Chapter 1: Introduction

The goal of the *National Fish, Wildlife and Plants Climate Adaptation Strategy* (hereafter *Strategy*) is to inspire and enable natural resource administrators, legislators and other decision makers to take action to adapt to a changing climate. Those actions are vital to sustaining the nation's ecosystems and natural resources—as well as the human uses and values that the natural world provides. The *Strategy* explains the challenge ahead and offers a guide for actions that can be taken now, in spite of remaining uncertainties over how climate change will impact living resources. It further provides guidance on longer-term actions most likely to promote natural resource adaptation to climate change. Since climate adaptation cuts across many boundaries, the *Strategy* also describes mechanisms to increase collaboration among all levels of government, conservation organizations, and private landowners.

The *Strategy* focuses on preparing for and reducing the most serious impacts of climate change and related non-climate stressors on fish, wildlife, and plants (see Chapter 2). It places priority on addressing impacts for which there is enough information to recommend sensible actions that can be taken or initiated over the next five to ten years in the context of climate change projections through the end of the century. Further, it identifies key knowledge, technology, information, and governance gaps that hamper effective action.

Photo: AFWA

The *Strategy* is not a detailed assessment of climate science or a comprehensive report of the impacts of climate change on individual species or ecosystems; an abundant and growing literature on those topics already exists (Parmesan 2006, IPCC AR4 2007, USGCRP 2009). It is not a detailed operational plan, nor does it prescribe specific actions to be taken by specific agencies or organizations, or specific management actions for individual species. In addition, the development of strategies and actions for this document was not constrained by assumptions of current or future available resources. The implementation of recommended strategies and actions, and the allocation of resources towards them, are the prerogative of the Strategy audience, i.e., decision makers. Rather, this is a broad national adaptation strategy: it identifies major goals and outlines more specific strategies and actions needed to attain those goals. It describes the "why, what, and when" of what the conservation community, collectively, must do to assist our living resources to cope with climate change. The "who, where, and how" of these strategies and actions must be decided through the many existing collaborative processes for management planning, decision-making, and action.

Federal, tribal, state, and local governments and conservation partners have initiated a variety of efforts to help prepare for and respond to the impacts of climate change on the nation's fish, wildlife, and plants and the valuable services they provide. This *Strategy* is designed to build on and assist these efforts across multiple scales and organizations. These entities are encouraged to identify areas of the *Strategy* that bear on their missions and work collaboratively with other organizations to design and implement specific actions to reduce the impacts of climate change on fish, wildlife, and plants.

In order for the *Strategy* to be effectively implemented, progress should be periodically evaluated and the *Strategy* reassessed and updated through the same sort of collaborative process among federal, state, and tribal fish and wildlife authorities as was employed in the production of this first effort. This report proposes that a coordinating body with representation from federal, state, and tribal governments meet semi-annually to evaluate implementation and to report progress annually.

The *Strategy* is organized into four chapters and several appendices. The first chapter explains the origins, vision, guiding principles, and development of this effort. It describes the need for action and explains how to use this document. Chapter 2 describes major current and projected impacts of climate change on the eight major ecosystem types of the United States and on the fish, wildlife and plant species those ecosystems support. Chapter 3 lays out the goals, strategies, and actions that can help fish, wildlife, plants, and ecosystems be more resilient and adapt in a changing climate. It also highlights some of the important roles and opportunities that other sectors such as agriculture, energy, and transportation have in promoting climate adaptation of fish, wildlife, and plants through their activities. Chapter 4 discusses implementation and integration, outlining how stakeholders at all levels of government can use this *Strategy* as a resource. Appendix A provides supplementary information and links to ecosystem-specific background papers that provide more depth and detail regarding climate change impacts and ecosystem-specific actions for each major ecosystem type of the United States. Additional appendices provide a glossary of terms used in the *Strategy*, a list of acronyms, a list of scientific names of species, and a roster of those involved in the development of the *Strategy*.

