Policy Challenges for Wildlife Management in a Changing Climate

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Abstract: *Try as it might, wildlife management cannot make wild living things adapt to climate change. Management can, however, make adaptation more or less likely. Given that policy is a rule set for action, policy will play a critical role in society's efforts to help wildlife cope with the challenge of climate change. To be effective, policy must provide clear goals and be based on a clear understanding of the problem it seeks to affect. The "National Fish, Wildlife, and Plants Climate Adaptation Strategy" provides seven major goals and numerous policy related actions for wildlife management in a period of climate change. The underlying themes of these recommendations and the major challenges to their achievement are identified and discussed.*

INTRODUCTION

As one of the major biome types on Earth, forests are of fundamental importance to wildlife. (Note: the term "wildlife" when used alone is meant as short hand for all species living in an undomesticated state: both plant and animal.) From the standpoint of species diversity, the most diverse terrestrial habitats on Earth are the great tropical rainforests. From the standpoint of sheer standing biomass, the great temperate rainforest of the Pacific Northwest may be unequalled. In terms of charismatic megafauna, which for most people are the face of wildlife, many signature North American species (e.g., deer, bear, elk, wolf, moose, cougar) are principally forest species. A large fraction of the lands American society has chosen to devote to conservation are forested lands.

Reflecting their importance, American society has developed a substantial institutional and policy framework for the management of its forests and for wildlife (the U.S. Forest Service and the National Forest Management Act, the U.S. Fish and Wildlife Service and the Endangered Species Act, state forestry and wildlife agencies and laws, etc.). This institutional and policy framework was developed in a period of relative biological stasis. The question now is whether this existing framework is

adequate during a period of great biological change and, if not, what adjustments might be in order.

THE PROBLEM

Climate is fundamental to biological systems. It is the interaction of temperature and precipitation that is the major determinant of the distribution of biomes (e.g., forest, grassland, desert, etc.) that in turn controls the distribution of species dependent on those systems. Drastic changes in climate are thought to have been proximal, if not an ultimate drivers, of past mass extinction events such as those that occurred at the end of the Cretaceous and Permian epochs (Twitchett 2006; Feulner 2009).

The earth is again entering a period of rapid climate change. According to the last National Climate Assessment (USGCRP 2009), measurements and observations show that, among other things: average air and ocean temperatures are increasing globally, rain falling in the heaviest storms is increasing, extreme events such as heat waves and drought are becoming more frequent and intense, sea level is rising, and Arctic sea ice is shrinking.

Not surprisingly, many species are showing signs of changes in their distribution and the timing of major life history events (e.g., migration, nesting, emerging, blooming, etc.) consistent with a warming climate (Parmesan 2006). Some of these observed changes are signaling that additional climate change is likely to affect the ability of some of our conservation institutions and/or laws to achieve their stated objectives. For example, the namesake species of Joshua Tree National Monument may no longer grow in that area in the coming decades (Cole and others 2011). Moose, one of the signature species of Minnesota's North Woods—and a prime game species—are in a sharp decline that is thought to be related to increasing temperatures (Cusick 2012). The great Western forest fires of the last half decade or so—fueled in part by temperature mediated insect infestations—may, in some cases, result in a change from forest to shrubland and grassland ecosystems (Williams and others 2010).

COMING TO GRIPS

Recognizing the emerging challenges of climate change for our wildlife resources, Congress in 2009 requested that the Council on Environmental Quality (CEQ) and the Department of the Interior (DOI) develop a national strategy to "…assist fish, wildlife, plants, and related ecological processes in becoming more resilient, adapting to, and surviving the impacts of climate change" (CEQ/USDOI 2009). As DOI's wildlife bureau, the U.S. Fish and Wildlife Service (FWS or Service) took the lead in structuring a process to fulfill this request. Because of the complementary nature of U.S. wildlife law, the Service invited the National Oceanic and Atmospheric Administration (NOAA) and state wildlife agencies to co-lead the effort. Ultimately, a Steering Committee of representatives from 15 federal agencies, five state fish and wildlife agency directors, and leaders of two inter-tribal natural resource commissions oversaw development of the *National Fish, Wildlife, and Plants Climate Adaptation Strategy* (NFWPCAS 2012).

