrating through estuaries of smaller coastal systems, we found that only about one-half of the fish that reached the estuary emigrated successfully to the ocean. The significance of this finding is for recovery planning. Plans need to identify where the fish are at risk. Heretofore, the plans considered the ocean to be one of the main sites of mortality. Our findings indicate that one-half of the mortality presently ascribed to the ocean now actually happens in a very restricted (1 to 2 kilometers) part of lower estuaries and not in the ocean as assumed. Further, our work suggests that the bulk of this mortality is via predation. This provides for management options that are much more tractable than trying to mediate for oceanic limiting factors.

Recent work with Pacific lamprey (*Entosphenus tridentatus*) has identified adult life history types heretofore unknown and important for the recovery plan developed by the USFWS. We have also identified habitat needs for both adults and juveniles; we were able to use some of this information recently at the request of local Native American tribes to recommend specific sites that could be purchased as refugia for these fish. We have also recently shown the value of tribal historical ecological knowledge to recovery planning.

Threatened and Endangered Species Management & Conservation

Management of federal forestlands in the Pacific Northwest and California has been strongly influenced by efforts to protect and manage habitat for Northern Spotted Owls and other species associated with old forests. This change in management objectives and philosophy on federal lands occurred in the early 1990s and has been controversial in a region where timber harvest has high economic impacts. The Oregon Cooperative Fish and Wildlife Research Unit has been instrumental in providing data, analytical expertise, and sound scientific information to guide management and policy decisions regarding the ESA-threatened Northern Spotted Owl across its range. In particular, peer-reviewed research produced by Unit scientists, including the current assistant Unit leader and three past Unit leaders, have aided in the development of a regional management plan for federal forestlands in the Pacific Northwest (Northwest Forest Plan), including a long-term monitoring plan, regular region-wide assessments of the status of the Northern Spotted Owl, development of a recovery plan, and the designation of critical habitat for the species. These impacts are the result of highly collaborative research conducted on Northern Spotted Owls between Unit scientists and USDA Forest Service, Bureau of Land Management (BLM), and USFWS researchers during the last 40 years, including topics that have encompassed basic ecology, population dynamics, habitat/species relationships, and most recently, the competition dynamics associated with the invasion of the Barred Owl (*Strix varia*) into the Pacific Northwest.

As part of this overall contribution to spotted owl conservation and management, Unit scientists continue to lead long-term research investigating Northern Spotted Owl demographics in six study areas in Oregon and Washington. These data are a primary component of the long-term monitoring program for the species that was implemented by the BLM and USDA Forest Service when the Northwest Forest Plan was enacted back in 1992. In addition, these data have been regularly analyzed in a meta-analysis framework incorporating other long-term data sets from across the species' range every five years since the late 1990s. The last four of these weeklong workshops have been hosted by Unit scientists (doctors Robert Anthony and Katie Dugger) and the Department of Fisheries and Wildlife here at Oregon State University. So far, two award-winning publications have resulted from these efforts, with another similar publication nearly ready for peer-review from the most recent workshop held in January 2014 (Anthony et al. 2006; Forsman et al. 2011; Dugger et al. in prep).

As Northern Spotted Owl management and conservation moves into the third decade since the species was listed and habitat loss on federal lands has greatly declined, the species is now facing new threats associated with an invasive, congeneric species—the Barred Owl. In the last 30 years, Barred Owl densities have increased from Washington to northern California, and competitive interactions with spotted owls are having negative effects on the spotted owl populations throughout their range. Because

of the ongoing, long-term monitoring program led by Unit scientists and the research their students and post-docs have conducted, we were perfectly poised to document competitive interactions of these two species and provide policymakers and management agencies with accurate information regarding the negative affect this invasive species is having on spotted owl populations.

Research with a strong foundation in quantitative ecology and cutting-edge analytical approaches to estimating vital rates (demographics), rates of population change, and relationships between demographics and the factors that affect them have been a signature of this Unit. Contributions to Northern Spotted Owl conservation and management are just one example of how the Oregon Wildlife Unit has been meeting the needs of its cooperators. Past research by the former Unit leader on bald eagle population dynamics in Oregon was instrumental to federal delisting of the species. The current assistant Unit leader and her students, continue to address cooperator needs through research on species population dynamics and factors that affect them. Current projects include research designed to increase our understanding of greater sage-grouse response to wildfire, factors that affect the survival of black-tailed and mule deer (*Odocoileus hemionus*), and interactions between cougar (*Puma concolor*) and wolves (*Canis lupus*) in Oregon where they now both occur. We are also developing correction factors for detectability of red-tree vole (*Arborimus longicaudus*) nests in Oregon forests in order to improve survey methods used by agencies and private timber companies to monitor this elusive old-growth forest species (also an important prey item for spotted owls). The strength of our research program is the strong collaborations and working relationships we have with our academic and agency-based colleagues, with the goal of conducting the highest-quality research possible in order to address questions and fill data gaps identified by our cooperators.

Fish-Eating Bird Management

The Unit has been leading investigations of the impact of avian predators on the survival of ESA-listed juvenile salmonids in the Columbia River basin, a land area the size of France, for the last 19 years. This long-term study, initiated following the discovery by Carl Schreck of significant avian predation on salmonid smolts in the Columbia River estuary (described above), has revealed that under some environmental conditions certain species of piscivorous colonial waterbirds can cause substantial mortality for some populations of anadromous salmonids. In particular, large breeding colonies of Caspian terns and double-crested cormorants near the mouth of the Columbia River have proved to be a gauntlet for out-migrating salmonid smolts that have nearly reached the Pacific Ocean. Although native to the Pacific Northwest, these two species of fish-eating birds have established breeding colonies in the Columbia River estuary that are the largest anywhere for their respective species. Using bioenergetics modeling and empirical data collected at the breeding colonies, we have demonstrated that Caspian terns and double-crested cormorants nesting in the estuary can, in some years, consume about 20 percent of all juvenile salmonids that survive the out-migration to the mouth of the Columbia River.

Higher up in the Columbia River basin, in northeastern Oregon and southeastern Washington, Caspian terns and double-crested cormorants use additional breeding colonies, but those colonies are much smaller than the large colonies at the mouth of the river, about one-tenth the size. Nevertheless, bioenergetics modeling and empirical data from the breeding colonies have indicated that certain colonies of fish-eating birds, in particular those of Caspian terns, are specializing on out-migrating salmonid smolts as a food supply and are having a disproportionate impact on smolt survival, given small colony size. We independently confirmed this surprisingly high impact by collecting passive integrated transponder tags, which had been used to tag salmonid smolts, on the bird colonies following the breeding season. The recovered tags indicated that up to 15 percent of certain distinct population segments of steelhead were depredated by Caspian terns nesting at a colony consisting of a few hundred breeding pairs.

The Unit is seeking to devise management approaches for piscivorous colonial waterbirds, such as Caspian terns and double-crested cormorants, which are protected under the Migratory Bird Treaty Act. The goal has been to identify methods of nonlethally controlling where the birds nest under the

premise that the diet of fish-eating birds is largely dictated by the available forage fish within commuting distance of the breeding colony. By developing methods to attract colonially-nesting waterbirds to designated colony sites and developing methods to dissuade waterbirds from nesting at certain sites where fish species of conservation concern are at risk, impacts of avian predators on survival of salmonid smolts can be reduced to acceptable levels.

The first implementation of this management approach was in the Columbia River estuary. We provided technical assistance to managers in their effort to relocate the largest Caspian tern-breeding colony in the world from one island, where salmonids were the primary prey type, to another island where it was hoped that salmonids would comprise a significantly smaller proportion of the diet. Using methods devised by our Unit, the Caspian tern colony was relocated in less than three years, the proportion of salmonids in the diet declined by more than 50 percent, and the terns experienced higher nesting success. This successful relocation of one Caspian tern colony has in the intervening years been responsible for avoiding the loss of about 100 million juvenile salmonids to Caspian tern predation in the Columbia River estuary.

The Leader-Wildlife Unit has also been the lead technical advisor for management agencies seeking to further reduce the size of the Caspian tern colony at its new home—East Sand Island—by redistributing most of the 10,000 breeding pairs at this colony to alternative colony sites constructed specifically for this purpose. Thousands of Caspian terns that formerly nested on East Sand Island in the Columbia River estuary now nest on specially constructed islands outside the Columbia River basin at sites where anadromous salmonids are not on the menu. Concurrently, Caspian terns nesting on East Sand Island are being encouraged to nest elsewhere by gradually reducing the area of suitable tern nesting habitat available on the island. This combination of push-and-pull tactics has made substantial progress in further reducing the impact of Caspian tern predation on survival of ESA-listed salmonids in the Columbia River estuary. Now this same approach is being used in the Columbia Plateau region to reduce the impact of Caspian tern predation on survival of smolts from DPSs/ESUs that originate in the upper parts of the Columbia River basin. These management approaches also hold significant promise for reducing the impact of predation by double-crested cormorants in the Columbia River estuary on survival of ESA-listed juvenile salmonids.

Adaptive Management

Many of the fundamental questions in ecology are also the key uncertainties that complicate natural resource management. Finding answers to these ecological questions simultaneously increases scientific understanding and improves natural resource management. The Unit has been developing approaches to natural resource management that employ the scientific method to natural resource management problems and provide the basis for resolving key uncertainties while managing. This work culminated in the publication of an award-winning book (Conroy and Peterson 2013), which was the first of its kind written to impart the principles and application of decision theory and adaptive management to natural resource graduate students and professionals. The decision theoretic approaches have been used to address a variety of complicated and contentious natural resource management issues that also illustrate the synergy facilitated by the Unit program.

River regulation and water development are among the most important problems facing aquatic biota throughout North America. Natural resource managers and planners can only be effective at conserving aquatic biodiversity if they are informed as to the potential effects of management actions. This requires the integration of science across a diverse set of disciplines. The extensive interdisciplinary research capabilities available to Unit scientists through federal, state, and university cooperators provide unique opportunities integrating cutting-edge science and applying it to natural resource management problems. While at the Georgia Unit, the assistant Unit leader organized an interdisciplinary team of scientists and water resource managers from U.S. Geological Survey, the University of Georgia, Auburn University, USFWS, Georgia Department of Natural Resources, The Nature Conservancy, and the Instream Flow Council to develop dynamic, spatially-explicit approaches to estimating the effects of

water use, river impoundment, land use, and climate change on aquatic biodiversity. The interdisciplinary effort also led to important advances in the individual disciplines. For instance, novel approaches were developed for estimating streamflows in individual stream segments within an entire basin. Similarly, novel metapopulation approaches were developed to evaluate the response of freshwater fishes and mussels at stream reach and landscape scales. This integrated approach also was recently used in the Southeast Resource Assessment to estimate the effect of anthropogenic climate change on stream fishes along sensitive thermal gradients in the Blue Ridge area of North Carolina.

In Oregon, as elsewhere, natural resource management over broad heterogeneous landscapes is complicated by the inherent uncertainty in ecosystem processes. Decision-making is further complicated when multiple user-groups and management agencies with overlapping jurisdictions have fundamentally different objectives and policies. The Unit has established programs in the West that are extremely informative to agencies and taskforces that must operate and make decisions in the face of this uncertainty. Brown bear (*Ursus arctos*) management in Alaska is a good example of the potential for cross-jurisdictional conflict. Brown bears are abundant and widespread throughout Alaska and are common in federally-managed lands, such as those managed by the National Park Service (NPS). Brown bears are also regulated as a game species by the Alaska Department of Fish and Game. Management of brown bears by the NPS generally involves nonconsumptive activities such as bear viewing. However, the implementation of liberal predator harvest regimes and predator control by the state was believed to conflict with federal values. This created the potential for conflict between the state and federal agencies. In these instances, it is important to distinguish disagreement about science from disagreement about management objectives. We worked closely with an interdisciplinary team of scientists and managers from academia and federal agencies and used structured decision-making to identify NPS values and objectives. We then developed a transparent, science-based approach to managing brown bears on NPS lands in Alaska that minimizes conflicts with the state. The approach also provided the basis for refining existing NPS monitoring that maximizes insights into brown bear population dynamics and improves future management.

Another example of the application of strategic decision-making relates to the fact that natural resource management agencies expend substantial resources restoring anadromous salmonids and their habitats throughout the Pacific Northwest. Unfortunately, restoration management actions, monitoring, and research are not formally integrated for most if not all of these efforts. Such decoupling hinders learning and transfer of information (knowledge) through time and across multiple projects, wasting valuable resources. We organized an interdisciplinary team of managers and scientists from academia and federal and state agencies to develop and evaluate framework for prioritizing stream restoration efforts in the California Central Valley. The evaluation was used to identify key unknowns regarding the capacity of watersheds to produce juvenile salmon and the effects of habitat restoration and water management on salmon recovery. The framework is currently being integrated into the California Central Valley Project Improvement Act Fisheries Program to adaptively manage salmon restoration. Results of the evaluation have also been used to change the focus of salmonid monitoring in the Central Valley.

Conclusions

This case study of the Oregon Cooperative Fish and Wildlife Research Unit exemplifies the significant role the Unit program has in transforming management challenges into conservation outcomes. The administrative structure allows cooperators "ownership" of the research agenda while allowing scientists the academic freedom to excel. This close coupling of innovation and applied management within an interdisciplinary Unit yields results well beyond a given study's parameters or a Unit's geographic borders.

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Roles of Cooperative Research Units in Contemporary Conservation of Natural Resources

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During the past century, conservation of wildlife and other natural resources has become increasingly complex. Natural resource agencies are faced with a multitude of legal, regulatory, and budgetary requirements and restrictions, along with competing societal and political viewpoints and perceptions. Combined, these factors interact to form superimposed layers of complex challenges often rife with uncertainty and typically requiring extensive monetary and time commitments for successful resolution of natural resource issues. Further complicating issues of wildlife management are large-scale changes in land cover and land use, climate change, increased risks of species extinctions, and amplified knowledge of ecological interactions and responses. These factors have elevated many natural resource issues from local scales to regional, continental, hemispheric, or global scales. Knowledge necessary to meet these challenges at increasingly larger spatial and temporal scales is lacking for most issues. This necessitates natural resource professionals to be proactive and to recognize and address information gaps to reduce uncertainty for future sound decision-making. Acquiring rigorous, unbiased information from scientific investigations is the basis to inform sound conservation decisions.

The public trust doctrine established that wildlife species in the United States are held by state and federal governments as trust resources to be managed for the public interest (Geist et al. 2001). Thus, all citizens have the opportunity to participate in the management of wildlife, and public acceptance of conservation actions is required for the continued sustainability of such efforts (Zinn et al. 1998). Integrating the emerging field of human dimensions into wildlife conservation has been recognized as essential to the success of conservation efforts (e.g., Enck et al. 2006). Therefore, stakeholder input is critical to the effective and efficient conservation of natural resources that ultimately contributes to the strategic assessment and planning that prioritizes conservation actions and is key to identification of scientifically-relevant information and knowledge needs for making informed decisions. Timely engagement among natural resource agencies, conservation groups, and scientists for the purpose of identifying essential research needs facilitates, informs, and accelerates implementation of conservation decisions. Finally, implementation of accepted conservation actions to achieve specific objectives by applying explicit strategies requires that trained natural resource professionals with appropriate knowledge, skills, and abilities are available.

The need for using science in natural resource management was recognized as early as the founding of the Boone and Crockett Club by Theodore Roosevelt and George Bird Grinnell in 1887. Until 1930, however, wildlife management primarily consisted of harvest regulations, artificial propagation of desirable species, control of undesirable species (e.g., predators), and establishment of refuges for certain species. In 1930, the American Game Institute (now Wildlife Management Institute) convened a group of conservationists (American Game Policy Committee), including Aldo Leopold, to develop foundational

policies to guide wildlife conservation in North America (Leopold 1930). In addition to numerous paradigm-shifting principles and policies proposed for wildlife management, adopted tenets included recognition of (1) developing conservation programs that included sportsmen, protectionists, scientists, and landowners; (2) doing scientific research to produce knowledge to guide conservation decisions; and (3) establishing a wildlife management profession. These foundational principles established by the American Game Policy Committee were updated but reaffirmed by Allen (1973).

The North America Model of Wildlife Conservation recognizes the fundamental principles of wildlife conservation and expresses seven foundational pillars essential to sustaining wildlife populations through conservation (Geist et al. 2001; Organ et al. 2012). One of the seven pillars is: "Science is the Proper Tool for Discharge of Wildlife Policy," which encourages that informed decision-making is based on sound evidence and knowledge generated through the scientific method (Geist et al. 2001; Organ et al. 2012). The Association of Fish & Wildlife Agencies supports the North American Model of Wildlife Conservation and is committed to scientific principles for management of natural resources; the group has expressed the need to integrate human dimensions and communication sciences in the decision-making process (Prukop and Regan 2005). Additionally, Jacobson et al. (2010) emphasized the need for multidisciplinary science to assist professionals in providing recommendations for wildlife conservation in the 21st century; they further noted the need for adequate resources, intellectual freedom, and transparency without fear of repercussions in pursuit of information and knowledge to answer questions as part of the conservation process. However, identification and prioritization of knowledge needs requires interactions among stakeholders with direct scientific investigations prior to the development of a natural resource crisis (Jacobson et al. 2010). Trust in the integrity of the science by stakeholders is essential to avoid polarization and gridlock in conservation planning; thus, including stakeholders early in the scientific process facilitates ownership and trust, which expedites resolution of conservation issues.