1.1 Origins and Development of the *Strategy*

Over the past decade there have been an increasing number of calls by government and non-governmental entities for a national effort to better understand, prepare for and address the impacts of climate change on natural resources and the communities that depend on them. These calls helped lay the foundation for development of this *Strategy*.

For example, in 2007, the U.S. Government Accountability Office (GAO) released a study entitled "*Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources*," recommending that guidance and tools be developed to help federal natural resource managers incorporate and address climate change into their resource management efforts (GAO 2007). In 2008, the U.S. Global Change Research Program (USGCRP) released the report "*Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*" that called for and identified a variety of new approaches to natural resource management to increase resiliency and adaptation of ecosystems and resources (CCSP 2008b). In addition, a coalition of hunting and fishing organizations published two reports in 2008 and 2009 on the current and future impacts of climate change on fish and wildlife and called for increased action to help sustain these resources in a changing climate (Wildlife Management Institute 2008, 2009).

In 2009, Congress asked the Council on Environmental Quality (CEQ) and the Department of the Interior (DOI) to 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" (U.S. Congress 2010). Acting for DOI, the U.S. Fish and Wildlife Service (FWS) and CEQ then invited the National Oceanic and Atmospheric Administration (NOAA) and state wildlife agencies, with the New York State Division of Fish, Wildlife, and Marine Resources as their lead representative, to co-lead the development of the *Strategy*. In 2010, the Interagency Climate Change Adaptation Task Force (ICCATF) endorsed development of the *Strategy* as a key step in advancing U.S. efforts to adapt to a changing climate[1].

[1] http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation

A 23-person Steering Committee was formed in January 2011. The Steering Committee includes representatives from 16 federal agencies with management authorities for fish, wildlife, plants, or habitat, as well as representatives from five state fish and wildlife agencies and two intertribal commissions. The Steering Committee charged a small Management Team including representatives of the FWS, NOAA, Association of Fish and Wildlife Agencies (AFWA, representing the states) and Great Lakes Indian Fish and Wildlife Commission to oversee the day-to-day development of the *Strategy*. The Management Team was asked to engage with a diverse group of stakeholders, as well as to coordinate and communicate across agencies and departments.

In March of 2011, the Management Team invited more than 90 natural resource professionals (both researchers and managers) from federal, state, and tribal agencies to form eight Technical Teams, each centered around a major U.S. ecosystem type. These Teams, which were co-chaired by federal, state, and tribal representatives, worked over the next eight months to provide technical information on climate change impacts and to collectively develop the strategies and actions for adapting to climate change. The Management Team worked to identify and distill the primary approaches common across ecosystems into the seven overarching goals, presented at right and discussed in detail in Chapter 3.

Strategy Goals:

- Goal 1. Conserve and Connect Habitat
- Goal 2. Manage Species & Habitats
- Goal 3. Enhance Management Capacity
- Goal 4. Support Adaptive Management
- Goal 5. Increase Knowledge & Information
- Goal 6. Increase Awareness & Motivate Action
- Goal 7. Reduce Non-Climate Stressors

1.2 The Case for Action

1.2.1 The Climate is Changing

Earth's climate has changed many times over its long history. Measurements and observations show unequivocally that the Earth's climate is now in such a period of change. In the United States, for example:

- Average air temperature has increased two degrees Fahrenheit (°F), and precipitation has increased approximately five percent in the United States in the last 50 years.
- The amount of rain falling in the heaviest storms is up 20 percent in the last century causing unprecedented floods.
- Extreme events like heat waves and regional droughts have become more frequent and intense.
- Hurricanes in the Atlantic and Eastern Pacific have gotten stronger in the past few decades.
- Sea levels have risen eight inches globally over the past century and are climbing along most of our nation's coastline.
- Cold season storm tracks are shifting northward.
- The annual extent of Arctic sea ice is shrinking rapidly.
- Oceans are becoming more acidic.
- Ocean currents and upwelling patterns are changing.