The NFWPCAS is an unprecedented effort by all levels of government that have authority or responsibility for wildlife in the United States to work together collaboratively to identify what needs be done in a period of rapid climate change. It was developed by teams of managers,

Table 1. Goals of the NFWPCAS.

Goal 1	Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate.
Goal 2	Manage species and habitats to protect ecosystem functions and provide sustainable cultural, subsistence, recreational, and commercial use in a changing climate.
Goal 3	Enhance capacity for effective management in a changing climate.
Goal 4	Support adaptive management in a changing climate through integrated observation and monitoring and use of decision support tools.
Goal 5	Increase knowledge and information on impacts and responses of fish, wildlife, and plants in a changing climate.
Goal 6	Increase awareness and motivate action to safeguard fish, wildlife, and plants in a changing climate.
Goal 7	Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate.

researchers, and policy experts drawn from federal, state, and tribal agencies organized around major ecosystem types. The Strategy identifies seven major goals that must be achieved to give wildlife the best chance of surviving the projected impacts of current and anticipated future climate change (Table 1). Numerous strategies (23) and actions (100+) are identified that are essential for achieving these goals.

All of the seven major goals identified in the NFWPCAS are things that the wildlife management community already does (e.g., conserve habitat, manage species and habitats, enhance management capacity, etc.). What will be new, and what the NFWPCAS tries to illustrate is that these things will need to be done in new ways, or in new places, or at new times, or in new combinations for conservation to be effective. In other words, conservation in a period of climate change will be equipped with the same types of tools, but they may need to be used in new ways. In some cases, such as policy, the existing tools themselves may need modification or even replacement.

POLICY RECOMMENDATIONS OF THE NFWPCAS

The NFWPCAS includes one recommended strategy and seven actions that are policy focused (Appendix 1). The major policy focused strategy (3.3) is to: *"Review existing federal, state, and tribal legal, regulatory and policy frameworks that provide the jurisdictional framework for conservation of fish, wildlife, and plants to identify opportunities to improve, where appropriate, their usefulness to address climate change impacts*." This recommended strategy is further broken down into seven specific actions that focus on: (1) incorporating the value of ecosystem services into habitat protection and restoration; (2) developing or enhancing market-based incentives to support restoration of habitats and ecosystem services; (3) improving compensatory mitigation requirements; (4) improving floodplain mapping, flood insurance, and flood mitigation; (5) identifying existing legal, regulatory or policy provisions that provide climate change adaptation benefits; (6) provide appropriate flexibility under the ESA to address climate change impacts on listed species; and (7) addressing sea level rise. Many other strategies and actions (see Appendix 1), although not focused specifically on policy, raise policy issues. For example, Action 2.1.8 is to: *"Utilize the principles of ecosystem based management and green infrastructure."* Depending on the specific context for utilizing these principles, new policy might be required.

As it stands, the NFWPCAS is a very long to-do list of the many things the wildlife management community needs to undertake to fully come to grips with the challenge of climate change to its mission and the resources for which it has authority and responsibility. Rather than rehash this extensive list, it may prove more informative to look for the underlying themes in the Strategy and to identify a few of the major challenges for wildlife conservation policy going forward.

UNDERLYING THEMES OF THE STRATEGY

Prior to the formal launch of the NFWPCAS development process, FWS held several Conservation Leadership Forums to convene representatives from other agencies, other levels of government, and the academic and non-governmental communities to consider the climate change challenge and to develop appropriate response. From those meetings emerged nine guiding principles that were used in development of the NFWPCAS (Table 2).

These guiding principles are reflected in so many of the NFWPCAS goals, strategies and actions that they suggest four broad themes for wildlife adaptation efforts.