Creation and Structure of Cooperative Fish and Wildlife Research Units

A monumental task was associated with the adoption of the recommendations of the American Game Policy Committee—how to start a new profession, achieve scientifically sound information for management and conservation decisions, and train wildlife professionals. Publication of *Game Management* provided the foundation for training wildlife professionals by demonstrating that wildlife was a renewable natural resource capable of being managed in a sustainable manner; however, programs to train wildlife professionals were lacking (Leopold 1933). Further, linkages between scientific knowledge and practicing wildlife managers were absent and limited the use of science in the conservation of wildlife. To generate biological information, train wildlife managers and biologists, and disseminate information to management agencies, a cooperative wildlife research unit was established at Iowa State College in 1933 through a collaborative partnership between the college, the state game agency, and with the support of Ding Darling (Goforth 2006). Based on this vision, the Cooperative Research Units (Unit) were established in 1935 and, subsequently, recognized by organic legislation with the 1960 Cooperative Units Act to achieve a threefold mission: (1) graduate education to train natural resource professionals, (2) conduct research identified by stakeholders as priorities for conservation, and (3) provide technical assistance to interpret and disseminate research findings (Goforth 2006). The Unit model established a collaborative framework to address natural resource issues that is emulated conceptually in many contemporary conservation initiatives where the North American Waterfowl Management Plan, Adaptive Resource Management, Structured Decision-Making, and Strategic Habitat Conservation are but a few examples (Lancia et al. 1996; Conroy and Peterson 2013). Due to the natural fit and defined mission, Units contribute substantively to many of these initiatives through participating on conservation planning teams, conducting research to address identified information needs, and providing interpretation of research results to facilitate and advance effective conservation decision-making. Thus, although 80 years old and initiated in response to the need to create a wildlife profession and train wildlife professionals, the Units and their mission remain relevant and critical to the contemporary field of applied wildlife ecology.

The current 40 Cooperative Research Units established at universities in 38 states create unique university-state-federal partnerships, with each Unit functioning under a renewable formal cooperative agreement, an established coordinating committee that governs and provides direction to the Unit federal scientists, and the traditions of the host university and state natural resource agency (Goforth 2006). The only constant presence across all Units is representation of the Wildlife Management Institute, which has supported Unit activities since their initiation. Research subject expertise of the scientists of a particular Unit is determined by the coordinating committee during filling of Unit vacancies. However, the Unit model provides the potential for access to any scientist in the Unit system with the appropriate skills required by individual cooperator or potential research sponsor; thus, any stakeholder can be served by the entire Unit system. Research topics and specific projects are proposed and approved by coordinating committee members representing the needs and interests of their respective institutions and agencies. Most Unit research projects reflect a management agency-driven information need for applied science results to address natural resource issues at the scale of an individual state. However, many times, natural resource issues cross geopolitical boundaries and governmental jurisdictions; thus, collaboration with natural resource agencies and Units of adjacent states, other state and federal agencies, conservation groups, and additional stakeholders is necessary for designing meaningful research investigations to successfully address stated information needs. The Units are uniquely positioned to not only provide research support within a designated state but also to facilitate and lead multistate or multiscale research investigations.

Units are distinctive in that research is conducted under a true partnership approach rather than the traditional research paradigm of submission of a proposal in response to a competitive request and being awarded a contract to conduct the selected research project. In the traditional model, research sponsors are separated from the investigations being conducted, with annual and final reports providing information on findings. In contrast, the Unit model encourages collaborator participation throughout the entire process from project conception and design through implementation and analyses, and finally completion typically as publication in a scientific journal. Such a collaborative approach integrating science and management is mutually beneficial as the interactions ensure that priority research objectives are being addressed; participants are familiar with the methods and results such that interpretation and dissemination of information are supported by stakeholders; and simultaneous learning and skill development among participants fosters future collaboration. Further, through the annual coordinating committee meeting, status of each project can be discussed to ensure satisfactory progress and continued stakeholder buy-in of cooperator-sponsored research projects.

Finally, the Unit model is dependent upon graduate students conducting research in an academic setting but also provides distinctive opportunities for students interested in applied resource management to develop knowledge, skills, and abilities to be competitive in their desired career path. Students conducting research associated with Units are exposed to the needs and structure of partner agencies and organizations, thereby adding to their own preparation for future careers in natural resources and adding value to traditional academic programs. By linking real-world natural resource issues with academic rigor and critical thought, students mature through their graduate school tenure to become capable professionals upon entrance into the natural resource profession. Many past and contemporary leaders in wildlife and natural resource fields were Unit students, having started their careers with the advantage of experience that comes with solving resource issues and is missing in many academic programs.

The unique partnerships within and among Units brings together stakeholders in a meaningful and productive manner to address conservation issues at local, state, regional, and national scales. These partnerships combined with the intellectual strengths of scientists associated with individual units and the Unit system combined with academic faculty of host universities produces meaningful data, information, and knowledge to inform conservation decisions. Available, unbiased, accurate information is essential for productive development, consideration, debate, and implementation of competing options for conservation. To illustrate the Unit model in action, we describe the collaborations among Units, state and federal agencies, nongovernmental organizations, and other stakeholders in response to an emerging conservation crisis.

Lesser Prairie-Chicken: A Case Study of Collaborative Conservation

The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is the iconic grassland bird of the southwestern Great Plains and represents a complex conservation challenge. Found primarily in the High Plains of Colorado, Kansas, New Mexico, Oklahoma, and Texas, the species is adapted to extreme environmental conditions that have historically caused large fluctuations in population abundance and range (Rodgers 2015). Although population abundance of the species fluctuates greatly in response to these environmental conditions, the species has drastically declined during the past century, with some estimates of greater than 90 percent reduction in population size and occupied range (Boal and Haukos 2015). Contributing factors to these declines beyond those projected due to natural fluctuations include conversion of native prairie to cropland, loss of natural ecological drivers of fire and grazing by bison (*Bison bison*), establishment and expanding presence of trees in prairie landscapes (e.g., eastern red cedar [*Juniperus virginiana*] and honey mesquite [*Prosopis glandulosa*]), hybridization with greater prairie-chickens (*T. cupido*), increasing frequency and severity of drought due to climate change, anthropogenic structures and disturbance (e.g., fences, wind farms, oil/gas wells, roads, powerlines), and excessive herbicide control of native shrubs (e.g., sand shinnery oak [*Quercus havardii*] and sand sagebrush [*Artemisia filifolia*]) (Spencer 2014; Boal and Haukos 2015; Fuhlendorf et al. 2002; Fuhlendorf et al. 2002, Lautenbach 2014; Bain and Farley 2002; Grisham et al. 2013; Wolfe et al. 2007; Hagen et al. 2011; Grisham et al. 2015; Haukos et al. 2015a).

As a state trust species until May 2014, the recent status of the lesser prairie-chicken varied among states, from being state endangered in Colorado to a popular game bird in Kansas (Van Pelt 2015). Indeed, contemporary harvest opportunities existed for lesser prairie-chickens in all states but Colorado (Haukos et al. 2015b). Additional issues complicating lesser prairie-chicken conservation and management include the need for large areas to support populations (e.g., greater than 10,000 hectares), occupancy primarily on private land (approximately 94 percent), and uncertainty regarding management targets for habitat quality (Boal and Haukos 2015; Elmore and Dahlgren 2015; Haukos and Zavaleta 2015). Contributing to the conservation challenge is the lack of contemporary information and limited knowledge of lesser prairie-chicken ecology and response to management. Much of the information related to lesser prairie-chickens was published prior to1990, concentrated on nesting ecology, and occurred in the southern portions of the range (Haukos and Boal 2015). Many of these studies were related to the use of a herbicide (tebuthiuron) to control sand shinnery oak (Grisham et al. 2015). Therefore, until recently, other than a series of studies in southwestern Kansas (e.g., Hagen 2003, Pitman 2003), there was limited contemporary information to guide lesser prairie-chicken conservation and management. In addition, there were few professionals with experience in managing lesser prairie-chicken populations and habitats.

The range of the lesser prairie-chicken was delineated as four distinct ecoregions based on dominant vegetation types that support spatially explicit populations (McDonald et al. 2014). With the exception of the northern Short-Grass Prairie/CRP Mosiac Ecoregion in Kansas, these ecoregions cross state boundaries and require coordination among states for effective conservation (i.e., Sand Shinnery Oak Prairie, Sand Sagebrush Prairie, and Mixed-Grass Prairie Ecoregions). Although many conservation challenges can be applied across the entire species range, several are definitely linked to specific ecoregions, necessitating conservation actions at multiple spatial scales. For example, loss of contiguous prairie habitats, effects of climate change, response to anthropogenic factors, potential for disease, and general life-cycle requirements are ubiquitous conservation concerns. However, ecological aspects such as habitat selection, food resources, response to habitat management strategies (e.g., prescribed fire, grazing, herbicides), predator communities, use of free water, invasive plants (e.g., trees), available microclimates, and population demography are ecoregion specific. Therefore, for conservation programs to be effective, they must be tailored to each ecoregion; however, the lack of ecoregion-specific information is currently hindering lesser prairie-chicken conservation.

Citing population and occupied range declines along with uncertainty regarding lesser prairie-chicken ecology and their response to perceived threats, the U.S. Fish & Wildlife Service (USFWS) was

petitioned to provide the species with federal protection in 1995. This request resulted in a "warranted, but precluded" finding and the species was subsequently considered a candidate for listing (Rodgers 2015; Van Pelt 2015). As a candidate species, the lesser prairie-chicken became a species of conservation concern with an elevated priority for research and management funding. Following the initial petition, the Lesser Prairie-Chicken Interstate Working Group (LPCIWG) was formed and included representatives from the five affected state wildlife agencies: USFWS, U.S. Forest Service (USFS), Bureau of Land Management (BLM), and Wildlife Management Institute (Rodgers 2015). The LPCIWG developed research priorities, facilitated research funding, disseminated information on species status and management, and developed several conservation plans based on existing information (Mote et al. 1999; Davis et al. 2008). In December 2012, the USFWS proposed listing the lesser prairie-chicken as threatened, which prompted the LPCIWG and Western Association of Fish and Wildlife Agencies (WAFWA) to prepare a "Lesser Prairie-Chicken Range-wide Conservation Plan" (Conservation Plan; Van Pelt et al. 2013). To assist in the preparation of the plan, WAFWA contracted with the Kansas Unit at Kansas State University to prepare an "Annotated Bibliography of the Lesser Prairie-Chicken" (Zavaleta and Haukos, unpublished). This continuously updated bibliography provides relevant information for more than 230 sources of information (e.g., journal articles, theses, dissertations, proceedings, unpublished reports) related to lesser prairie-chickens divided among 16 subject topics. The bibliography and associated source material provided background for the WAFWA plan in addition to being available to any stakeholder or researcher who requests access to these resources. In May 2014, the lesser prairie-chicken was granted threatened status on the federal endangered species list, thus, becoming a federal trust species under the jurisdiction of the USFWS.

By 2012, a multitude of basic information needs identified by the LPCIWG were addressed though research efforts either investigated or facilitated by the Texas Unit at Texas Tech University in collaboration with Texas Parks and Wildlife Department (TPWD), Great Plains Landscape Conservation Cooperative, The Nature Conservancy, and Grasslans Charitable Foundation. These efforts included an assessment of aerial survey methodology, which was used in designing the current range-wide lesser prairie-chicken survey (McRoberts et al. 2011; Timmer et al. 2013; McDonald et al. 2014). In particular, a series of studies in the Sand Shinnery Oak Prairie Ecoregion conducted by students under C. Boal at the Texas Unit investigated breeding season ecology in Texas and New Mexico, role of avian predation on reproductive behavior, over-winter ecology, habitat selection, and use of free water (Grisham 2012; Behney 2009; Pirius 2011; Borsdorf 2013; Gicklhorn, in progress). Of particular note were two long-term studies of lesser prairie-chicken ecology in eastern New Mexico—Grasslans Charitable Foundation funded a 10-year study of lesser prairie-chicken and other community (vegetation, invertebrate, herptile, and small mammal) response to restoration of sand shinnery oak prairie using herbicides and grazing treatments, and The Nature Conservancy funded a concurrent 10-year study of lesser prairie-chicken lek dynamics, invertebrate dynamics, and vegetation structure. Sutton Avian Research Center was contracted for the initial five years of lesser prairie-chicken data collection for the Grasslans project (Patten et al. 2006). However, the Texas Unit assumed responsibility for analyses of the final five years of lesser prairie-chicken data as well as the entirety of the remaining community data (Boal et al. 2014; Zavaleta 2012). Results from these completed studies contributed significantly to the WAFWA conservation plan and served as foundations for much of the subsequent research efforts.

Recognizing the need for information among ecoregions on lesser prairie-chicken ecology, relative population threats, and response to potential management should the species be granted federal protection, the Kansas (D. Haukos), Texas (C. Boal), and New Mexico (S. Carleton) Units, in collaboration with the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Lesser Prairie-Chicken Initiative (LPCI; C. Hagen) and state and federal agencies designed, prioritized, and initiated a series of studies across the range of the lesser prairie-chicken starting in 2012. The studies included common methodology to ensure comparable results among ecoregions and research designs addressing information needs at the species and ecoregion scales. Research partnerships were created with faculty at Texas Tech (B. Grisham) and Oklahoma State (D. Elmore, S. Fuhlendorf) universities through the unique Unit research funding mechanisms established by cooperative agreements

to be able to simultaneously conduct research in all five states. Many general aspects of research were common to all studies (e.g., annual and seasonal survival, reproductive success, movements and space use, anthropogenic influence), including the novel use of satellite transmitters to track the species on a much finer temporal scale than previously possible. Response to conservation efforts such as the USDA Conservation Reserve Program's (CRP) availability and juxtaposition, grazing management, and habitat manipulation (e.g., fire, herbicides) were measured at the ecoregion scale. Additional studies were ecoregion specific (e.g., tree removal, water use, foods consumed, dispersal). To directly link stakeholders to the research efforts, several of the principal investigators were members of the LPCIWG science team and WAFWA lesser prairie-chicken science working group. In addition, agency personnel contributed to the initiation, design, analyses, and interpretation of research results by formally serving on the graduate committees of Unit students involved in the research. Investigations into 56 identified research objectives were implemented in 2012 to 2014 among the Units and associated collaborators, several of which have already been completed.

The Kansas Unit coordinated research funding to design an interdisciplinary lesser prairie-chicken research program addressing the information needs identified by Kansas Department of Wildlife, Parks, and Tourism (KDWPT), Colorado Parks and Wildlife (CPW), USDA NRCS LPCI, USDA Farm Services Agency, WAFWA, USFS, USFWS, and The Nature Conservancy. The 27 studies being conducted under this collaboration by eight graduate students, one postdoctoral research associate, and more than 25 research technicians were established in partnership with collaborators and research sponsors. To address specialized research topics (e.g., population genetics), additional investigators from Bowling Green State University and Ohio State University were added to the research team. The research in Colorado was overseen by a CPW employee who was included in all aspects of the research process. Collected data were made available to WAFWA and other conservation groups designing mitigation strategies and mitigation banking for lesser prairie-chickens. To date, two of the research technicians involved in this research have been hired by KDWPT.

The Texas Unit and Texas Tech University (B. Grisham) in conjunction with the Kansas Unit developed several studies addressing pressing research needs related to climate change, response to land management, and population demography. The USFWS Office of Science Applications funded two graduate students for a lesser prairie-chicken metapopulation analysis including responses to projected climate change conditions in the Great Plains. The Center of Excellence for Hazardous Materials Management (CEHMM) provided funding for a postdoctoral research associate to continue analyses of the 10-year Grasslans Charitable Foundation and The Nature Conservancy data sets in New Mexico, with a focus on response to management strategies and identification of factors influencing lek stability. A partnership was created with the Sutton Avian Research Center to include the initial five years of the lesser prairie-chicken data from the Grasslans Charitable Foundation project for the climate change and land management projects. The LPCI and TPWD provided funding for a graduate student to investigate lesser prairie-chicken use of CRP in Texas.

The New Mexico Unit has received funding from USFWS, CEHMM, BLM, LPCI, National Fish and Wildlife Foundation, Playa Lakes Joint Venture, and New Mexico Department of Game and Fish to support four graduate students and 15 research technicians to meet resource agency information needs to guide management and conservation. These projects are focused on the impacts of 1) energy development and extraction, 2) contemporary use of CRP grasslands at the southern extent of their distribution, 3) re-establishment of periodic fire, and 4) shrub encroachment on seasonal demography, habitat selection, and spatial movement patterns. Combined, these studies are being used to understand landscape connectivity and identification of movement barriers through additional population genetic analysis and landscape level impacts of fragmentation using vital rates and space use patterns. All of these projects have been developed at the request and in close collaboration with state, federal, and private wildlife and conservation agency cooperators.