All of these changes have been well documented, as described in the report: *Global Climate Change Impacts in the United States* (USGCRP 2009, the primary scientific reference on climate change science for this document). Moreover, the changes are harbingers of far greater changes to come. The science strongly supports the finding that the underlying cause of today's rising temperatures, melting ice, shifting weather, and other changes is the accumulation of heat-trapping carbon dioxide (CO_2) and other greenhouse gases (GHGs) in the atmosphere (IPCC AR4 2007). Because GHGs remain in the atmosphere for many years, those that have already been emitted will continue to warm the Earth (and contribute to ocean acidification) for decades or centuries to come (Wigley 2005). Meanwhile, GHG emissions continue, increasing the concentrations of these gases in the atmosphere. Our future climate will be unlike that of the recent past. Traditional and proven approaches for managing fish, wildlife, plants, and ecosystems may no longer be effective either in kind, in scale, or both.

1.2.2 Impacts to Fish, Wildlife and Plants

Given the magnitude of the observed changes in climate, it is not surprising that fish, wildlife, and plant resources in the United States and around the world are already being affected. The impacts can be seen everywhere from working landscapes like tree farms and pastures to wilderness areas far from human habitation (Parmesan 2006). Although definitively establishing cause and effect in any specific case can be problematic, the overall pattern of observed changes in species' distributions and phenology (the timing of life events) is consistent with biologist's expectations for a warming climate (Parmesan 2006). As the emissions of GHGs and the resulting climate changes continue to increase in the next century, so too will the effects on species, ecosystems, and their functions (USGCRP 2009). Furthermore, climatic changes are also likely to exacerbate existing stresses like habitat loss and fragmentation, putting additional pressure on our nation's valued living resources (USGCRP 2009).Changes that have already been observed include:

- Species are shifting their geographic ranges, often moving poleward or upwards in elevation. For instance, geese that used to winter along the Missouri River in Nebraska and South Dakota now seem to migrate only as far south as North Dakota, to the dismay of waterfowl hunters (Wildlife Management Institute 2008). These shifts may also bring wildlife into more densely populated human areas, creating situations of human-wildlife conflict. In addition, some marine species are also shifting both location and depth (Nye et al. 2009).
- The timing of life history events (phenology), such as spring blooming, is changing (Post et al. 2001). This could affect whether or not plants are successfully pollinated (the pollinators might come at the wrong time), or whether food is available when needed. For example, in the Rocky Mountains, the American robin (see Appendix D for a list of scientific names of species mentioned in the text) is now arriving up to two weeks earlier than it did two decades ago. However, the date of snow melt has not advanced, so food resources may be limited when the birds arrive (Inouye et al. 2000).
- Declines in the populations of species, from mollusks off the coast of Alaska to frogs in Yellowstone, have been attributed to climate change (Maclean and Wilson 2011).
- Different species are responding differently to changes in climate, leading to decoupling of important ecological relationships (Edwards and Richardson 2004). For example, changes in phenology for Edith's checkerspot butterfly has led to mismatches with both caterpillar host

plants and nectar sources for adult butterflies, leading to population crashes in some areas (Parmesan 2006).

- Habitat loss is increasing due to ecological changes associated with climate change, such as sea level rise, increased fire, pest outbreaks, novel weather patterns, or loss of glaciers. For example, habitat for rainbow trout in the Southern Appalachians is being greatly reduced as water temperatures rise (Flebbe et al. 2006).
- Since water absorbs CO_2, the oceans are becoming more acidic, affecting the reproduction of species like oysters (Feely et al. 2008). The pH of seawater has decreased significantly since 1750, and is projected to drop much more by the end of the century as CO_2 concentrations continue to increase (USGCRP 2009). Although not technically climate change, this additional impact of the accumulation of CO_2 in the atmosphere is expected to have major impacts on aquatic ecosystems and species.
- The spread of non-native species as well as diseases, pests, and parasites has become more common. For instance, warmer temperatures have enabled a salmon parasite to invade the Yukon River, causing economic harm to the fishing industry (Kocan et al. 2004). Also, the increasing threats of wildlife diseases due to non-native species include diseases transmissible between animals and humans, which could negatively impact native species, domestic animals, and humans (Hoffmeister et al. 2010).