Be Inclusive and Collaborative. Climate change is so pervasive, and its impacts potentially so far-reaching, that no single agency, no single level of government, indeed no single sector will be able to mount an effective response on its own. All affected agencies and interests need to be at the table working collaboratively to be effective.

Think, Plan, and Act at the Right Scale. The days are over of believing that a single set of best management practices universally applied will automatically lead to a biologically functional landscape. Different agencies and organizations work at different scales. Entities that operate at the local scale need to do so in the context of the broader physical, biological, and institutional landscape of which they are a part. And entities that operate at the national or regional scale need to be mindful of the needs, realities, and differences of the many landscapes in which they operate.

Integrate Across Sectors. A corollary of being inclusive within the conservation sector is also to be inclusive of other sectors. Much of what governs the fate of wildlife is not the actions or inactions of the wildlife management community, but actions by other sectors that affect the natural world (e.g., agriculture, transportation, energy development, construction, etc.).

Table 2. Guiding Principles of the NFWPCAS.

- Build a national framework for cooperative response.
- Foster communication and collaboration across government and non-government entities.
- Engage the public.
- Adopt a landscape/seascape based approach that integrates best available science and adaptive management.
- Integrate strategies for natural resources adaptation with those of other sectors.
- Focus attention and investment on natural resources of the United States and its Territories.
- Identify critical scientific and management needs.
- Identify opportunities to integrate climate adaptation and mitigation efforts.
- Act now.

Starting an adaptation planning process by including everyone and everything may be too large a burden for any sector to bear, but once each sector has a working understanding of its needs relative to adaptation, it needs to reach out to the other sectors relevant to its interests to identify commonalities, synergies, conflicts and resolutions.

Engage, Communicate, and Act. The effects of climate change on species are beginning to be readily apparent. Because projections of future conditions and impacts come with great uncertainty it is tempting to wait until more is known, the models are better; there is less uncertainty before we act. Unfortunately, like many large systems, Earth's climate has great inertia, and once change is entrained it will not be quickly or easily restrained. There is unequivocal evidence that the climate is changing, that the underlying cause is the growing accumulation of greenhouse gases (GHGs) in the atmosphere resulting from human activity, and that there is no plausible institutional or policy framework in place to restrain additional GHG emissions which will increase the impacts on wildlife. Species are already responding; it's time for the wildlife management community to engage, communicate, and act on what we do know, even if the rates and patterns of change and the future status of species and communities remain uncertain.

MAJOR POLICY CHALLENGES GOING FORWARD

Achieving the goals of the NFWPCAS will in many instances require having the right policies. As noted above, the NFWPCAS has one major strategy and a number of actions focused on or related to having the correct conservation policies. Whether existing or new, these policies will need to be developed and employed in the face of several emerging realities about wildlife conservation in a period of climate change.

No Precedent. Depending on how it is defined, wildlife management is a few hundred to a few thousand years old. The best global circulation models are now projecting that if GHGs continue to accumulate at current rates, average global temperatures will by 2100 reach levels that have not occurred for millions of years (Houghton and others 2001). Wildlife management, either as primitive practice or modern profession, has not seen such a period of change in its history. There is no precedent, no body of knowledge derived from experience to underpin wildlife conservation policy for a period of rapid climate change. Nor can we replicate the Earth to take an experimental approach to discover the best way forward.

Policy can be defined as a rule for decision-making. Many of the decisions the conservation community will have to make in the coming decades will have to be made in unprecedented circumstances. It will be a time of trial and error and wildlife conservation policies will need to be cast in flexible terms to acknowledge and adjust to that uncomfortable reality.