In Oklahoma, eight research projects have been initiated concentrating on the management and assessment of the grassland component of lesser prairie-chicken habitats in the Mixed-Grass Prairie Ecoregion. The Oklahoma Unit supports lesser prairie-chicken research through Oklahoma State

University faculty through facilitation of funding from the Oklahoma Department of Wildlife Conservation and the Joint Fire Science Program. Major research topics include effects of prescribed fire and livestock grazing as well as use and assessment of remote sensing techniques to measure quality of lesser prairie-chicken habitats.

The data compiled across and among the completed contemporary research projects and all of the ongoing studies will eventually be combined to develop ecoregion and range-wide analyses including an integrated population model that will identify common influences on population demography among ecoregions. Use of sensitivity analyses will provide insights as to which factors have the greatest influence on population growth, which in turn can be targeted for conservation efforts. Functional relationships between population vital rates and landscape characteristics will be used to design landscapes to create scenarios that increase population growth rates. Characteristics of occupied and unoccupied habitat across the species range will be used to create species distribution models to identify unoccupied areas that have a high potential of supporting lesser prairie-chicken populations.

The combined research efforts being led by Units will provide the foundation for future conservation planning, including development of recovery plans and mitigation structures measuring impacts to lesser prairie-chicken populations. The comprehensive research approach and common methodology will reduce uncertainty in results among ecoregions. Graduate students and technicians involved in these investigations will produce trained biologists with experience and knowledge related to lesser prairie-chicken ecology and management that will be available for assuming the responsibility of recovering the species.

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The Future of Cooperative Fish and Wildlife Research

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The early fish and wildlife conservation profession and institution in the United States faced a number of fundamental challenges during the 1930s. Knowledge of basic principles as to limiting factors and management techniques, as well as a cadre of trained professionals to restore populations and habitats, was severely lacking (Leopold 1930). The Cooperative Fish and Wildlife Research Unit Program (CRU) is based upon an original model designed to fulfill these needs (Goforth 2006; Whalen and Thompson 2015). During the past 80 years, the profession and institution have evolved in response to changing scientific, environmental, social, political, and demographic factors (Jacobson et al. 2010; Organ et al. 2012; Organ and Batcheller 2010). This evolution has been necessary for maintaining relevancy, and some argue further transformative institutional changes are needed (Jacobson et al. 2010). How relevant is the CRU model to current and future needs of the conservation profession and institution? Should the CRU refocus in order to maintain relevancy or move towards an entirely different model? Herein, we offer perspectives on these questions and propose a vision for the future of the CRU.

Current Challenges, Emerging Needs

The 1973 North American Wildlife Policy (Allen 1973, 74) contained the statement, "The future of wildlife is tangled in the total complexity of man's relationship to nature." In the more than 40 years

since this statement was written, that complexity has been magnified. Human population growth and high per capita rates of resource consumption, combined with economic globalization, have expanded the fish and wildlife conservation paradigm from restoration of populations and habitats to sustaining the functionality of landscapes and the ecosystems they contain (Worldwatch Institute 2014). Stressors operating at the landscape level include domestic energy production demands, water allocation issues, human-wildlife conflicts, land uses (e.g., grazing, crop production, human infrastructure development), international wildlife trade, invasive species, fish and wildlife diseases and zoonotics, and climate change. The role of science in informing public policy—a pillar of North American conservation (Organ et al. 2012)—has been perceived to have diminished greatly (Mahoney et al. 2008). The need to integrate human dimensions inquiry into ecological science, with comparable rigor, is essential for communicating science to policy makers and stakeholders (Organ et al. 2014). Purposeful application of decision-making tools to achieve more durable, transparent policy outcomes is needed as stakeholder demands become more contested (Riley et al. 2003; Williams et al. 2009). New and emerging scientific tools in areas such as conservation genomics and geospatial data analysis offer considerable potential for wildlife managers, but these new tools require specialized training and thoughtful integration into existing management and decision-making frameworks.

The significance of these issues is reflected in published and unpublished internal science planning and prioritization documents of the Association of Fish & Wildlife Agencies (AFWA), the U.S. Fish & Wildlife Service (USFWS), and the U.S. Geological Survey (USGS), representing three of the CRU's principal cooperators (Williams et al. 2013). Themes include the following:

- Landscape conservation science, planning and design (USFWS, USGS)
- Climate adaptation (AFWA, USFWS, USGS)
- Socioeconomic and cultural values (AFWA, USFWS)
- Science communication and delivery (USFWS, USGS)
- Monitoring (USFWS)
- Energy production and wildlife management (AFWA, USFWS, USGS)
- Emerging diseases/biosecurity (AFWA, USFWS, USGS)
- Ecosystem services (AFWA, USFWS, USGS)
- Advanced technologies (USGS)
- Ecological flows (USGS)
- Invasive species (AFWA, USFWS, USGS)

The American Fisheries Society (AFS) and The Wildlife Society, professional scientific societies that underpin institutional standards for science, education, and ethics, are concerned over the frequent lack of integration between science and management. This lack of integration is manifested in different ways, including gaps between the direction of science education and applied management expectations, which is a product of ineffective bi-directional dialogue between scientists and managers, as well as factors related to priorities at universities and priorities within agencies (Jacobson et al. 2010; McMullin et al. 2009).

Throughout the fish and wildlife conservation institution in the United States there is concern over the future workforce: Will there be appropriate training to meet emerging conservation challenges, and will the workforce reflect the diversity of the American public? Currently, 37.4 percent of Americans are nonwhite, Hispanic, or Latino according to U.S. Census data, but such Americans account for only 11.7 percent of hires during the last three years in government natural resources agencies (Taylor 2014). Recruitment and development of a highly skilled, diverse workforce is needed immediately as baby boomer retirements escalate (Hallerman et al. 2014).

Role of the CRU

Goforth (2006) and Whalen and Thompson (2015) provide concise historical and structural information on the CRU. They outline the strengths of the program via the collaborative framework, the applications of science to management, the development of natural resource leaders, and the role in bridging the science needs of state and federal agencies and NGOs with expanded university resources. By means of the CRU, a framework has been in place for decades to facilitate cooperation in tackling conservation challenges. This framework has shown itself to be robust to new developments in science as well as to new and emerging needs of natural resource managers. The role of the CRU in addressing contemporary and future needs has come into question though, and these concerns warrant attention.

Questions About The CRU

Despite the CRU's long-standing record of success (e.g., Goforth 2006, Whalen and Thompson 2015), concerns have been raised by some in the conservation community about the efficacy of the CRU model in addressing the challenges of the future. For example, these themes have occurred in recent years; counterpoints to those themes follow:

- *Is the CRU just a state-based program that cannot escape state boundaries and address larger issues at the landscape scale (i.e., a geography with boundaries defined by ecosystems as opposed to political or institutional units)?* Haukos et al. (2015) provide explicit evidence to the contrary with the multistate landscape scale research on the lesser prairie chicken (*Tympanuchus pallidicinctus*). Other examples include the eight-state Western Elk Research Collaborative and a multi-CRU effort in the eastern United States to facilitate scenario planning for climate change adaptation. The multistate, multi-agency effort is part of a broader transborder initiative that the CRU has invested in heavily. The CRUs as the focal point of a state, federal, university, nongovernmental organization (NGO) cooperative are quite capable and adept at working across borders and addressing landscape-scale science (Haukos et al. 2015).
- *Does the CRU have thematic limitations, and can it address the deeper, more fundamental scientific and theoretical, ecological, and methodological issues? Does it produce small-bore science that misses the big and important issues bedeviling us all?* Schreck et al. (2015) provide explicit examples of how one CRU's breadth and depth of expertise has been applied to develop methodological tools that have advanced science and how theoretical inquiry into vexing conservation issues such as endangered salmon stocks and old-growth forest have yielded science breakthroughs. The CRU has worked across large landscapes and hemispheres from the Arctic to southern California and across Russia, Asia, and Canada investigating relationships between air quality, water quality, and fisheries. This work ranged in extent from microscopic to macroscopic, from conservation genomics and under the skin physiology to population modeling (Schreck et al. 2015).
- *Is the CRU basically a federally subsidized technical assistance to the states?* The CRU is a cooperative, and each cooperator (e.g., states, NGOs) contributes to the benefit of all cooperators and stakeholders. The examples provided by Haukos et al. (2015) and Schreck et al. (2015) illustrate the benefits in species conservation, technical guidance, and workforce development derived by the federal government and other natural resource conservation entities in addition to the states from the CRU-directed conservation outcomes.
- *Does the CRU produce students at land grant universities who are not the big-picture thinkers we need to address the challenges of tomorrow, but who are instead trained to deal with the natural resource issues of the past?* The CRU produces students uniquely prepared to address the challenges of tomorrow by virtue of their association with and mentoring by scientists and practitioners alike. The CRU is training its students in advanced technology and preparing them to be future leaders through a variety of opportunities in current research and development areas

including studies in Adaptive Management and Structured Decision Making and training in recently evolving disciplines ranging from molecular biology to global climate change analysis (Whalen and Thompson 2015). Distance learning opportunities through the use of new web-based technologies are provided to the CRU students and afford them the ability to benefit even further from the greater CRU network.

- *Has the CRU become a program that is increasingly out of touch with mainstream ecological science as emphasized in universities in the U.S.?* To the contrary, being embedded in major universities in 38 states allows the CRU scientists to be in the vanguard of mainstream ecological science. In particular, the CRU scientists have been in the forefront of adopting new scientific advancements including conservation genomics and landscape-scale geospatial data analysis, which are revolutionizing all aspects of ecological science. In recent years, the proportion of postdoctoral associates enrolled by the CRU has increased and these associates are on the cutting-edge of mainstream ecological science.
- *Has the gap between natural resource issues and the curricular focus of universities that is growing ever larger degraded the capacity and relevance of the CRU at an increasing rate?* The CRU plays an essential role in maintaining connection between the management community and universities. Students and faculty have greater awareness of natural resource issues by virtue of the CRU scientists embedded into faculty. The technical assistance role of the CRU scientists serves to keep natural resource managers abreast of university science advances (Whalen and Thompson 2015). Relevance of natural resource issues in university curricula is vastly expanded by the CRU relative to most typical faculty because of focus on actionable agency-sponsored science. Many, if not most, Unit projects have coprincipal investigators from state and federal agencies who interact with students, often on a daily basis.
- *Is the CRU model, as a jointly funded enterprise where the federal government is responsible for staffing, old, inflexible, and no longer relevant to today's world?* The CRU staffing model, although developed 80 years ago, comports squarely with the current desires of Congress as expressed in appropriations language, where cost-sharing between federal agencies, states, and the private sector is preferred (e.g., 114 STAT. 2762A–118 PUBLIC LAW 106, 2000) (Goforth 2006; Whalen and Thompson 2015). Federal dollars invested in scientist salaries are leveraged to generate funding well in excess of that investment.

A Vision for the Present and Future of the CRU

The CRU has evolved considerably over the course of its history and trained scores of practitioners and scientists currently active in federal and state agencies, NGOs, and universities (Whalen and Thompson 2015). To ensure the CRU continues to provide the science that supports natural resource decision-making and develops the next generations of natural resource leaders, a number of initiatives are proposed.

Networks of Expertise

Whalen and Thompson (2015) described the geographic diversity of the CRU, with Units at 40 university campuses in 38 states, all with direct access to the faculty and resources of those institutions. Schreck et al. (2015) illustrated the applied science breadth that an individual Unit can encompass to meet a diverse array of cooperator science needs. Haukos et al. (2015) demonstrated how several individual Units can collaborate and be the catalyst that engages multiple partners, including USGS Science Centers, Landscape Conservation Cooperatives, state fish and wildlife agencies, U.S. Department of Agriculture, USFWS field stations, universities, and NGOs in addressing large-landscape, complex natural resource science needs.

The CRU will identify thematic networks of expertise that can be mustered to address technical science problems ranging from development of advanced technologies to collaboration on studies that will benefit from the experimental power of having multiple study sites formed around a common

experimental design. The nucleus of these networks of expertise will be the CRU scientists who share expertise in particular technical disciplines. Such thematic networks of expertise could mirror the science themes listed above, as well as incorporating disciplinary areas such as:

- Population demography and modeling
- Conservation genetics and genomics
- Human dimensions
- Fish and wildlife health (including conservation medicine)
- Landscape ecology
- Climate science
- Invasive species
- Spatial ecology
- Quantitative science
- Restoration ecology
- Urban fish and wildlife ecology
- Ecosystem services
- Habitat and population monitoring
- Toxicology

The CRU will enable these networks of expertise with enhanced communication tools, funding support, and collaboration with professional scientific societies. These networks will be catalogued and distributed to cooperators and utilized in transboundary research development and implementation. The incentive for cooperators will be a greater return on their investment in a single CRU by virtue of access to a larger network. Cooperator engagement with any given network will be fundamental to ensuring the collaboration has an applied focus and can enhance outcomes by virtue of management feedback within an adaptive management framework.

Landscape Science

The CRU is in a unique position to facilitate scientific inquiry at landscape scales because the on-the-ground science they conduct at the behest of cooperators generates interest from beyond the traditional cooperator network. The CRU is not established to advocate for any particular science agenda; it serves to facilitate the needs of others and provide science solutions to their challenges—a neutral, trusted partner. The CRU will be better able to fulfill this role with technical and administrative improvements (see Conclusions) that will provide for a nimble complementary role with other efforts, such as Landscape Conservation Cooperatives (LCCs), and bring the strength of the CRU in identifying science solutions to the forefront. Each Unit is a cooperative science endeavor among state, federal, university, and nongovernmental cooperators. Units host regular cooperator meetings to discuss science needs and achieve consensus on research that the Unit will pursue. The USGS is a participant in all cooperator meetings as, to a lesser degree, are the USFWS and the Wildlife Management Institute (WMI). USGS can identify science needs brought forth by state cooperators that align with needs of other states, as can the states through their regional associations or AFWA. USFWS can bring regional and national perspectives, as well as science needs identified by LCCs. WMI has facilitated multiagency collaboration for decades and is instrumental in brokering the science needs of LCCs. The cooperator model that is in place has the capacity to identify and catalyze investigation and application of landscape science. Haukos et al. (2015) described how effectively this model can work in practice, where individual needs of several states overlapped with those of federal natural resource agencies and multiple CRUs responded. With the development of networks of expertise, the CRUs can be engaged as needed to tackle particular science aspects.

Building the Workforce of the Future: The Unit Brand

Developing the next generation of natural resource conservation professionals through graduate and postdoctoral education is one of the three legs of the CRU's mission. The CRU model that requires research to be sanctioned by cooperating agencies and organizations ensures that students will be engaged in research that has real-world management application. The needs of cooperating agencies are varied and range from traditional population and habitat management to landscape ecology and human dimensions, as well as application of advanced technologies such as unmanned aerial systems, conservation genomics, stable isotopes, and Bayesian analytics, to name a few. The diversity of the CRU research portfolio, based on the diverse needs of cooperators, will provide a cadre of skilled entry-level professionals whose skills range from traditional techniques to new and emerging technologies. However, a proactive approach to identify future scientific and technical skills that will be needed should be implemented in order to ensure that agencies are prepared to meet emerging challenges.

Ensuring that the future workforce will represent the diversity of the American people—an important component of societal relevance—will require additional efforts (Hallerman et al. 2014). As noted in the demographic data cited above, recent hires are not representative of U.S. population as a whole. The CRU can be a catalyst for increasing workforce diversity—indeed, the CRU has received numerous diversity awards in recent years, but it may have to expand upon its efforts beyond traditional recruitment approaches to increase its impact. Fortunately, an existing initiative in which the CRU is engaged—the Doris Duke Conservation Scholars Program (Duke Program)—shows promise. The Duke Program recruits undergraduate students from underrepresented societal segments through a competitive process at universities with Units. Currently, five universities and Units participate. These students are mentored by the CRU graduate students and faculty and work as technicians on Unit research projects. The students benefit by receiving hands-on training in research and orientation towards natural resource agency operations.

A similar effort is being developed through collaboration between USGS and USFWS where undergraduate technicians from underrepresented societal segments will assist graduate students in Units' applied research on national wildlife refuges. This effort and the Duke Program can establish a pathway for students to go on to pursue graduate education or enter the workforce after undergraduate training. As such, these programs can serve as pathways for both future scientists and resource managers.

A greater challenge is encouraging students from diverse backgrounds to pursue natural resource education in the first place. The AFS Hutton Program is an innovative effort that targets students in high school through an eight-week paid internship program with a fisheries professional mentor. Currently, the Hutton Program is not directly linked with incentives or programmatic connections that would support their continued involvement in collegiate natural resource education. Hutton, the Duke program, and the USFWS/CRU initiative could be expanded and greater linkages could be built so that these pathways become highways for developing a skilled workforce in natural resources.

Bridging Science and Management

Management and science should not represent a customer/client relationship in natural resources conservation. The relationship is most beneficial when collaborative and interactive and when it fosters learning that reduces uncertainty in how agencies fulfill their public trust responsibilities. The CRU is well positioned to facilitate such a relationship—in fact, its origins 80 years ago were based on this premise (Gofoth 2006; Whalen and Thompson 2015). Fruitful engagement is best fostered through ongoing relationships among managers and researchers where the initial focus is on conservation issues and challenges. The coupling of on-the-ground practical knowledge of managers with scientific design expertise of researchers can lead to identification of products needed to address these conservation issues and challenges. Some products could be in the form of research projects and science deliverables. Others could be technical assistance, such as training in emerging science tools or how to apply and interpret new science. The CRUs are particularly well positioned to help state wildlife management agencies and partners capitalize on the best aspects and applications of new and emerging technologies. Throughout,

the skills and training necessary to address emergent needs should be articulated by cooperators, and the CRU should incorporate them into education to prepare the future workforce.