HOTTER SUMMERS THREATEN EASTERN BROOK TROUT

The West Fork of the Kickapoo River in western Wisconsin is an angler's paradise. Its cool, shaded waters and pools abound with native brook trout. But brook trout require cold water to reproduce and survive—and water temperatures are already rising. By the end of this century, the self-sustaining population in the West Fork could be gone. In fact, up to 94 percent of current brook trout habitat in Wisconsin could be lost with a 5.4 °F increase in air temperature (Mitro et al. 2010). Although climate change has not caused the loss of any brook trout populations to date, the warming effects on air temperature is projected to significantly reduce the current range of brook trout in the eastern United States.

Photo: M. Mitro-Wisconsin DNR

The threat is not limited to Wisconsin or to brook trout. Climate change is viewed as one of the most important stressors of fish populations, and cold-water fish species are especially susceptible to rising temperatures. Declining populations would have serious ecological and economic consequences, since these fish are key sources of nutrients for many other species and provide major fishing industries in the Northeast, Northwest, and Alaska (Trout Unlimited 2007).

In some cases, adaptation measures may help reduce the threat. The first step is measuring stream water temperatures and flow rates to identify which trout habitats are at greatest risk. Monitoring efforts have already shown that some trout streams are at lower risk because they have water temperatures far below lethal limits, while other streams are not likely to see increases in water temperatures even when air temperatures rise, since adequate amounts of cool groundwater sustain the stream's baseflow in summer. This information enables fisheries managers to focus on the streams and rivers that are at greater risk from climate change and from changing land-use that would decrease groundwater discharge rates. In some streams, these deteriorating conditions are unlikely to be reversed. In other streams, adaptation strategies can be implemented to reduce stream water temperatures such as planting trees and other stream bank vegetation for shade, or narrowing and deepening stream channels to reduce solar heating. Protecting and enhancing water infiltration rates on land is another adaptation strategy that can increase cooler groundwater discharge rates during the critical summer low flow conditions.

This "triage" stream assessment approach is similar to how accident or battlefield responders work, where efforts are focused on those most likely to respond to treatment. Thus, limited funding is directed toward streams that are at higher risk from the effects of rising temperatures, and on streams where adaptation actions are more likely to have a positive impact.

1.2.3 Ecosystem Services

Living resources are of immense value and benefit to people. The materials and processes that ecosystems produce that are of value to people are known as "ecosystem services" and can be organized into four general categories (Millennium Ecosystem Assessment 2005):

- *Provisioning Services*, including food, water, medicines, wood, etc.
- *Regulating Services*, such as climate regulation, flood suppression, disease/pest control, or water filtration, etc.
- *Cultural Services*, such as aesthetic, spiritual, educational, and recreational services.
- *Supporting Services*, such as nutrient cycling, soil formation, pollination and plant productivity, etc.