Unknown Destination. CO2 is the principal GHG. In the range of atmospheric concentrations of CO2 explored with current climate models, global average temperature appears to increase proportionate to CO2 concentration; the more CO2, the more temperature will increase. At present, CO2 concentrations appear to be increasing at least linearly, perhaps even accelerating (IPCC 2013). Under current patterns of usage of fossil fuels, the burning of which is the principal source of the CO2 increase, there is no plateau in sight for CO2 concentrations and, therefore, temperature. If global climate effects are also proportionately sensitive to

temperature, then the climate of a +1°C world will be different, both from that of the current world and from the climate of a +2°C world. Thus, the world is not moving from the current climate to a new climate, it is leaving the current climate, with no fixed destination. Novel climates will emerge presenting species with new combinations of temperature and precipitation that they may not have experienced before in their individual evolutionary histories (Williams and Jackson 2007). This makes adaptation planning and policy formulation even more challenging. Plans and policies need target conditions around which to be formulated. Even if the effects of each 1°C increase are modest by themselves, their impacts will likely prove ecologically cumulative. Having multiple degrees of temperature increase means having multiple or at least iterative plans and policies that are, perhaps, very different. *Wildlife conservation plans and policies will need to be re-visited regularly in light of the emerging trends in GHG accumulation and the resulting level of projected climate change.*

Species Shift, Communities Change. There are many unknowns with regard to the response of living systems to climate change. One thing that is known with some certainty is that in past periods of climate change species responded individually and not as tightly integrated communities. In other words, each species shifted its range in its own way at its own rate and, therefore, the co-occurring assemblages of species that are recognized as natural communities changed in composition (Hunter and others 1988). This has profound implications for wildlife conservation planning and policy in an era of rapid climate change.

Many of our existing conservation plans use natural communities as coarse filters for conserving wildlife diversity (i.e., as proxies for habitat). The logic is that by identifying the range of communities and then conserving some of each, their constituent species will be maintained (Hunter and others 1988). This coarse filter approach is often complemented by the use of a fine filter that is focused on the needs of certain individual species that may be of particular importance for one or more reasons (i.e., ecological, economic, social, cultural, etc.).

The individualistic response of species to climate change is already becoming apparent. Some species ranges are beginning to shift (e.g., the Joshua Tree example). If natural communities are defined as all the species in a given area interacting together, then is the North Woods without moose still the North Woods? The potential replacement of forests with shrublands and grasslands after the recent major fires in the American Southwest is perhaps an extreme example of community change. The larger message for the wildlife conservation and management community is that we are entering an era when effective conservation will hinge more than ever on understanding the needs of individual species. With more than 1500 native taxa already listed as Threatened or Endangered in the United States and likely many more to come due to the impacts of climate change, this will be a major challenge. Even without considering climate change, a major study of the conservation status of U.S. species (Stein and others 2000) suggested that up to a third of our native species in major taxonomic groups (e.g., vertebrates, flowering plants, etc.) are at risk of extinction in the coming decades due to existing threats. A subsequent global analysis suggested that up to 35 percent of species could be at risk due to climate change (Thomas and others 2004). Although no cross-comparison of the two studies seems to have been done, the conservative conclusion at the moment is that anywhere from 33-68 percent of native species could be at risk. That is perhaps an order of magnitude more species than the 1500 currently listed in the United States.

Wildlife conservation policies will need to recognize the essential independence of species in terms of their response to climate change. The sheer magnitude of species that may need to be managed suggests that conservation policies will also have to try and differentiate the relative importance of species for a variety of considerations (environmental, ecological, utilitarian, etc.)

Speed Kills. Perhaps the most challenging feature of the current period of climate change from an evolutionary perspective is its projected speed. The range of estimates from the last National Climate Assessment (USGCRP 2009) is that, at current rates of CO2 emissions, average annual temperature in the United States could increase by 3-6^{o}C by 2100. Although the world has experienced this level of temperature increase and more in past periods (Stager, this volume), those past increases played out over time frames of 10,000's to 100,000's of years—100 to 1,000 times slower than what is currently anticipated over the next century. The adaptive capacity of species is currently one of the great unknowns in projecting the future of wildlife in a changing climate. Some species may prove to have greater adaptive capacity than is currently anticipated nevertheless, the fossil record suggests that evolution is a relatively slow process even in geologic terms. Relying on a slow process in a period of rapid change may leave many species unable to keep up.