Collaboration among researchers and managers should not end with a final report or a workshop. Ongoing engagement is essential in ensuring that science as delivered can yield desired outcomes. To foster this process, the CRU has developed capacity in decision-tool science. Adaptive management provides for a rigorous, iterative framework that facilitates learning by researchers and managers from management interventions, and adapting management accordingly, with systems modeling and scientific monitoring (Williams et al. 2009). This feedback loop ultimately can reduce uncertainty and ensure that resources are directed most efficiently and effectively.

Application of science to natural resources management can be contentious, particularly if there are opposing stakeholder interests. The CRU has developed capacity to train students in, as well as deliver, Structured Decision Making (SDM) processes. When stakes are high and transparency is essential, SDM is a valuable tool. The CRU is helping to develop a workforce with adaptive management and SDM capability so that agencies that hire the CRU students will have internal capacity.

Cooperating agencies have fundamental monitoring needs ranging from impact of harvest rates on species viability to population status of lesser-known species. Coupling of needs across cooperators can yield efficiencies and leverage resources to the benefit of all. For example, a state may need information on a species' population status as part of their State Wildlife Action Plan (SWAP), and that same species could either be a surrogate species for a LCC or a rare species under the umbrella of a surrogate species. A monitoring effort as part of a Master of Science project not only could inform the SWAP; it also could test the efficacy of the surrogate in representing the landscape needs of a priority species. The CRUs are positioned well to leverage such projects.

Conclusions

We began this paper with two questions: How relevant is the CRU model to current and future needs of the conservation profession and institution? And should the CRU refocus in order to maintain relevancy or move towards an entirely different model? We believe the CRU model, rather than being a relic of the past, was, at its inception 80 years ago, a harbinger of the future. It established a vital framework for federal, state, and nongovernmental collaboration in development of applied science to achieve conservation outcomes. The model is robust in relation to new advances in science and technology, while continuing to deliver the best of traditional fish and wildlife science and scientific training to the broader management community. Efforts in recent years (e.g., Haukos et al. 2015) have demonstrated that the model is not constrained by geography or organizations and functions effectively across political borders and large landscapes. A USFWS partner described one such multi-Unit endeavor as follows: "Any effort to collect data in a similar manner across multiple projects to first answer smaller localized questions, but then use this same information at a larger scale to get a landscape perspective, is resulting in information that will ultimately inform future management across multiple spatial scales" (Clay Nichols, USFWS, Arlington, TX, personal communication, February 24, 2015). This statement speaks to the essence of the CRU model: grass roots science and management that collectively informs landscape-level conservation.

Rather than recasting the model, efforts can focus on further enabling transboundary landscape work. This effort may involve modifications to the cooperative agreements for each Unit as they become renewed in order to facilitate a broader cooperator network. Modifications can be designed to allow greater cooperation and sharing of resources among other science practitioners and collaboratives such as USGS Climate Science Centers, USGS Ecosystem Mission Area Science Centers, USFWS Fishery Centers, LCCs, and Joint Ventures. Cooperators could dedicate funds to be used to incentivize transboundary work. In addition to annual cooperator meetings, periodic "brainstorming" sessions where cooperators and others can discuss issues and challenges and forecast future challenges and science needs would be productive. Ideally, there would be forums where these discussions would occur in a regional context (e.g., LCCs, AFWA regional associations, USFWS project leader meetings). Currently, the CRU

is engaged in such discussions with a range of partners including traditional cooperators and other conservation organizations (e.g., Wildlife Conservation Society).

The CRU is the brainchild of the legendary J.N. "Ding" Darling. Darling, in reminiscing on the uncertain beginnings of the CRU, noted that the Unit program "has produced an amazing volume of original information on wildlife problems and has developed scores of new techniques in wildlife management while training literally thousands of young people for professional careers in wildlife work" (Lendt 1979, 80). Indeed, since the year 2001 alone, more than 2,500 students have graduated from the Unit program, with most going on to careers with state, federal, and private conservation institutions. The CRU model has stood the test of time and is well positioned to continue serving the evolving needs of the conservation institution.

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Closing Remarks
Cooperative Research Units: Getting Ready for the Future

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There are two kinds of people in this world—those who want to talk about how it used to be and those who want to talk about how it's going to be. In this session, we have learned about the rich 80-year history of the Cooperative Fish and Wildlife Cooperative Research Units and we have learned how they are uniquely positioned to help us get ready for a future full of change and challenges.

Our speakers have shared with us some case examples of past and recent projects that have four characteristics in common:

1. They are projects to solve pragmatic management problems at local to global scales.
2. They help build a cadre of future conservation leaders.
3. They strengthen partnerships between federal, state, tribal, local governments, and nongovernmental conservation organizations.
4. They make efficient use of scarce resources.

Increasingly, we have seen that all the biggest fish and wildlife management problems transcend state boundaries, and many Coop Unit projects are collaborative between multiple units and states to address regional and larger scales. Several examples include the Northwest Forest Plan and Columbia Basin fish recovery strategies as well as the sage grouse and prairie-chicken conservation strategies, which are based on pioneering work by the units.

I have been working in fish and wildlife conservation for more than 45 years. And in my experience, every 10 to 15 years some "big thinker" in a federal agency decides the Coop Unit model is "obsolete" or "out of touch" with the broader science challenges and orders the budget cut and/or the organization changed. This is the equivalent of kicking the hornets' nest!

Each time, all hell breaks loose as the partners rise up and yell, "Over my dead body will you screw up these Coop Units!" Normally, the issue settles down with the security of the Coop Units restored. But also, each time is an opportunity to rearticulate the value, expand the partnerships, and remove barriers to more effective collaboration. The purpose of this session at the North American Wildlife Conference is to do these things without having to have a crisis to stimulate it. We have a new Chief, Dr. John Organ, who has organized this session to stimulate exactly that healthy conversation.

Looking forward, we face a future of conservation challenges like none we have faced to date. There are three huge forces of change simultaneously bearing down on fish and wildlife conservation:

1. Rapid human population growth and the development forces that accompany that growth.
2. A rapidly changing climate.
3. An increasingly tight budget situation at both the state and federal levels.

As an example, I live in the Pacific Northwest—salmon country. By 2100, the best projection for human population growth in our area is roughly three to four times the population at 2000. How will we create a landscape conservation strategy capable of protecting fish and wildlife in the face of this growth? Consider the energy, water, and land demands.

As if this wasn't daunting enough, in Portland, Oregon, in 2100, we will probably have the climate that is currently associated with Sacramento, California. The rate of change of the climate is roughly 400 miles of latitude per century. Now, consider what the interactions will be between a changing climate and a rapidly increasing development demand, fueled by expanding human population.

Regarding available budgets in the future for conservation research and management, make no mistake—the battle is just beginning! There are plenty of deficit hawks and, frankly, mindless government haters in congress and state legislatures across America. The battle over the scope and role of government and science is just beginning. The outcome is far from clear.

We also see that the good old days of state fish and wildlife agencies having the resources to have their own research divisions are rapidly disappearing. Increasingly, cooperative and collaborative research is the only option that is productive and fundable.

All of these forces point to the role of Cooperative Fish and Wildlife Research Units providing the critical information to address the challenges of the future. And for research capacity to survive, the chorus of supporters and partners will have to sing loudly! We already have strong support from states, federal agencies, nongovernmental organizations, and tribes. This support is important but not sufficient. We also need effective business and political voices speaking up for the units and that is a challenge for the future.

The bottom line is: in this reality, you don't get the conservation program you deserve—you get the one you fight for. Now is the time to expand on this rich 80-year history of excellence in science and collaborative problem solving. We need more partners, broader funding bases, more regional projects, and new voices connecting strong resource management to a livable community and a healthy economy. These are the messages of relevance that will gain political traction and financial support in current political decisions regarding priorities.

We will build a new strength in our Coop Unit program, building on our rich tradition, mindful of a huge challenge posed by the forces of the future—and we will plan for the way it is going to be!

Workshop.
Urban Wildlife Conservation in Cities and Suburbs: Pollinators, Agriculture, and the Great Midwest

Bees, Flowers, and People in Urban-Agricultural-Wildland Interfaces

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There are many published papers of bee species recorded from cities throughout the world (Hernandez et al. 2009; Frankie et al. 2013). Most of these accounts are associated with flowers from various types of urban vegetation, vegetable/habitat gardens, and even fallowed sites within urban environments. In this paper we discuss the ecological work on native bees and their flowers in California and generalize, where possible, about relationships between bees, flowers they prefer, and people who interact with both groups of organisms.

Sixteen hundred bee species have been recorded in California, which is 40 percent of the 4,000 bee species known in the U.S. and Canada. This high diversity can be attributed to the highly diverse

landscapes with diverse plant communities throughout the state. About 20,000 bee species have been recorded globally, and some experts claim there may be closer to 25,000 (J. Asher, personal communication; Frankie et al. 2014). Much work remains for bee biologists and bee taxonomists, especially in some developing countries.

The Urban California Native Bee Survey

In 1999, the Urban Bee Lab of the University of California at Berkeley (UC Berkeley) initiated a survey of native bee species and native and nonnative flowering types (species and cultivars) they prefer to visit in urban gardens statewide. It started with several city gardens in north-coastal Berkeley and adjacent Albany. With productive results from these two cities, the survey quickly expanded to seven cities and subsequently to 15 (Frankie et al. 2009). The study area now covers major cities from the northernmost city of Redding to Palm Springs in southern California and inland to the Great Valley and eastward to Bishop on the east side of the Sierra Nevada mountains in the Great Basin region (see Figure 1).

Two methods were used to survey bee species and record relative host flower attractiveness: bee visitation, or frequency counts, on selected plant species—three-minute counts on approximately one square-meter of flowering vegetation to record which bee groups (or species when possible) were associated with which plant species and their frequencies of occurrence. Visiting bees were also netted from host flowers for later positive identifications at the species level. About 8,000 of these counts were progressively put into an ACCESS database that eventually led to a list of the most frequently encountered bee species and the most attractive floral host plants. These findings have recently been published in a book entitled *California Bees and Blooms: A Guide for Gardeners and Naturalists* (Frankie et al. 2014). Although the work is based in California, the conceptual approach and survey methodology can serve as a model for other states or regions as most of the common bee genera treated are found throughout the U.S. and Canada.

Major Findings

One of the survey's major findings was that many cities contained a higher diversity of native bees than originally presumed. Several patterns emerged from the survey. Between 90 and 100 bee species were recorded in most monitored cities: Ukiah in northern California had 95 species; San Luis Obispo in southern California had 99 species. At the high end of bee diversity was Descanso Gardens of La Cañada Flintridge of southern California (near Pasadena) where 112 species of bees have been collected to date. The overall state total for all gardens combined is 400-plus species from 500-plus host flower types. When sampling was repeated over a period of at least three to four years, many bee species were recorded, including the rare ones. Native bees were scarce in a few cities, such as San Diego, Carmel/Pacific Grove, and Paso Robles. These had relatively low plant diversity and/or few relatively bee-attractive plant types.

Another major finding was that there were predictable relationships between plant types and groups of bee genera and species they attract throughout the state. For example, the climbing nonnative vine *Wisteria sinensis* (Fabaceae) is attractive to large carpenter bees (*Xylocopa* spp.). This is the only group large enough to push open the stiff flower parts to reach the nectar. Honeybees try but are mostly unsuccessful. The California poppy, *Eschscholzia californica* (Papaveraceae), attracts three main groups of bees: honeybees, one bumblebee species, *Bombus vosnesenskii,* and up to four species in the sweat bee family, Halictidae (*Halictus* spp. and *Agapostemon texanus*). In early spring, andrenids are also common visitors to California poppy. At the other extreme are species such as the native *Phacelia tanacetifolia* (Boraginaceae) and the nonnative *Lavandula* "Provence" (Lamiaceae) that each can attract diverse bee species statewide; 60 for the former and 57 for the latter plant type.

Predictability of bee-flower relationships can be put to practical use in designing bee (or general pollinator) gardens, which is becoming popular in California and other states as well (Frey 2001, 2009).

Individuals with this knowledge have started businesses offering to create pollinator habitat gardens or to modify existing gardens to attract native bees and other flower visitors (K. Frey, J. Pawelek, personal communication). These predictable relationships can also be used to establish habitat gardens within agricultural areas with the goal of attracting native bees to supplement honeybee pollination.

Native Bee Biology, Behavior, and Ecology

Generalizations are difficult to make about native bees as a group. Each species is distinct in its biology, behavior, and ecological relationships. Each species has its own life story, which is the case for all organisms—invertebrates and/or vertebrates. To effectively use the above predictive knowledge requires background information on both bees and plants. We have been gathering this kind of information since 2003 when we established a bee-flower evaluation garden at the Oxford Tract field facility on the University of California campus in Berkeley. Its goals were: 1) describe bee-flower relationships by documenting which bee species were attracted to the almost 250 plant species (and cultivars) that we have evaluated thus far; 2) monitor selected bee-flower relationships through time to gather data on bee diversity, abundance, and seasonality; and 3) gather information on plant management methods that encourage vigorous flowering resulting in ample pollen and nectar.

Oxford Garden Findings

A wide variety of ornamental plant species and cultivars have been grown over the years in the UC Berkeley Oxford Tract garden, providing the opportunity to evaluate bee-attractive host flowers for most of the resident native bee species (Van Groningen et al. 2014). The most attractive flowers belong to members of the families Asteraceae, Lamiaceae, and Boraginaceae (Hydrophyllaceae). Host plant records for bees in other cities with different seasonal climates, such as Sacramento and La Cañada Flintridge, helped to confirm these preferred host plant families. Many favored host plant species were native to California; however, many nonnatives were also attractive, such as a variety of *Lavandula* spp., *Cosmos* spp., *Nepeta* spp., and *Salvia* spp. Origins of nonnatives were mostly northern Mexico and the Mediterranean. Some were also natural hybrids and products of selected breeding. Ornamental plants from Central and South America, Africa, Australia, and New Zealand were noticeably unattractive to California native bee species.

Monitoring bees over time in the Oxford garden also provided information on bee seasonality. Like seasonal patterns of flowering, bee species have predictable seasons when adults are present. Adults emerge during specific time periods to mate, forage, construct nests, and reproduce. Native plant and native bee seasons in California range over about 10-and-a-half months. We recognize four seasons for native bee species. The first is from late winter (mid-December) to early spring, the second lasts through most of spring, the third entails the summer months, and the fourth is late summer through early fall (late October). During each of these periods, characteristic groups of bees can be expected to appear, with overlap between seasons for some species (see Figure 2).

Flowering times of native California plants are largely focused on spring and early summer. Many of these plants flower relatively briefly, and native bees appear to have adapted to search for each new flowering species as they appear in a succession in wild areas. The tendency to search has been retained in bees in urban areas as they seek new plants as the flowering season progresses with both native and nonnative plant species. The searching behavior is also important in establishing habitat gardens as described below.

Nesting

Although we know that bees visit their preferred flowers in urban areas, and sometimes in high numbers, we do not know much about their nesting habits. Do they nest in gardens they visit for flowers, or elsewhere? A long-term study by the Urban Bee Lab in Costa Rica is currently investigating this

question. Preliminary results suggest that nests of most species are widely scattered and not necessarily located near the urban floral resources they visit (Frankie et al. 2013). Much work remains to be done on this question.

Most California native bee species—an estimated 70 percent—are ground nesters. Most others are cavity nesters, nesting in old beetle holes, hollow stems, or other tubular cavities. A few actually chew nest tunnels in soft wood or pithy stems. Honeybees and bumblebees build hives in larger cavities like tree holes and abandoned rodent and bird nests. The few remaining are cuckoo bees that parasitize nests of other bees.

The nesting behavior and seasonal activity of cavity-nesting species can be studied in greater detail by making artificial cavities in 4-inch-by-4-inch wooden blocks or using other hollowed structures such as paper straws or bamboo. Care must be taken in managing these artificial cavities as they are typically clustered together and can attract natural enemies of bees (Maclvor and Packer 2015). Clustering rarely occurs in nature as nests of most native bee species, cavity or ground nesters, are usually widely scattered—probably to reduce discovery by natural enemies. It is recommended that the artificial cavities be periodically cleaned out, at least once each year.

Education Outreach to the Public

Certain biological, behavioral, and ecological facts about native bees lend themselves conveniently to public education. All outreach should address the "sting scare." We do this by noting that bees are vegetarians seeking pollen and nectar and are not interested in stinging humans. Wasps, on the contrary, are mostly carnivores, and some wasps, like yellow jackets, will go after your picnic foods. However, most wasp species, like bees, are beneficial, preying on or parasitizing some plant-eating pests.

It can also be mentioned that only female bees sting (males do not have stingers). This is part of the characteristic morphology and lifestyle of all bees, wasps, and ants, all three of which belong to the order Hymenoptera (Grissell 2010). A common question among our audiences has been how to distinguish male and female bees. The response is that some species are easy to separate and others require expert skill (and use of a microscope). If large male bees (e.g., *Xylocopa* spp.) are available for presentations, we invite the audience to hold the male and feel the vibrations as the bee attempts to escape. The vibration sensation is unforgettable by those who dare to hold or just touch the bee briefly. Kids love the experience and often have very little fear of holding the bee. They in turn get their parents, who are often more afraid of bees than their children, to participate in the experience.

There are many other interesting facts that can be described, such as male territorial behavior, especially in male carpenter bees; greenhouse tomato pollination by bumblebees, which involves vibration of specialized anthers in the family Solanaceae to release pollen through small pores; and primary nectar robbing in flowers by carpenter bees, which pierce holes in petal bases, followed by secondary robbing at the same flower holes by honeybees and other bees. Audiences we address include school groups, garden clubs, native plant societies and clubs, beekeepers, farmers, farm workers, extension specialists, master gardeners, Audubon chapters, college students, horticulture professionals, and other scientists.

During most presentations on native bees, audiences will ask if native bees are declining like honeybees (with reference to Colony Collapse Disorder, or CCD) and what the causes of decline are. The standard answer we offer is that there is no single cause that can be attributed to decline. There are, however, several factors that, in combination, most likely result in bee decline. The most obvious causes include: 1) loss of habitat through human development, 2) widespread use of pesticides, and most recently neonicotinoid compounds, 3) human pollution of large landscapes (such as smog in Chinese cities), 4) drought conditions (one to several years), and 5) long-term climate changes that disrupt flowering patterns and synchronization with pollinators (Henry et al 2012; Whitehorn 2012; Williamson & Wright 2013; Sandrock 2014; Rundlöf 2015; Frankie et al. 2013).

Many NGOs (nongovernmental organizations) and community groups have organized events and other creative ways to call attention to honeybees and native bees. These actions include forming bee

watch groups such as Texas Bee Watch; conducting annual citizen bee counts; establishing programs to replace water-thirsty lawns with native plants; creating school gardens to educate the next generation about urban wildlife and especially bee pollinators; lobbying civic groups and government agencies to build pollinator conservation into their mission statements; lobbying local horticultural nurseries to label plant products that contain neonics or insisting on plant materials with no history of neonic exposure; and developing literature, posters, and webinars to better educate the public on the status of pollinators and what individuals can do to become involved with pollinator conservation (Sonoma bee count, Frankie et al. 2014; Tallamy 2009).

Habitat Gardening

The interest in habitat gardening to attract wildlife has expanded to include pollinators, in addition to the birds, butterflies, and small mammals that people wish to see in their gardens (Tallamy 2009). Habitat gardening is the design and implementation of several principles to encourage wildlife to visit and thrive in gardens. These principles for bees include:

1. **Food.** This can be achieved by planting flowers, particularly those native to the area. Flowers provide nectar and pollen for foraging bees, which utilize the nectar for flight fuel and a mixture of nectar and pollen to feed their young.
2. **Water.** Honeybees require water for survival, but most native bees meet their water needs through drinking nectar, though many will need water to make mud for nesting. A birdbath with exposed rocks or floating cork so bees can land and drink is one option.
3. **Nesting.** Most native bees nest underground and leaving bare patches of dirt/soil in the garden will encourage them to stay and nest. Bee condos, which provide habitat for cavity nesting bees, can also be added to habitat gardens. They must be managed properly, however, which means cleaning them out after use and mounting them in places where they will be best utilized. Bee condos need a roof to protect them from rain and should be placed where they receive morning sun and afternoon shade to ensure the brood survives.

The Urban Bee Lab gives presentations all over California to interested groups, teaching them how to create these types of gardens for bees or how to modify existing gardens to become bee-friendly. Our research in urban areas has led to the creation of a list of attractive bee plants for California gardeners, which is posted on our website: helpabee.org. These lists and observations across the state have also led to the creation of several "garden recipes" that help gardeners design the perfect pollinator garden suited to their needs (Frankie et al. 2014; Pawelek et al. 2015, in press).

Habitat gardening is becoming so popular that several landscaping and garden design companies (Kate Frey Sustainable and Organic Gardens, Wild Bee Garden Design, BASE Landscape Design) have expanded to include our recipes. Cities and schools are also becoming interested in having bee-friendly plantings and installing pollinator gardens. Even community gardens, like the Emerson Park Community Garden in San Luis Obispo, have been successfully modified to be pollinator-friendly (Pawelek et al. 2009). Several public and private gardens, like the Melissa Garden in Healdsburg and the Haagen Daaz Honey Bee Haven in Davis, are specifically designed and planted to attract and benefit bees.

Habitat Gardens in Agricultural Lands

In 2009, the Urban Bee Lab was invited by the USDA Natural Resource and Conservation Service to apply our knowledge of bee-flower relationships to small farms in Brentwood, Contra Costa County, California, to investigate whether urban horticultural bee-attractive plants could be used to develop habitat gardens to attract native bees to agricultural fields with the goal of supplementing honeybee pollination of crops. The work began in 2010 with one small organic farm, Frog Hollow Farm, owned and operated by farmer Alfred Courchesne. By 2012, the project, dubbed "Farming for Native

Bees," had grown to include eight farms (four organic and four conventional). Four of these were treatment farms on which bee-attractive plants have been progressively added and four were control farms used for comparison.

The Farming for Native Bees project aims to:

1. Provide farmers with a stable, cost-effective, and sustainable **supplement** of native bees to honeybees.
2. Establish **new habitats** that will work to conserve and protect California's native bees.
3. Form **partnerships** between researchers, farmers, and other stakeholders to implement native bee habitats and outreach to members of the agricultural community.

More specific ecological goals included: 1) interface local farming ecology with native bee ecology, 2) synchronize flowering of installed bee plants with crop flowering species, 3) record native bee species that move between installed bee plants and crop flowers, and 4) enhance nesting habitat for bee species regularly moving between bee and crop flowers. Using these data, we are working on developing a series of prescriptive treatments to be utilized by farmers to enhance native bee pollination services for specific crops (e.g., cherries, several varieties of berries, and apples).

Preliminary results from the Farming for Native Bees project have been extremely promising. We introduced approximately 80 bee-attractive plant types to the four treatment farms, with more than 300 individual plants in each habitat garden. These habitat gardens have attracted 106 species of bees to the Brentwood farm locations, and we have identified at least nine native bee species regularly moving between bee plants and crop flowers. The project is now looking at nesting requirements for target bee species (e.g., *Ceratina* spp.).

Researchers from the lab regularly visit the farms (sometimes as many as three times a week during the growing season) and interact with farmers and their workers. We share information about bees, and farmers share information about farming management and operations. This exchange of knowledge has been crucial to project success, particularly for developing native bee farming practices that can be applied in a practical farm setting. As partnerships between the Urban Bee Lab and participating farmers have matured, unexpected opportunities have arisen. Farm partners have offered more areas to establish native bee habitat. Farmers are also now able to recognize native bees on their crop plants and they report observations.

While results of Farming for Native Bees have been encouraging, the work is ongoing and there are still a number of unknowns that need more investigation. Emphasis is now being put on farmer adoption of native bee farming and how this work can be realistically interfaced with the busy and unpredictable nature of farming operations. To explore this issue further, the farming project is being replicated in Ventura County, California, with avocado growers whose operations are often much larger than the small farms in Brentwood.

Concluding Remarks

The recent declines in honeybee populations have dramatically impacted public knowledge and perception of bees. Colony Collapse Disorder and, more recently, neonic pesticides are widely recognized issues. Many publications and documentary films on the plight of bees have begun to appear, and NGOs such as the Xerces Society, Pollinator Partnership, and numerous small, local groups across the nation have been promoting native bees and other flower visitors as alternative pollinators. Many civic and governmental organizations have also written pollinator conservation into their mission statements and actions to help honeybees and to learn more about native bees have followed.

Through research and outreach in urban, agricultural, and natural areas, the Urban Bee Lab has sought to inform and encourage this growing public interest and action. We believe that by helping the public develop their "bee eyes" to better see the world of bee-flower relationships and their importance to plants, wildlife, and humans, we can help change the course of bee decline.

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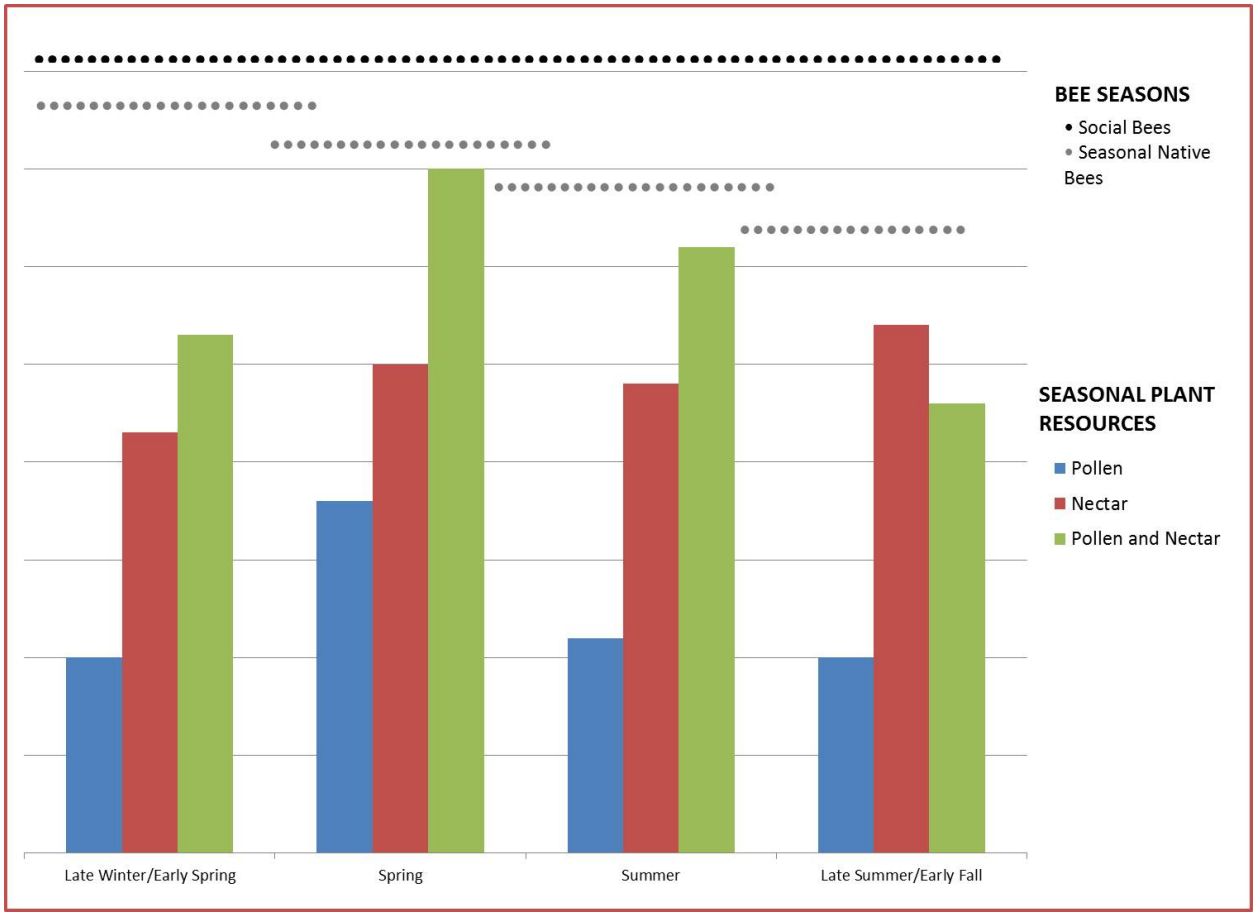
Figure 1. Distribution of California cities surveyed for bee-flower relationships, 1999 to present.

Figure 2. Generalized presentation of bee seasons superimposed on floral resource seasons (Frankie et al. 2014).



Urban Pollinator Conservation in the U.S. State Wildlife Action Plans

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Introduction

The U.S. State Wildlife Action Plans (SWAPs) provide an important framework for conserving many ecologically and economically important groups of organisms. Forty of the 56 SWAPs incorporate information about animal pollinators, including species of bees, flies, butterflies, skippers, moths, bats, and birds. Pollinators are essential for reproduction of many species of flowering plants and thus have considerable value in natural as well as agricultural ecosystems. Concerns have been raised recently in the United States about population declines in many pollinator species, from bumblebees and honeybees to the monarch butterfly. In this paper, we provide information about pollinator species that have been included in the SWAPs and discuss strategies by which states could incorporate information about pollinators and pollinator conservation activities into future SWAP revisions. Although our paper focuses primarily on urban pollinators, many of the recommendations we present here are broadly applicable to pollinator taxa in other settings and contexts as well. We conclude with a case study of pollinator conservation activities associated with implementation of the Nebraska State Wildlife Action Plan.

Development and Taxonomic Coverage of State Wildlife Action Plans

The State Wildlife Action Plans, also known as Comprehensive Wildlife Conservation Strategies, describe strategic conservation approaches for wildlife and wildlife habitats in each of the 50 U.S. states, the District of Columbia, and five U.S. territories. Each plan is the product of close collaboration between state, federal, tribal, and local conservation partners who have joined together to identify shared conservation priorities. Each plan has been designed to help guide wildlife conservation activities in a particular state or territory over a five to 10 year period for the express purpose of preventing species of wildlife from becoming endangered. Together, the plans form a comprehensive blueprint for wildlife conservation across the entire United States (Association of Fish and Wildlife Agencies (AFWA) 2012).

The process of preparing the SWAPs began in 2000, when the U.S. Congress established the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program. As a condition of receiving funding under these programs, Congress required all 50 U.S. states, the District of Columbia and five U.S. territories to develop SWAPs by October 1, 2005. Each SWAP was required to identify wildlife species needing conservation efforts, identify key habitats for these species, identify threats to species and their habitats, outline strategies for ameliorating those threats and conserving species and their habitats, and describe methods for monitoring and evaluating the results of these actions. States were given the flexibility to customize the details of the plans in order to meet their own unique needs and ecological conditions. The SWAPs produced by each state and territory were then reviewed by the U.S. Fish and Wildlife Service (USFWS) and all of the plans were officially approved in 2006 (AFWA 2012). In accordance with guidance provided by USFWS, every SWAP was required to include the following set of basic elements:

1. Information on the distribution and abundance of wildlife, including low and declining populations, that describes the diversity and health of the state's wildlife;

2. Descriptions of locations and relative conditions of habitats essential to species in need of conservation;
3. Descriptions of problems that may adversely affect species or their habitats, and priority research and survey efforts;
4. Descriptions of conservation actions proposed to conserve the identified species and habitats;
5. Plans for monitoring species and habitats, and plans for monitoring the effectiveness of the conservation actions and for adapting these conservation actions to respond to new information;
6. Descriptions of procedures to review the plan at intervals not to exceed 10 years;
7. Coordination with federal, state, and local agencies and Native American tribes in developing and implementing the wildlife action plan; and
8. Broad public participation in developing and implementing the wildlife action plan (AFWA 2012).

Each SWAP includes a list of Species of Greatest Conservation Need (SGCN) for a particular state or territory. These lists were developed by state wildlife agency staff in collaboration with teams of outside experts and partners. The lists of SGCN in the first set of SWAPs tended to focus on vertebrate organisms, with birds, mammals, fish, reptiles, and amphibians well represented. Invertebrate groups such as insects, mollusks, crustaceans, and worms received less attention in the first round of SWAPs (Bried and Mazzacano 2010; The Heinz Center 2013). These differences in coverage of taxonomic groups exist for several reasons. Fish, mammals, and birds are popular with hunters, anglers, bird-watchers, wildlife-enthusiasts, and many members of the general public. Dedicated funding is available for the conservation of many of these species, supported by excise taxes on hunting and fishing equipment and also by private contributions from wildlife enthusiasts (Organ and Mahoney 2007). Many of the state fish and wildlife agencies were established for the explicit purpose of conserving fish and game species and thus may not have the legal authority to manage nonvertebrate groups. In some states, certain nonvertebrate groups such as insects fall under the authority of the state department of agriculture rather than the state fish and wildlife agency (The Heinz Center 2013).

Pollinators and Pollinator Declines in the United States

Pollination is a mutually beneficial relationship between plants and pollinators wherein the plant provides pollen and/or nectar to the pollinator and the pollinator provides reproductive services for the plant (National Research Council (NRC) 2007). Roughly 75 percent of the 240,000 species of flowering plants worldwide rely on pollinators for flower reproduction (NRC 2007). This includes many plant species that provide browse or forage for larger wildlife, as well as plant species that provide seeds and fruits to support birds and small mammals. Many of the most popular game species as well as many of the most popular "watchable wildlife" species are thus dependent on animal pollinators for part or all of their food requirements. Pollinators are also crucial to the U.S. agriculture industry, since 130 of the plant species grown as crops in the U.S. rely on animal pollinators to produce seeds and fruit (Klein et al. 2007; Calderone 2012).