There are four basic responses of species to climate change: acclimation, relocation, adaptation (in the evolutionary sense), or extinction. Acclimation is a function of a species phenotypic plasticity and genetic variation to address short-term changes at any point in time. Although an assessment of the genetic diversity of a species may provide some insight into both its ability to acclimate in the short-run and to adapt in the long run, it is no guarantee of success in novel circumstances. Relocation is a function of both behavior and selection pressure. For relocation to be a successful survival strategy, a species needs suitable habitat to which it might relocate, and the ability to reach that habitat.

Given the speed at which climate is projected to change, both short-term acclimation and relocation are likely to be the principal mechanisms by which current species might endure this period of change over the short-term. Thus, the most promising interventions for maximizing the retention of species diversity will be to provide a range of habitats and some level of biological connectivity across the landscape. Given the importance of population size to both demographic survival and genetic diversity, the amount of each habitat type conserved will also prove important. The modern landscape is so fragmented from a biological standpoint that the managed relocation of species may prove necessary as a component of "functional connectivity" going forward. Determining what all of this means in operational terms will prove to be the heart of wildlife management's challenge for the next century. *Wildlife conservation policies need to emphasize the retention of significant amounts of the variety of habitats across the landscape and their functional connectivity, including the possibility of managed relocation.*

Friend or Foe. Invasive species are one of the major challenges to wildlife conservation. As of 2000, they were ranked number two as a cause of species listings under the U.S. Endangered Species Act (Stein and others 2000) and their impact may have grown since that time. The conservation community is predisposed to see a species new to an area as a threat and to move to contain or eliminate it. With relocation as one of the principal responses of species to a changing climate, more and more species will be showing up in areas they have not previously inhabited. Will they be invasive? Should they be viewed as exotic? Or, are they the climate pioneers?

Current policies on invasive species were not formulated with this situation in mind. A blind reaction to something new as a threat might actually work against one of the principal means by which species will attempt to adjust to climate change. *Wildlife conservation policies will need to develop criteria by which to differentiate climate change pioneers from invasive species.*

Climate Change is Only One of the Problems. There are few, if any, natural communities that have not been impacted to some degree by non-climate stressors. Habitat loss, fragmentation, and degradation have already taken a toll on the status of many U.S. species (Stein and others 2000). As mentioned earlier, the impacts of invasive species have also been substantial for many native species. Pollution, especially in the form of pesticides and chemicals that disrupt the endocrine systems of vertebrates are also a problem in some cases (Colborn and others 1996). It is expected that climate change will not only be a threat in its own right through direct challenges to the thermal and moisture tolerances of species, but also by exacerbating these existing stressors. Consequently, one of the major goals of the NFWPCAS is reducing these existing stressors, the theory being that species will then be better able to cope with the additional pressures of climate change. This recommendation is a common theme in the wildlife adaptation literature (Mawdsley 2009; Heller and Zavaletta 2009). *Wildlife conservation policies will need to be based on an inclusive and integrated consideration of species vulnerabilities and not simply their climate related vulnerabilities.*

Realism. Wildlife management is, in some sense, a misnomer. It is really about managing human behavior that affects wildlife rather than managing wildlife itself. The human activity of harvesting is managed so as to leave wild populations that can replenish themselves. Management, however, cannot make a species reproduce. Human activities that can alter land use are foregone in some circumstances to retain the conditions that support a species. But management cannot make a species use a certain habitat or stay in a certain area. So it is with adaptation to climate change. Management cannot make a species adapt to climate change, but it can influence the human activities that will make such adaptation more or less likely.

Human activity with regard to the use of fossil fuels has now reached a level that is entraining a directional shift in Earth's climate and wildlife is responding. As a primary driver of biological systems, climate will always trump management. Management, at best, will be a tugboat that can only nudge a much larger ship in a hopefully useful direction. *Going forward, wildlife conservation policies will need to be based on a clear-eyed assessment of their potential leverage to reach a desired outcome*.