Available evidence indicates that certain pollinator species have been declining in the U.S. (NRC 2007). Probably the most widely known example of a pollinator decline in the U.S. is the phenomenon known as "colony collapse disorder" in commercial honeybee colonies (vanEngelsdorp et al. 2009). Declines in pollinator populations can be traced to a multitude of causes, including intensive agricultural practices, use of certain pesticides, and habitat loss and degradation (Potts et al. 2010). Some species such as bumblebees and honeybees have experienced declines as a result of the spread of pathogens and diseases (Kremen et al. 2002; NRC 2007). Climate change is also expected to provide additional challenges to pollinator populations, ranging from disruption of migratory paths of pollinators such as hummingbirds and bats to decoupling of plant-pollinator interactions when plants and pollinators respond differently to climate cues (NRC 2007).

New Discoveries Highlight Urban Pollinators

Recent field studies have revealed that urban and suburban landscapes across North America can actually support diverse assemblages of animal pollinators. More than 200 species of bees have been recorded from the New York City metropolitan area in recent surveys by John Ascher and colleagues at the American Museum of Natural History, including four species new to science (Olson 2011). In Maryland, Droege and Shapiro (2011) and Shapiro and Droege (2011) have found 49 native bee species in field surveys within the heavily urbanized Port of Baltimore and 82 native bee species at the Cove Point Liquefied Natural Gas facility in Calvert County. One interesting finding from these surveys is that some native bee species, such as the large carpenter bee (*Xylocopa virginica*), may nest preferentially in urban areas near human habitations (Droege and Shapiro 2011; Shapiro and Droege 2011). Bee taxa such as large carpenter bees that thrive in urban areas can provide important pollination services for the urban flora, including decorative plantings, green roofs, bioretention plantings, street trees, and urban vegetable and fruit gardens (Keasar 2010).

Even relatively rare species of pollinators may occur in urban areas. Small patches of suitable nesting or foraging habitat for rare pollinator species may persist in urban parks and other areas where native vegetation is present. The lead author conducted surveys of native bees in urban Washington, DC, during the spring, summer, and fall of 2014, and identified at least three nesting sites for the declining American bumblebee (*Bombus pensylvanicus*): one in a meadow at the U.S. National Arboretum and two in vacant lots in the Shaw neighborhood. The Karner Blue butterfly, discussed in more detail below, is another example of a rare insect species that persists within the Albany, New York, metropolitan area. The monarch butterfly can be found in many urban and suburban areas throughout the United States where its larval milkweed hosts and/or nectar plants for the adult butterflies are present.

Pollinators, Urban and Otherwise, in the SWAPs

Pollinator conservation was not specifically identified as a priority topic for the original set of SWAPs (The Heinz Center 2013). Nonetheless, many individual pollinator species were included in the first set of SWAPs, including species of hummingbirds, bats, bees, butterflies, skippers, moths, and flies. According to an analysis prepared by The Heinz Center (2013):

- 230 different species of butterflies are mentioned in 40 of the 56 total SWAPs.
- 36 SWAPs mention one or more moth species, some of which are known pollinators.
- 49 different SWAPs mentioned a total of 64 different bat species, although only a few of these are confirmed pollinators.
- 18 distinct hummingbird species were included in 24 SWAPs.
- Only 11 SWAPs cited flies, mentioning 11 different species.
- Only 10 SWAPs mentioned bees, although these states included a total of 31 bee species.

In light of the recent conservation attention to the monarch butterfly, it is interesting to note that only three states or territories selected the monarch butterfly as a SGCN in their first SWAP documents: California, Kansas, and the District of Columbia. California's SWAP specifically mentioned the overwintering sites for the monarch butterfly on the Monterey Peninsula as a conservation priority. Kansas's inclusion of the monarch butterfly in its SWAP appears to have been driven by public interest generated in part by the "Monarch Watch" program at the University of Kansas. And the heavily urbanized District of Columbia has small populations of most of its butterfly species and thus was one of the few jurisdictions to include common and widespread butterflies as SGCN (M. Pfaffko, personal communication 2014).

Urban pollinators, particularly butterflies and moths, feature prominently in many of the SWAPs. One of the best-studied urban species is the federally endangered Karner Blue butterfly (*Lycaeides*

melissa samuelis; USFWS 2003). The type locality for this species was a large sand dune complex located entirely within the city limits of Albany, New York (Nabokov 1943, 1949). Destruction of this area by human activities contributed to conservation concern for this species that ultimately led to its formal listing as endangered under the U.S. Endangered Species Act (Andow et al. 1994). The Karner Blue butterfly has subsequently been found in several other states and was included as a SGCN in eight of the original SWAPs: Illinois, Indiana, Michigan, Minnesota, New Hampshire, New York, Ohio, and Wisconsin.

New Context for State Fish and Wildlife Agencies

Since the completion of the original SWAPs, several key documents have appeared that provide important new context and guidance for state fish and wildlife agencies interested in managing pollinator populations. Probably the best known is President Obama's "Presidential Memorandum – Creating a Federal Strategy to Promote the Health of Honeybees and Other Pollinators." Issued on June 20, 2014, this memorandum calls for federal and state agency action to stem pollinator declines and specifically identifies SWAPs as a vehicle for the conservation of the monarch butterfly and other pollinator taxa (The White House 2014). In September 2014, the directors of the U.S. state fish and wildlife agencies unanimously passed a resolution in support of voluntary efforts to conserve the monarch butterfly at the annual business meeting of AFWA. In March 2015, a new memorandum of understanding was signed by AFWA President Larry Voyles and USFWS Director Dan Ashe that encourages the states and USFWS to collaborate on projects that benefit monarch butterflies and other pollinator taxa, including incorporating these species in SWAP revisions. Finally, the recent petition to list the monarch butterfly as a threatened species under the U.S. Endangered Species Act has generated considerable interest in voluntary and nonregulatory approaches to conserve this species and other declining pollinators.

Opportunities for Pollinator Conservations in State Wildlife Action Plan Revisions

State fish and wildlife agencies are currently in the process of revising the original set of SWAPs, with revisions due to USFWS by October 2015 (AFWA 2012). Many states are taking advantage of this opportunity to incorporate new information about animal pollinators in their revised SWAPs. At the AFWA Wildlife Diversity Program Managers meeting in January 2015, the authors facilitated a conversation with representatives from state fish and wildlife agencies about their plans for incorporating pollinator taxa, pollinator habitats, and conservation actions to benefit pollinators into their SWAP revisions.

Many states are considering adding high-priority pollinator taxa to their lists of SGCN. In addition to the monarch butterfly, most states are evaluating other species in the order Lepidoptera as potential SGCN for their SWAP revisions. Besides butterflies, other pollinator groups of interest within Lepidoptera include skippers (family Hesperiidae) and hawk or sphinx moths (family Sphingidae). Most states already include information about relevant vertebrate pollinators such as hummingbirds and nectar-feeding bats in their existing SWAPs (The Heinz Center 2013).

States can also highlight ecological communities that support multiple pollinator species in the habitats chapter of their State Wildlife Action Plans. Ecological communities that support large and diverse pollinator communities throughout the United States include many of the early successional habitats such as barrens, prairies, grasslands, shrub-scrub communities, and wet meadows, including sites that have been restored through human activity (Droege et al. 2009). Certain key habitat features support many native bees, particularly open areas of bare, sandy soil. Remnant areas of natural vegetation within agricultural landscapes and urban landscapes are also especially important for supporting populations of pollinator species.

States will likely include many different actions to benefit pollinator species in their SWAP revisions. These actions may include conservation of existing pollinator habitat areas as well as restoration or creation of habitat areas for pollinators. Some states are discussing the application of

integrated pest management in parks and natural areas to reduce pesticide exposure to nontarget organisms, including pollinators. Many states are considering the implementation of surveys and inventories for particular pollinator taxa, including native bees, butterflies, moths, and skippers. Data from these surveys would then be included in the state Natural Heritage databases and the national NatureServe database. Several eastern states, including Maryland and Delaware, have collected enough information on native bee populations to begin the process of developing NatureServe S-ranks and G-ranks for these important pollinator species (M. J. Sarver, personal communication 2014).

First Steps for States Interested in Pollinator Conservation

For states that have not yet begun to consider the incorporation of pollinators into their SWAPs, some basic first steps might include:

- Highlighting and recognizing pollinator SGCN in the SWAP revision through a call-out box in the document or even a separate stand-alone publication;
- Highlighting key pollinator habitats in the state, as part of the SWAP revision;
- Commissioning statewide surveys for one or more pollinator groups;
- Identifying specific conservation actions in the SWAP that also benefit pollinators;
- Working with the Natural Resources Conservation Service to explore opportunities for restoration of pollinator habitats within agricultural landscapes; and
- Working with partners to develop and implement outreach and education programs, especially in urban areas, that help build public understanding of pollinator declines and generate support activities that conserve pollinator populations (The Heinz Center 2013).

Case Study: Pollinators in Nebraska's State Wildlife Action Plan

The Nebraska SWAP includes pollinator taxa such as butterflies, moths, and skippers as SGCN. Through SWAP implementation, conservation practitioners across the state are taking action to improve the status of these species. For example, surveys are underway to determine if the rare Tawny Crescent (*Phyciodes batesii*) is still extant in Nebraska and needing conservation action or if it has been extirpated due to climate change. Many prairies are being restored using high diversity seedings that include specific host plants for at-risk pollinators such as the Regal Fritillary (*Speyeria idalia*).

Many partners are providing pollinator habitat at large landscape scales that benefit multiple species. For example, Nebraska Pheasants Forever, Inc. is actively restoring and enhancing habitat that benefits quail, pheasants, and pollinators. It is widely understood that habitat enhancements that include increasing habitat complexity and available pollen and nectar sources will benefit pollinators and also provide quality habitat for many socially important vertebrate species. Nebraska Pheasants Forever, Inc. not only impacts thousands of acres annually, but also actively promotes pollinators and their importance and provides educational resources to stimulate pollinator conservation and pride among landowners.

Pollinators can also provide validation and insights of a successful restoration. A prairie restoration in a landscape dominated by row crop agriculture had documented use by the native bee species *Tetraloniella cressoniana*, a specialist on *Salvia,* despite little to no habitat in the immediate vicinity. Although this prairie was not restored specifically for pollinators, the presence of this species indicates it is providing habitat for a variety of species.

Pollinator conservation efforts are also effective at much smaller scales and provide substantial opportunities to engage small communities and local individuals. Nebraska's Watchable Wildlife Small Granting Program provides technical and financial assistance to individuals seeking to improve wildlife viewing opportunities, many of which have included pollinator gardens and pollinator awareness. Through these programs, the Nebraska Game and Parks Commission has educated local nurseries regarding using native plants which therefore encourages more local use of native plants.

Pollinator conservation efforts can be readily addressed through citizen science projects. Existing programs and applications such as iNaturalist will be used to empower master naturalists to collect information regarding the distribution and trends for many Lepidoptera species across Nebraska.

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Wildlife Management at the Urban-Agricultural Interface: Science You Can Use

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The Urban-Agricultural Interface: A Zone of Tension

The interface between agriculture and cities is often one of conflict between urban and rural residents. Despite close proximity, residents of this zone generally have a completely different set of goals, lifestyles, and daily activities. Urban residents may object to agriculture's influence on the adjacent environment while agrarian neighbors can be resentful of urban intrusion into day-to-day farming activities (Figure 1) (see Schoeneberger et al. 2001 for additional discussion on this zone). Ultimately, wildlife is often the loser in this challenging environment. Increasing landscape fragmentation hinders species movement, habitat is lost through urbanization and intensification of farming operations, and remaining natural areas are degraded by surrounding land-use management and practices. What options are available to resource professionals for creating win-win solutions that satisfy diverse rural and urban landowner interests while also addressing wildlife issues now and in the future?

Agroforestry: Working Trees for Wildlife and People

One key option in the toolbox is agroforestry—the intentional combination of agriculture and forestry to create an integrated and sustainable land-use system for the benefit of both landowners and wildlife. There are five basic types of agroforestry in the U.S., broadly known as alley cropping, forest farming, riparian forest buffers, silvopasture, and windbreaks (Garrett 2009). These practices can be designed as multipurpose systems that support food and fiber production while providing clean water, wildlife habitat, and other public services such as recreational and aesthetic benefits; odor, noise, and dust control; and reduced energy consumption. Agroforestry practices can be used on agricultural lands as well as urban and suburban lands to support wildlife and enhance ecosystem services (Garrett 2009; Jose 2012).

Some of the most versatile agroforestry practices for use at the urban-agricultural interface include riparian forest buffers and windbreaks, which can also be referred to as corridors or buffers. These linear landscape features can provide functions that directly and indirectly support wildlife depending on where these features are located and how these elements are designed and managed. There are three general ways that buffers and corridors can benefit wildlife: restore landscape connectivity, provide habitat, and protect habitat quality. Each of these benefits is briefly described below along with some of the available scientific information for implementing these conservation practices.

Restore Landscape Connectivity

Agroforestry corridors can decrease the impacts of habitat fragmentation by reducing habitat isolation if plantings are well planned and connected with other habitats. Systematic reviews of landscape corridor studies conclude that corridors can be effective for species movement although evidence demonstrating that corridors support population viability is currently limited (Davies and Pullin 2007; Gilbert-Norton et al. 2010). Corridors can increase movement between habitat patches by approximately 50 percent compared to patches that are not connected with corridors (Gilbert-Norton et al. 2010). This enhanced opportunity for species movement may benefit biodiversity and even minimal migrations (i.e., one individual per generation) between habitat patches may mitigate loss of genetic diversity (Mills and Allendorf 1996). For example, in the Tensas River basin in northern Louisiana, a study documented corridor use by the threatened Louisiana black bear (*Ursus americanus luteolus*). In an area dominated by

extensive crop fields, bears used riparian forest buffers, ranging in width from 15 to 250 feet (5 to 75 meters) to travel between hardwood patches (Anderson 1997).

Corridor width is often considered one of the primary design criteria when designing for landscape connectivity (Bennett 2003; Hilty et al. 2006). Numerous studies have examined the issue of corridor width for specific species. However, many of the studies have not evaluated a significant range of widths to adequately determine optimal corridor widths. In addition, for a given width, corridor effectiveness for connectivity will vary with corridor length, habitat quality, and many other factors. With those limitations in mind, Figure 2 summarizes recent research on recommended corridor widths to support species movement.

There are concerns that corridors can have unintended negative consequences including the increase and spread of antagonistic species (e.g., predators and pathogens), foster negative effects of edge, increase invasion by exotic species, and increase the spread of unwanted disturbances such as fire (Haddad et al. 2014). Although available scientific research is limited on these possible effects, it is worthwhile to assess these potential impacts when planning a corridor project for wildlife and to mitigate negative outcomes (USDA 2004).

Provide Habitat

The urban-agriculture interface is often subject to frequent disturbances that can impact shelter and food resources for wildlife. Corridors and buffers can offer more stable habitat in these shifting landscapes subject to intensive agricultural management and urban development. Riparian forest buffers, windbreaks, and other agroforestry practices provide improved wildlife habitat by increasing the structural and compositional plant diversity on the landscape (Jose 2012). For example, multi-row windbreaks (planted with native woody species such as green ash, Osage orange, black walnut, and hackberry) can provide valuable year-round habitat for more than 108 bird species and 28 species of mammals in the Midwest (Johnson and Beck 1988). The size of the windbreak or shelterbelt plays an important role in determining the overall habitat suitability (Figure 3).

If planted with diverse flowering species, agroforestry practices can serve as critical nectar and pollen sources for numerous types of pollinators, several of which are undergoing population declines due to habitat loss. These woody-based practices can also provide nesting habitat for pollinators, particularly native bees. Approximately 30 percent of native bees are solitary wood-nesters that require trees and shrubs for nesting (Potts et al. 2005; Grundel et al. 2010). They build their nests inside hollow tunnels provided by soft pithy centers of branches or tunnels left behind by wood-boring beetle larvae while others excavate their own tunnels. About 70 percent of native bee species create nests underground and require undisturbed ground that can be found in the woody component of an agroforestry practice which is often not subject to tillage or soil disturbance (Potts et al. 2005; Cane et al. 2007). Bumblebees often construct ground-level nests at the interface between fields and linear woody habitat such as hedgerows and windbreaks (Kells and Goulson 2003). Bumblebee nest densities can be twice as high in these linear woody habitats compared to grassland and woodland habitats (Osborne et al. 2008).

The value of riparian forest buffers as important habitat to support local and regional biodiversity is well documented (Naiman et al. 1993). Optimizing these landscape features to have the greatest impact on wildlife and biodiversity can be accomplished by using available evidence-based methodologies for locating and implementing riparian forest buffers (e.g., USDA 2004; Johnson and Buffler 2008).

Protect Habitat Quality

Terrestrial and aquatic habitat embedded within cities, towns, and farms is often vulnerable to degradation due to surrounding land management practices. Surface runoff laden with sediment, fertilizers, pesticides, and petroleum byproducts is one the most common impacts. Vegetated buffers can help mitigate these impacts by reducing the transfer of contaminants and by remediating certain types of pollutants (Dosskey 2001). Typically a standard-width buffer is recommended for trapping and treating polluted surface runoff; however, studies indicate that this overly simplified approach may result in low-performing buffers for water quality protection (Dillaha et al. 1989; Daniels and Gilliam 1996; Dosskey

et al. 2002). Several user-friendly design aids have been developed for estimating buffer width to achieve a desired level of performance based on site characteristics and pollutant types to be mitigated (Figure 4) (Dosskey et al. 2008, 2011). Using these tools can offer a higher level of confidence that the implemented buffer will aid in protecting wildlife habitat from water quality impacts.

Common farming methods and urban landscape care rely heavily on pesticides, which can have harmful effects on sensitive wildlife, particularly insects, amphibians, fish, and other aquatic species. Windbreaks, hedgerows, riparian forest buffers, and other tall, woody, vegetated barriers can help reduce spray drift from pesticide applications (Richardson et al. 2004; Kjær et al. 2014). Tree and shrub layers provide a large surface area over which particles of pesticides may adhere and also provide wind-speed reduction at the application site, reducing the movement of pesticides off their target (Figure 5). Spray drift reductions of 80 to 90 percent can be achieved with woody buffers; however, pesticides can harm buffer vegetation, so plant species selection is critical (Ucar and Hall 2001). If the primary purpose of the buffer is spray drift mitigation, the buffer should be planted with vegetation that is relatively undesirable to pesticide-sensitive wildlife to minimize attracting the species to the buffer.

Habitat Functions Under Climate Change

Many environmental and anthropogenic factors are impacting wildlife, and climate change is another stressor that will exacerbate many of these problems (Staudinger et al. 2013). Many of the wildlife benefits that corridors and buffers provide will likely become even more valuable in the future under a warming climate and increasing extreme weather events (Schoeneberger et al. 2012). Habitat fragmentation will impede the ability of many species to respond, move, and/or adapt to climate related impacts. Enhancing landscape connectivity between remaining habitat fragments with corridors may reduce population fluctuations and extinction risk and promote gene flow and adaptation (Figure 6) (Mawdsley et al. 2009; Krosby et al. 2010).

A predicted rise in stream water temperature may be one of the more significant effects of climate change on stream biota (Mohseni et al. 1999). Elevated water temperature threatens the sustainability of aquatic communities, particularly sensitive cold-adapted fish species such as salmon and trout (Mohseni et al. 2003). Shade provided by riparian forest buffers can reduce solar radiation received by a stream, leading to lower summer water temperatures and reduction in stream temperature fluctuations (Barton et al. 1985; Bowler et al. 2012). In the Tucannon River in Washington, for example, spring Chinook salmon (*Oncorhynchus tshawytscha*) runs hit a low of 54 fish in 1995 and juvenile salmonids were absent in lower reaches of the river. Since 1999, more than 1,100 acres (445 hectares) of riparian forest buffers and other restoration measures have been implemented, reducing summer water temperatures by about 10 degrees Fahrenheit (5.5 degrees Celsius) (Smith 2012). Young salmon are now using areas of the river that were previously too warm for them, and returning Chinook adults have increased in number to 1,239 in the year 2012 (Gallinat and Ross 2013).

Climate change is expected to result in more extreme precipitation patterns that will lead to higher surface runoff and soil erosion rates, ultimately affecting aquatic habitat quality with increased sedimentation and pollution loads (Wuebbles and Hayhoe 2004). Riparian buffers and other conservation practices can play an important role in protecting aquatic habitat resources under climate change (Schoeneberger et al. 2012).

Agroforestry Tools and Resources for Wildlife Habitat Management

Table 1 provides a cross-section of available tools to support planning, design, and management of agroforestry systems for wildlife management. Although not an all-encompassing list, it illustrates the range and types of tools that are available for implementing riparian forest buffers, windbreaks, and other agroforestry practices to help enhance landscape connectivity, provide habitat resources, and protect habitat.

Conclusion

The highly dynamic edge between cities and farmlands poses significant challenges for managing wildlife and natural resources. Developing sustainable solutions at this zone of tension requires building mutually satisfying scenarios that achieve landowner objectives. Agroforestry can be one source of solutions that accomplish multiple goals including the protection and enhancement of wildlife habitat for species ranging from game animals to pollinators. With increasing pressure on natural resources, current and future wildlife biologists may want to consider incorporating agroforestry into their toolbox and career development. As one student who recently completed an agroforestry class at Virginia Tech states, "It changed the way I look at problem-solving. Instead of insulating factors, taking a holistic approach is very real-world applicable and valuable."

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Table 1. Tools and resources for planning and designing agroforestry practices for wildlife.

Tool or Resource	Type	Description	Source
Riparian Restoration to Promote Climate Change Resilience Tool	GIS	A tool that identifies areas in the riparian zone that would benefit most from increased shading produced by planting of trees.	conservationdesign.org/rpccr
Riparian Connectivity	GIS	A GIS-based methodology for identifying critical gaps in riparian corridors that should be augmented with riparian forest buffers.	nac.unl.edu/documents/research/publications/2004riparianconnectivity.pdf
AgBufferBuilder	GIS/Model	A GIS-based computer program for designing buffers around agricultural fields that utilizes terrain analysis to account for spatially nonuniform runoff.	nac.unl.edu/tools/AgBufferBuilder.htm
Wildlife Species Richness in Shelterbelts	Habitat Model	A habitat suitability index model for evaluating potential species richness in shelterbelts and windbreaks.	nwrc.usgs.gov/wdb/pub/hsi/hsi-128.pdf
USDA PLANTS	Database	Online database of botanical information, images, and links on plants in the U.S.	plants.usda.gov/java
CanVis 3.0 Visual Simulation Kit	Software	A 2-D image-editing tool to visually simulate agroforestry and other conservation practices.	nac.unl.edu/simulation/index.htm
Pollinator Tech Notes	Technical Notes	A series of technical notes on designing agroforestry practices for pollinators.	nac.unl.edu/publications/agroforestrynotes.htm
Inside Agroforestry: Pollinators	Newsletter	A newsletter with numerous articles on incorporating pollinator considerations into agroforestry practices.	nac.unl.edu/documents/insideagroforestry/IA_vol23issue2_pollinators.pdf
Handbook for Agroforestry Planning and Design	Handbook	A guide to assist in the planning and design of agroforestry practices.	centerforagroforestry.org/pubs/training/HandbookP&D13.pdf
Conservation Buffers: Design Guidelines	Handbook	Guidelines for buffers and other linear vegetative practices based on a synthesis of more than 1,400 research publications.	nac.unl.edu/buffers

Riparian Buffer Design Guidelines	Handbook	Riparian buffer design guidelines for water quality and wildlife habitat functions on agricultural landscapes in the Intermountain West.	treesearch.fs.fed.us/pubs/29201
Conservation Corridor Planning at the Landscape Level	Handbook	This manual provides a process for planning and implementing corridors for wildlife at the landscape and watershed level.	nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_009912.pdf
Using Farm Bill Programs for Pollinators	Handbook	A guide to using Farm Bill programs to support pollinator habitat. An updated version is being prepared.	plants.usda.gov/pollinators/NRCSdocuments.html

Figure 1. Image of West Des Moines, Iowa, illustrating the expanding urban-agricultural interface (image credit: Natural Resources Conservation Service).

Figure 2. The black bar denotes the suggested minimum corridor width to support species movement while the gray bar indicates the upper end of recommended widths (Bentrup 2008). These ranges should be refined based on species and landscape context. References for the data used to develop this figure can be found on the USDA's National Agroforestry Center webpage for "Conservation Buffers."

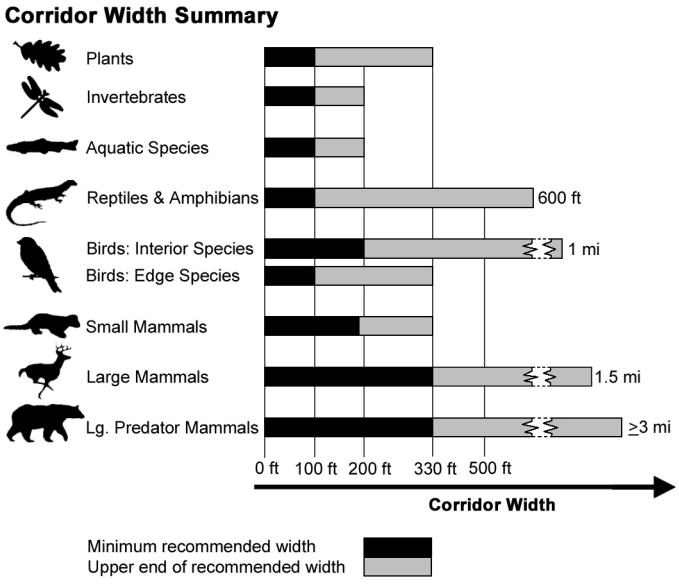


Figure 3. A habitat suitability index model for species richness for shelterbelts and windbreaks (Schroeder 1986). Other modeled factors affecting wildlife species richness include the number of rows in the shelterbelt, the diversity of woody vegetation, number of snags, and the arrangement of shrub and tree rows within the shelterbelt.

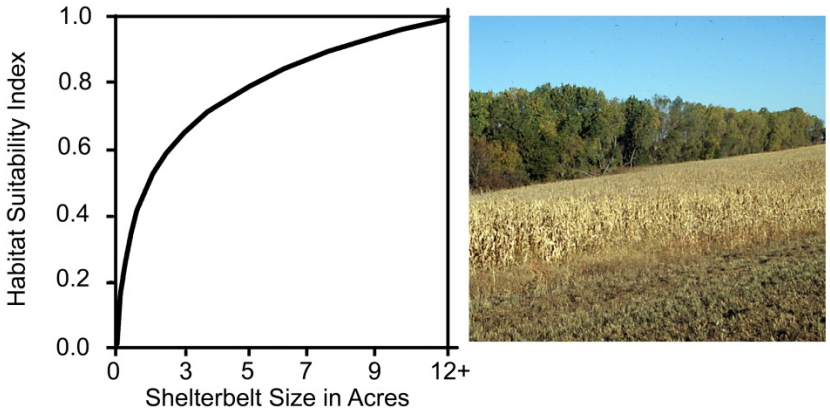


Figure 4. A design aid for estimating buffer width to achieve a preferred level of trapping efficiency for water quality protection. This tool and instructions are available in Dosskey et al. 2008.

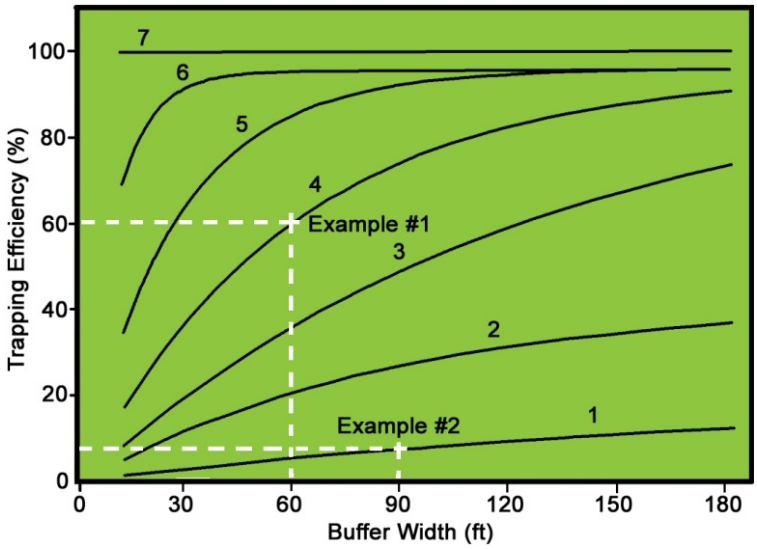


Figure 5. The black bar denotes the suggested minimum width for a spray drift buffer while the gray bar indicates the upper end of recommended widths (Bentrup 2008). These ranges should be refined based on the specific spray chemical and other site variables. References for the data used to develop this figure can be found on the USDA's National Agroforestry Center webpage for "Conservation Buffers."

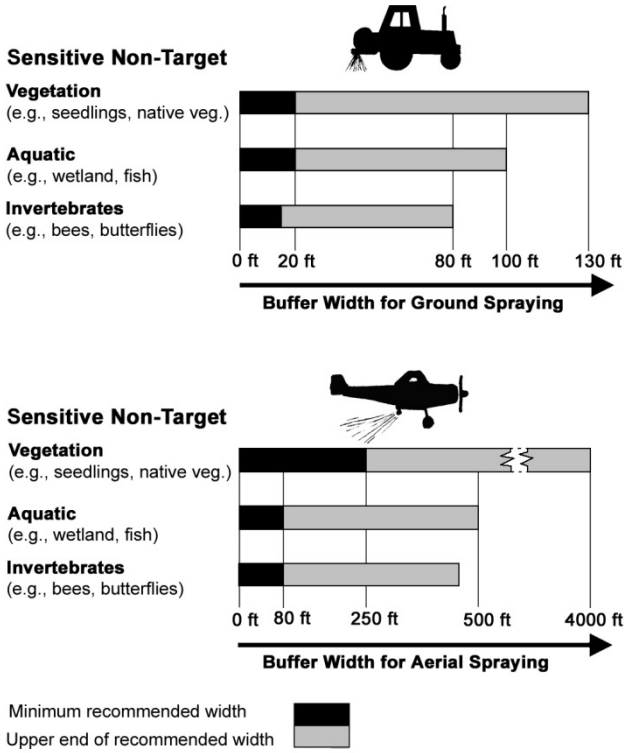
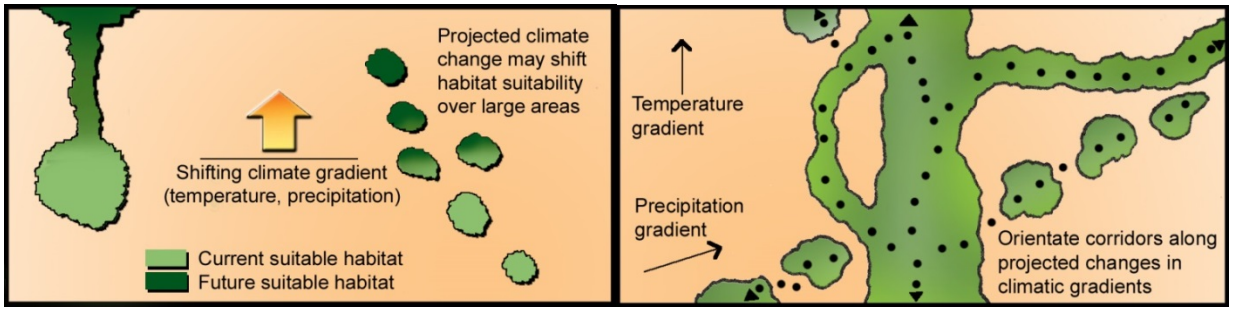


Figure 6. Connectivity under climate change may be enhanced by establishing corridors and stepping-stone reserves that align with predicted climate gradients (Bentrup 2008).



Planting Natives: A Preview of a New Mobile Tool

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National Wildlife Federation (NWF) has been encouraging people to plant landscapes for wildlife since 1973. Our goal is to help people help wildlife. We are engaging Americans to create wildlife habitat where they live, work, play, learn, and worship. To date, we have certified more than 180,000 properties including 700,000 gardening adults; 800,000 school children; 20,000 teachers; 135,000 active in this program's social media community; 3,000 Habitat Stewards and 100 Host Ambassadors; almost 200 communities; and 11 active NWF state affiliates (e.g., North Carolina Wildlife Federation).

Who lives in urban areas? Eighty percent of the nation does. These are our "natural" constituent—the voters, funders, political decision-makers, future stewards, etc. NWF's Garden for Wildlife program aims to connect people to nature in the easiest way possible, where they live.

Why should we do more? Why should we focus on urban areas when we know there are great needs in other conservation lands? We all know the threats posed by climate change, destruction of habitat from development, agriculture, invasives, etc. For example, 90 percent of monarch butterfly habitat has been destroyed and there is great stress also occurring on bees and other native pollinators. NWF's Garden for Wildlife program addresses each of these problems through three main goals: restoring wildlife habitat, helping with climate adaptation, and water conservation.

We know everyone loves birds and butterflies and wants to attract these kinds of wildlife to their yards. We know that native plant communities are essential for healthy wildlife populations. The act of "planting for a purpose" is the definition of gardening. NWF advocates for this special kind of gardening, Gardening for Wildlife.

Dr. Doug Tallamy, an entomologist with the University of Delaware, in his book *Bringing Nature Home*, writes about how you can sustain wildlife with native plants (Tallamy 2007). Plants are the foundation of the food web in any ecosystem. That includes the urban, suburban, and rural ecosystems. Ninety percent of the insects that eat plants can develop and reproduce only on the native plants with which they share an evolutionary history. Insects are critical to all terrestrial food webs (Wilson 1987).

We know people like to feed birds by putting out bird feeders. What Tallamy proposes is that the native plants in our yards are, in fact, bird feeders because they make the insects birds need to reproduce. Ninety-six percent of our terrestrial birds rely on insects, mostly caterpillars, to feed their young (Dickinson 1999). And it takes fantastic numbers of insects to support bird reproduction. For example, a Carolina chickadee feeds its young almost exclusively on caterpillars, bringing 390 to 570 caterpillars to the nest per day (Brewer 1961). Chickadees feed their young for 16 days before they fledge; therefore, they must catch 6,000 to 9,000 caterpillars to rear one clutch!