CONCLUSION

A large fraction of species studied in the context of climate change are showing changes in their distributions or the timing of life history events that are consistent with a warming world (Parmesan 2006). Some natural disturbance regimes like floods and fires seem to be occurring outside historical bounds, in some cases forcing a switch from one biome type to another. Additional warming is anticipated, as are effects on precipitation and other climate variables; hence further biological response seems inevitable.

The NFWPCAS was a Congressionally mandated, collaboratively executed attempt by the U.S. wildlife management community to begin to come to grips with the challenge of climate change.

It identifies seven major goals and numerous strategies and actions that need to be pursued to give wildlife the best chance of coping with the increasing impacts of climate change. Many of its recommendations are focused on, or are related to the need to review current wildlife conservation policies in light of climate change. As the community begins that work in earnest, it confronts serious challenges related to the unique aspects of climate change, including: (1) its uniqueness in human history; (2) the individuality of species responses in periods of change; (3) the speed of the changes projected to come; (4) the challenge of differentiating between invasive species and climate change pioneers; (5) the interaction of climate change with existing stressors; and (6) perhaps most importantly, the disparity in the power of management interventions in the face of the scope and scale of climate's inertia and its impact on living things. The later point serves to underscore the fundamental point that ultimately, climate change adaptation efforts cannot succeed without the curtailment of CO2 emissions at some level. *In other words, in the long run, there will be no adaptation without mitigation.*

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Appendix I: Policy-related Strategies & Actions

Strategy	Action
Goal 1: Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate.	
Strategy 1.1: Identify areas for an ecologically-connected network of terrestrial, freshwater, coastal, and marine conservation areas that are likely to be resilient to climate change and to support a broad range of fish, wildlife, and plants under changed conditions.	1.1.5: Re-prioritize conservation targets of existing land and water conservation programs in light of areas identified in 1.1.1.and listed in 1.1.4 and 1.4.2.
Strategy 1.2: Secure appropriate conservation status on areas identified in Action 1.1.1 to complete an ecologically connected network of public and private conservation areas that will be resilient to climate change and support a broad range of species under changed conditions.	1.2.1: Conserve areas identified in Action 1.1.1 that provide high priority habitats under current climate conditions and are likely to be resilient to climate change and/or support a broad array of species in the future. 1.2.2: Conserve areas representing the range of geophysical settings, including various bedrock geology, soils, topography, and projected climate, in order to maximize future biodiversity.
Strategy 1.3: Restore habitat features where necessary and practicable to maintain ecosystem function and resiliency to climate change.	1.3.6: Develop market-based incentives that encourage habitat restoration where appropriate.
Strategy 1.4: Conserve, restore, and as appropriate and practicable, establish new ecological connections among conservation areas to facilitate fish, wildlife, and plant migration, range shifts, and other transitions caused by climate change.	1.4.3: Conserve corridors and transitional habitats between ecosystem types through both traditional and non-traditional (e.g., land exchanges, rolling easements) approaches. 1.4.5: Assess existing physical barriers or structures that impede movement and dispersal within and among habitats to increase natural ecosystem resilience to climate change, and where necessary, consider the redesign or mitigation of these structures. 1.4.6: Provide landowners and stakeholder groups with incentives for conservation and restoration of key corridor habitats through conservation programs such as those under the conservation title of the Farm Bill and landowner tools under the ESA as well as other mechanisms such as conservation easement tax incentive programs designed to protect private lands of high connectivity value under climate change.