Ninety percent of the insects that eat plants can only eat specific plants; if those plants are absent from our landscape, so will be the bird food they produce (Forister et al. 2015). We can and should improve the productivity of gardens during the nesting and migration seasons. That is, in Tallamy's words, "We should build better bird feeders."

Tallamy and Kimberley Shropshire have investigated the connection between plants and the Lepidoptera they support in the mid-Atlantic states (Tallamy & Shropshire 2009). They have found that some plants are far better at hosting caterpillars than others. Oaks, for example, serve as hosts for 557 species of Lepidoptera, the most on any plant in North America, while Ginkgo trees support on four and Zelkova supports none. Tallamy and his student Melissa Richard have shown that when native plant communities are replaced with plants from outside of local food webs, there are five times fewer caterpillar species available for birds and 22 times fewer caterpillars themselves (Richards & Tallamy, submitted). He further compared caterpillars collected in his yard in one hour in July 2014 and found that a white oak had 410 caterpillars while his neighbor's Callery pear had one. This is why we at NWF are encouraging gardeners to plant high value natives like oaks.

Working with the U.S. Forest Service and Tallamy, NWF is expanding this work from the mid-Atlantic to the rest of the country. We are developing a native plant database that will act as a web-based tool to identify which genera species are hosts to the most caterpillars. It will be searchable by zip code, allowing people to determine those that are the most ecologically valuable plants to buy from a nursery. There is currently a growing call to know more about which natives to plant. In fact, knowing which plants are best for wildlife is one of the biggest obstacles to people who want to replace their lawn or exotics with natives. Our web-based tool will guide them to the answer with just a few swipes. We anticipate that people will carry their lists to nurseries, asking for the top 10 ranked native plants, both woody and herbaceous.

NWF, along with our partners in the U.S. Forest Service and University of Delaware. We hope this simple product will increase the demand for natives and encourage a national movement to help wildlife where people live, work, play, learn, and worship. There are nine million self-identified wildlife gardeners, but there are 95 million gardeners in the United States equaling 120 million homes (U.S. Fish & Wildlife Service 2011). What a huge opportunity for conservation and what a huge opportunity for education.

From a conservation perspective, we have usurped so much of the natural world that we now need to build functioning ecosystems at home. We want people to start using criteria in addition to aesthetics to decide what to plant, from simply decorative value or privacy screens to ecological value for wildlife or forage for pollinators. If we can create interest in replacing some lawn with plants that provide value for local ecosystems, people will expand their view of plants and their vital roles in our lives. Think of the opportunity for creating food-web value, watershed protection, soil restoration, carbon sequestration, ecosystem resiliency, and pollinator habitat, as well as human mental health and wildlife appreciation.

One of the most important roles of landscape plants is in watershed management. Plants filter pollutants before they reach our streams and rivers, they slow and reduce storm water runoff, and they shade our streams, reducing the water temperature in ways that encourage stream life to flourish. They also provide the leaf pack that feeds aquatic invertebrates. Fortunately, many local communities are offering financial incentives for establishment of rain gardens to help with storm water runoff. We can help these programs also offer wildlife benefits. The National Wildlife Federation has an emerging program that is addressing this by specifically working to green religious congregation grounds. We are calling this program Sacred Grounds. In a pilot, we worked with three congregations in the Washington, DC, area. One of the congregations focused on replacing the lawn in a 100-year flood storm water basin. Because of this, the congregation was eligible for a $6,000 rebate, which allowed them to pay for the cost of preparing the ground and then installing 2,500 natives in 2,500 square feet. They intend to do the whole basin, but this was a good start. We are finding tremendous interest from widespread congregations to beautify their grounds, create wildlife habitat, and thereby "care for creation." The local municipalities also are very keen on this as it gives them another avenue beyond water pollution issues to reach congregations.

Our goal is to create a demand for natives. Our target audiences include reaching master gardeners, master naturalists, bird lovers, municipalities, nature centers, garden clubs, and the wildlife professional community. We will be getting the word out through key publications that reach gardeners such as *Home and Garden* magazine.

We hope you will become part of the movement and share this tool and all the benefits it will bring to our nation's wildlife.

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Workshop.
Women's Wildlife Conservation Network Workshop: Recruiting Female Natural Resource Leaders

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Background of Women as Leaders

Women in western societies have made significant progress toward job parity with men over the last half-century (AAUW 2015). Nonetheless, women are paid on average 22 percent less than men in equivalent positions despite the fact that, in 40 percent of households, women are the major income earners for their families (AAUW 2015). For white-collar federal workers, the disparity is less at 13 percent, but still not at equity (AAUW 2015). In addition to salary discrepancies, men remain more likely to hold the most powerful positions in environmental organizations (Taylor 2014). For example, 90 percent of the presidents at large conservation and preservation organizations (budget of greater than $1 million) are male. A variety of challenges face women seeking leadership positions, all of which require proactive and conscious engagement to address (Caprino 2013). Some conservation organizations, like The Wildlife Society (TWS), have begun working to raise the awareness around this inequality. For example, the 2014 TWS annual meeting featured a session, "Human Diversity and Changing Professional Identities in Wildlife Professions," that focused on identifying, recruiting, and retaining a diversified workforce and discussed gender among other issues.

In response to this disparity in demographics within the field of wildlife conservation, a small group of female leaders formed the Women in Wildlife Conservation Network (WWCN) in 2011. The WWCN specifically seeks to inspire and empower women in the natural resources community, to provide a venue to share and learn from each other, to help women aspire to and succeed in leadership positions, and to welcome women of all ages into the conservation field. To date, the WWCN has held three workshops at the North American Wildlife and Natural Resources Conference, a well-established forum for national- and state-level leaders. They have focused on a range of topics that support the development of leadership skills for women wildlife professionals. The workshops are open to both genders to help raise awareness, provide ample networking opportunities, and, ultimately, to narrow the gender gap in the field of wildlife conservation.

The 2015 WWCN North American Wildlife and Natural Resources Conference workshop focused on improving women's opportunities to attain leadership positions. Two recruiters—individuals who work for firms that assist in recruiting CEOs, presidents, and other high level positions for natural resources groups and other entities—offered their insights into the process they use for recruiting conservation leaders and discussed ways that women candidates can avoid their often common stumbling

blocks. The use of recruiters is common in the nongovernmental community for the most senior of positions. While recruiters are not typically used for government agencies, the information is nearly always applicable to all seeking a high-level position. These recruiters spoke specifically to issues they have encountered first hand, emphasizing tools for attracting recruiters from the start and for successfully navigating the interview process. Much of the information they provided is true and valuable for *both* genders, but women are particularly prone to certain aspects that were highlighted. Examples included the common ways women particularly undersell themselves in résumés and interviewing, how women can more effectively describe their accomplishments, how to manage their unique "brand" (e.g. LinkedIn profiles, bolstering résumés), what to do or not do during the interview, and negotiating equitable compensation.

Summary Recommendations

An overarching theme of the workshop focused on countering the general lack of assertiveness by women throughout the recruitment process relative to their male counterparts. The workshop speakers provided a number of concrete recommendations to promote the competitiveness of women for leadership roles, particularly when working with professional job recruiters. These included: (1) maximizing your online professional profile, (2) bolstering your résumé, (3) mastering the interview by effectively telling your story and highlighting accomplishments, and (4) negotiating equitable pay.

Maximize Your Online Professional Profile

An online presence is important for both professional recruiters and others as they search for potential candidates. Many candidates have a weak online presence, especially pertaining to their LinkedIn profile. LinkedIn is a social networking website designed specifically for job searches and searchers. Recruiters look for comprehensive profiles that detail accomplishments and special skills a candidate offers. For example, linking to websites and blogs that provide further depth of content can enhance information about oneself.

Recruiters will evaluate the baseline profile, looking for key details on the individual's history of work and what the individual is currently doing. When filling in a baseline profile, it is very important to include quantifiable result-oriented information for every position held to demonstrate what the individual has accomplished throughout their career. Recruiters also will assess a potential candidate's connection to others in the field, and even whether the individual joined groups of relevance. When an individual joins a group, it directly links her to all the individuals within that group, further expanding her networking capacity. Although LinkedIn offers the opportunity to endorse others, the recruiters placed less importance on this than having a positive, accomplishment oriented, and complete profile.

Bolster Your Résumé

Women typically undersell themselves in their résumé. As with LinkedIn profiles, it's important to both describe what your current and past positions entail but also to place significant emphasis on related accomplishments. Job functions *do not* equal accomplishments and a résumé should speak to both. For recruiters, the best predictor of the future is the past, including skills, job performance, and accomplishments. It is important to provide quantifiable information. Some examples to consider include:

- What have I done to make money, save money, or where have I implemented or changed a process that impacted the bottom line?
- What size budget do I or did I oversee?
- What is the staff size I do or did supervise, directly and indirectly?
- What size grants have I brought in and from what kinds of sources?
- Is there a way to quantify the percentage growth—and/or the overall program size, staff size, and revenues—you've helped to impact?

The recruiters also stressed the importance of keeping résumés up-to-date, urging candidates to review and refine their résumé at least one or two times a year. Potential job candidates also need to be ready to supply their résumé immediately if called by a recruiter.

Master the Interview

Women can increase their likelihood of successfully landing jobs by avoiding common pitfalls associated with underselling themselves during the interview process. In particular, the workshop recruiters stressed the importance of advance preparation, effective communication of your unique story, and the ability to embrace your accomplishments.

Before an interview ever occurs, it is essential to do your homework. Read everything you can get your hands on about the organization. It is especially important to fully understand the job description. If possible, talk to your colleagues who have connections or knowledge about the hiring organization with an eye toward developing an insider's view of the ideal candidate. For example, the hiring committee may hope to stabilize the organization by hiring a candidate with the skills to help fill a prolonged gap in management. Or they may be looking for a visionary to help reinvigorate a stagnating program. By having a discrete amount of insider knowledge, a candidate can more effectively describe how they might fit the job and into the organization itself. Furthermore, go beyond researching the organization to which you are applying and the individuals working within it and be sure you are aware of the issues in the broader field. What are the key challenges, opportunities, and/or changes? What models are other organizations deploying that could be relevant? Being able to articulate a broad understanding of the field will help them feel that you are the right candidate.

In the interview, it is critical to tell your unique story effectively. Make sure you do not assume that they know you, even if you know them and/or have a great résumé that has spelled out many of your strengths. The hiring committee needs to hear about your accomplishments from you during the interview, reiterating high points from your résumé. Specifically, tell the hiring committee how your past fits into where they want to go. Often the opening question is a variant of *why are you here*, *why are you interested in the job*, or *what do you have to bring to this job* (Skrentny 2004). This is your opportunity to give a three-minute overview of your résumé in a fashion that fits their priorities. Let them know you are passionate about the subject area. For both your opening statement and throughout the interview, keep your answers concise and do not read from prepared statements. As one recruiter explained, the person who answers the most questions in the interview wins. If you aren't sure you gave them enough depth, you can always ask if more information is needed. Provide specific examples from your background in your answers to questions. Examples can make abstract discussion about your strengths and abilities more tangible. Even if they do not ask behavioral-based questions (questions that assess your emotional intelligence and are based on concrete real-life examples), consider giving behavioral-based responses (Clifford 2006). Try to relate answers to what you found, what you did, and what was the result.

One of the challenges for women is a hesitancy to take credit for their achievements, but it is vital to show a hiring committee your leadership and to take appropriate and clear credit for what you have done. The hiring committee needs to hear about your professional accomplishments as a leader during the interview, even if you have a strong résumé that documents this well. Ultimately, the interviewers need to recognize what your role in the issue at hand was and what wouldn't have happened if you hadn't been there. This process can lead to the "pronoun problem." Men tend to say "I," while women tend to say "we." If you did something, use "I"; but balance both pronouns throughout an interview.

Be prepared to share your vision. Generally speaking, if you are interviewing for a new job, you are applying to a bigger, broader, and more strategic position than you currently have. The interviewers may know you are really good at your current job, but you have to help them see you are ready to make the leap to the next job. A common question toward the end of an interview is "What would you do if you got the job?" This is the place where it might be good to give the caveat "I don't know everything about the organization…" but still go for it and think and dream big.

For all interviews, be ready for typical questions. Some of the most commonly asked are: "Describe a mistake you made and how you addressed it. What is your management style and give an example? What is the stretch area for you in this job—what don't you know that you need to know to be successful, and how will you get up to speed?" Think ahead of time about how you might be answer these questions.

Toward the end of an interview session, job candidates are often given the opportunity to ask questions of the hiring committee. This is a chance to acquire information that will help the candidate decide whether the job is a good fit or not. It can be helpful to write down these questions ahead of time. In fact, questions from candidates may contribute to the hiring committee's evaluation, so it is worthwhile to be thoughtful. For example, you may want to ask about budgets or why the last person left.

It is crucial that female job candidates remember that nonverbal cues can be as important as verbal presentations. When listening to members of the hiring committee and responding to questions, make eye contact, especially with the person who asked you the question. If in a group, make sure you make eye contact periodically with all in the room. Be aware of your posture. For example, do not lean on your elbow, sending an inadvertent message that you are bored, or slump in your chair as if tired. Furthermore, try to enjoy yourself. You are in a room of people who share your passions. Just as you may be nervous, remember that the hiring committee may feel similarly because they are trying find the right person for the job—and that can take a lot of time and resources. Clothing sends a nonverbal message as well, so dress professionally. If you aren't sure what to wear, ask the recruiter or the human resources contact who is setting up your interview to provide a sense of the organization's dress code.

Finally, while recruiters work for the client, they can give you advice and information about the client. They may be able to tell you about particular issues of interest or pitfalls to avoid.

Negotiate Equitable Pay

Because many women are paid less than male counterparts in equivalent positions, the workshop recruiters emphasized the need to actively participate in negotiating salary when a position is offered and during the course of working for a specific employer. Women can improve their chances of achieving equitable pay by actively monitoring the marketplace and engaging in salary negotiations regularly over the course of their professional careers.

The recruiters offered several tips for doing this. First, they emphasized arming oneself with research about salary scales. Some resources that can be useful depending on the position include organizational 990 forms that are publicly available on the Internet, Guidestar, and the U.S. Office of Personnel Management (e.g., typically the most senior positions are publically available). Additionally, it can be useful to ask colleagues in other organizations about general salary scales for similar positions. Second, the recruiters stressed that negotiating salary, promotions, or salary adjustments is a business norm rather than a personal or social negotiation. As such, women should not be apologetic in bringing up the subject and actively negotiating. If interviewing for a new position, try to ask upfront about what the position pays to be better prepared for salary negotiations. Then, throughout the negotiation process—it may entail more than one conversation—maintain a positive attitude and present salary research findings objectively (e.g., the salaries of equivalent positions in similar organizations).

Conclusion

Women interested in moving up in leadership can gain experience and visibility by working on internal committees, nonprofit boards, and within networking groups. Always keep your résumé and LinkedIn profile updated because you never know when a time-limited opportunity will arrive—or when a recruiter may come knocking.

As female leaders develop their own brand through social media and move forward in interview and salary negotiation processes, it is important to take a no-apologies approach and be one's own advocate. Confidence and self-worth sells, and there is experience to be gained in trying. Furthermore, persistence pays, so even if a job fails to come through the first time, another will work out in the future.

As participants learned from the recruiters featured at the WWCN Women's Leadership Workshop, women who assert themselves with gusto and confidence are much more likely to land leadership roles.

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Registered Attendance

Alabama

Jud Easterwood, Gary Hepp

Alaska

Christine Cunningham, Bruce Dale, Christopher Estes, Lisa Evans, Jack Frost, John Haddix, Joel Helm, Nancy Hillstrand, Steve Klein, Brent Koenen, Ashley List, Brad Meyen, Matthew Moran, Elizabeth Neipert, Wayne Owen, Peter Probasco, Mark Sledge

Alberta

David Ingstrup

Arizona

Debbie Brewer, Chris Cantrell, Loren Chase, Doug Cummings, Al Eiden, Carolyn Enquist, Michael Ingraldi, Terry Johnson, Kent Komadina, Scott Lavin, Janet Lynn, James Odenkirk, Mike Rabe, James Douglas Ripley, Esther Rubin, San Stiver, Hannah Telle, Kellie Tharp, Bill Van Pelt, Larry Voyles

Arkansas

Brad Carner, Ricky Chastain, Daniel Farrer, Donald McKenzie, Luke Naylor, Susan Rupp

Armed Forces Pacific

Chiaki Kimura, Scott Vogt

California

Tim Baumann, Bill Berry, Brian Boroski, Chuck Carroll, Kirsten Christopherson, Diana Craig, Cece Dahlstrom, Shelley Davis, Kelly Ebert, Rhys Evans, Nancy Ferguson, Geoffry Geupel, Jason Gibbons, Suzanne Hall, Mark Hennelly, Dawn Lawson, Ren Lohoefener, Matthew Lorne, Robert Lovich, Michelle Maley, John McCamman, Kimberly O'Connor, Luis Perez, Tim Pochop, Thomas Rademacher, Jacque Rice, Timothy Schweizer, Shannon Shea, Jeremy Sokulsky, Sean Suk, Lisa Talcott, Daniel Taylor, Katie Umekubo, Deanne Weber, Todd Wills, Lauren Wilson, Walter Wilson, Robert Wolf, Darryl York, Dan Yparraguierre, Alisa Zych

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