Goal 2: Manage species and habitats to protect ecosystem functions and provide sustainable cultural, subsistence, recreational, and commercial use in a changing climate.	
Strategy 2.1: Update current or develop new species, habitat, and land and water management plans, programs and practices to consider climate change and support adaptation.	2.1.1: Incorporate climate change considerations into new and future revisions of species and area management plans (e.g., North American Waterfowl Management Plan, National Forest Plans, State Wildlife Action Plans, and agency-specific climate change adaptation plans such as federal agency adaptation plans required by E.O. 13514) using the best available science regarding projected climate changes and trends, vulnerability and risk assessments, scenario planning, and other appropriate tools as necessary. 2.1.3: Identify species and habitats particularly vulnerable to transition under climate change (e.g., wetlands, cool-water to warm-water fisheries, or cool season to warm season grasslands) and develop management strategies and approaches for adaptation.
	2.1.5: Review and revise as necessary existing species and habitat impact avoidance, minimization, mitigation, and compensation standards and develop new standards as necessary to address impacts in a manner that incorporates climate change considerations. 2.1.6: Review permitting intervals in light of the scope and pace of climate change impacts. 2.1.8: Utilize the principles of ecosystem based management and green infrastructure. 2.1.9: Develop strategic protection, retreat, and abandonment plans for areas currently experiencing rapid climate change impacts (e.g., coastline of Alaska and low-lying islands).
Strategy 2.2: Develop and apply species-specific management approaches to address critical climate change impacts where necessary.	2.2.2: Develop criteria and guidelines that foster the appropriate use, and discourage inappropriate use of translocation, assisted relocation, and captive breeding as climate adaptation strategies.
Strategy 2.3: Conserve genetic diversity by protecting diverse populations and genetic material across the full range of species occurrences.	2.3.4: Seed bank, develop, and deploy as appropriate plant materials for restoration that will be resilient in response to climate change.

Goal 3: Enhance capacity for effective management in a changing climate.	
Strategy 3.2: Facilitate a coordinated response to climate change at landscape, regional, national, and international scales across state, federal, and tribal natural resource agencies and private conservation organizations.	3.2.1: Use regional venues, such as LCCs, to collaborate across jurisdictions and develop conservation goals and landscape/seascape scale plans capable of sustaining fish, wildlife, and plants. 3.2.2: Identify and address conflicting management objectives within and among federal, state, and tribal conservation agencies and private landowners, and seek to align policies and approaches wherever possible. 3.2.3: Integrate individual agency and state climate change adaptation programs and State Wildlife Action Plans with other regional conservation efforts, such as LCCs, to foster collaboration. 3.2.4: Collaborate with tribal governments and native peoples to integrate traditional ecological knowledge and principles into climate adaptation plans and decision-making.
Strategy 3.3: Review existing federal, state and tribal legal, regulatory and policy frameworks that provide the jurisdictional framework for conservation of fish, wildlife, and plants to identify opportunities to improve, where appropriate, their usefulness to address climate change impacts.	3.3.1: Review existing legal, regulatory and policy frameworks that govern protection and restoration of habitats and identify opportunities to incorporate the value of ecosystem services and improve, where appropriate, the utility of these frameworks to address climate change impacts. 3.3.2: Review existing legal, regulatory and policy frameworks and identify opportunities to develop or enhance, where appropriate, market-based incentives to support restoration of habitats and ecosystem services impacted by climate change. Identify opportunities to eliminate disincentives to conservation and adaptation. 3.3.3: Review existing legal, regulatory and policy frameworks and identify opportunities to improve, where appropriate, compensatory mitigation requirements to account for climate change. 3.3.4: Review existing legal, regulatory and policy frameworks that govern floodplain mapping, flood insurance, and flood mitigation and identify opportunities to improve their usefulness to reduce risks and increase adaptation of natural resources and communities in a changing climate. 3.3.5: Review existing legal, regulatory and policy tools that provide the jurisdictional framework for conservation of fish, wildlife, and plants to identify existing provisions that provide climate change adaptation benefits. 3.3.6: Continue the ongoing work of the Joint State-Federal Task Force on Endangered Species Act Policy to ensure that policies guiding implementation of the ESA provide appropriate flexibility to address climate change impacts on listed fish, wildlife, and plants and to integrate the efforts of federal, state, and tribal agencies to conserve listed species. 3.3.7: Initiate a dialogue among all affected interests about opportunities to improve the usefulness of existing legal, regulatory, and policy frameworks to address impacts of sea level rise on coastal habitats.

Strategy 3.4: Optimize use of existing fish, wildlife, and plant conservation funding sources to design, deliver, and evaluate climate adaptation programs.	3.4.1: Prioritize funding for land and water protection programs that incorporate climate change considerations. 3.4.2: Review existing federal, state, and tribal grant programs and revise as necessary to support funding of climate change adaptation and include climate change considerations in the evaluation and ranking process of grant selection and awards. 3.4.3: Collaborate with state and tribal agencies and private conservation partners to sustain authorization and appropriations for the State and Tribal Wildlife Grants Program and include climate change criteria in grant review process. 3.4.4: Collaborate with agricultural interests and businesses to identify potential impacts of climate change on crop production and identify conservation strategies that will maintain or improve ecosystem services through programs under the conservation title of the Farm Bill or other vehicles. 3.4.5: Review existing conservation related federal grants to tribal agencies and revise as necessary to provide funding for tribal climate adaptation activities. 3.4.6: Develop a web-based clearinghouse of funding opportunities available to support climate adaptation efforts.
Goal 4: Support adaptive management in a changing climate through integrated observation and monitoring and use of decision support tools.	
Strategy 4.1: Support, coordinate, and where necessary develop distributed but integrated inventory, monitoring, observation, and information systems at multiple scales to detect and describe climate impacts on fish, wildlife, plants, and ecosystems.	4.1.4: Expand and develop as necessary a network of sentinel sites (e.g., tribal lands, National Estuarine Research Reserves, and National Wildlife Refuges) for integrated climate change inventory, monitoring, research, and education. 4.1.8: Promote a collaborative approach to acquire, process, archive, and disseminate essential geospatial and satellite-based remote sensing data products (e.g., snow cover, green-up, surface water, wetlands) needed for regional-scale monitoring and land management.

Goal 7: Reduce non-climate stressors to help fish, wildlife, plants, and ecosystems adapt to a changing climate.	
Strategy 7.1: Slow and reverse habitat loss and fragmentation.	7.1.3: Provide landowners with appropriate incentives for conservation and restoration of key habitats, such as conservation easement tax incentive programs, designed to protect private lands of high habitat connectivity value under climate change. 7.1.6: Consider application of offsite habitat banking linked to climate change habitat priorities as a tool to compensate for unavoidable onsite impacts and to promote habitat conservation or restoration in desirable locations. 7.1.7: Consider market-based incentives that encourage conservation and restoration of ecosystems for the full range of ecosystem services including carbon storage. 7.1.8: Minimize impacts from alternative energy development by focusing siting options on already disturbed or degraded areas.
Strategy 7.2: Slow, mitigate, and reverse where feasible ecosystem degradation from anthropogenic sources through land/ocean- use planning, water resource planning, pollution abatement, and the implementation of best management practices.	7.2.1: Work with local and regional land-use, water resource, and coastal and marine spatial planners to identify potentially conflicting needs and opportunities to minimize ecosystem degradation resulting from development and land and water use. 7.2.8: Reduce ground and surface water withdrawals in areas experiencing drought and/or increased evapotranspiration. 7.2.9: Promote water conservation, reduce water use, and promote increased water quality via proper waste disposal. 7.2.11: Incorporate the recommendations and actions from the *National Action Plan for Managing Freshwater Resources in a Changing Climate* into water resource planning.
Strategy 7.4: Reduce destructive capture practices (e.g., fisheries bycatch, destructive fishing gear), over-harvesting and illegal trade to help increase fish, wildlife, and plant adaptation.	7.4.5: Increase efforts to monitor and reduce illegal species trade in the United States.

This paper received peer technical review. The content of the paper reflects the views of the authors, who are responsible for the facts and accuracy of the information herein.