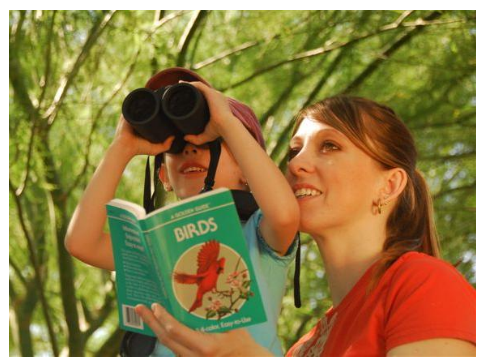


Photo: AFWA

It is possible to calculate the economic contribution associated with some of these services. For example, hunting, fishing, and other wildlife-related recreation (an example of Provisioning and Cultural services) is estimated to contribute $122 billion to our nation's economy annually (U.S. DOI and U.S. DOC 2006), while the world's fisheries (a Provisioning service), most of which are based on wild, free-ranging species, support approximately $116 billion in economic activity a year to the U.S. economy (NMFS 2010). Americans and foreign visitors made some 439 million visits to Interior-managed lands. These visits (example of a Cultural service) supported over 388,000 jobs and contributed over $47 billion in economic activity. This economic output represents about eight percent of the direct output of tourism-related personal consumption expenditures for the United States for 2009 and about 1.3 percent of the direct tourism related employment (U.S. DOI 2011). The continuance or growth of these types of economic activities is directly related to the extent and health of our nation's ecosystems and the services they provide.

Other examples of ecosystem services, though no less real, have yet to be fully quantified economically. For example, Native Americans and other indigenous peoples around the world still depend on wild species for their livelihoods. Forests help provide clean drinking water for many cities and towns. Coastal habitats such as coral reefs, wetlands, and mangroves help protect people and communities from storms, erosion, and flood damage (U.S. DOI and U.S. DOC 2006). For many people, quality of life depends on frequent interaction with wildlife. Others simply take comfort in knowing that the wildlife and natural places that they know and love still survive at least somewhere. For many Native Americans and rural Americans, wild species and habitats are central to their very cultural identities. The animals and plants that are culturally important to these communities have values that are difficult to quantify and weight in monetary terms.

Despite growing recognition of the importance of ecosystem functions and services, they are often taken for granted and overlooked in environmental decision-making. Thus, choices between the conservation and restoration of some ecosystems and the continuation and expansion of human activities in others have to be made in recognition of this potential for conflict and of the value of ecosystem services. In making these choices, the economic values of the ecosystem goods and services must be known so that they can be compared with the economic values of activities that may compromise them and so that improvements to one ecosystem can be compared to those in another (NRC 2005).

Where an ecosystem's services and goods can be identified and measured, it will often be possible to assign values to them by employing existing economic valuation methods such as the examples given above. However, some ecosystem goods and services cannot be valued because they are not quantifiable or because available methods are not appropriate or reliable. Economic valuation methods can be complex and demanding, and the results of applying these methods may be subject to judgment, uncertainty, and bias.

However, if policymakers consider benefits, costs, and trade-offs when making policy decisions, then quantification of the value of ecosystem services is essential. Failure to include some measure of the value of ecosystem services in benefit-cost calculations will implicitly assign them a value of zero. In brief:

- If the benefits and costs of an adaption action or policy are to be evaluated, the benefits and costs associated with changes in ecosystem services should be included along with other impacts to ensure that ecosystem effects are adequately considered in policy evaluation.
- Economic valuation of changes in ecosystem services should be based on the total economic value framework, which includes both use and nonuse values.
- The valuation exercise should focus on changes in ecosystem goods or services attributable to a policy action, relative to a baseline.

Unlike actions to mitigate the impacts of climate change (which often require coordinated actions at various levels of government), adaptation decisions are largely decentralized. They will be made to a large extent in well-established decision-making contexts such as private sector decision-making or public sector planning efforts. Some adaptations will have a public good character and as such, may be provided by the local, state, tribal, or federal government. These adaptation decisions can be evaluated using traditional tools such as cost-benefit analysis. Private sector decisions are likely to be evaluated using standard investment appraisal techniques, for example, calculating the net present value of an adaptation investment, analyzing its risks and returns, or determining the return on capital invested.

Because climate change is a long-term problem, both the level and timing of adaptation decisions is important. Both sets of decisions – level and timing – will be taken under considerable uncertainty about the precise impacts of climate change. Timing decisions should recognize the following:

- Early action may be more cost effective in situations where long-lived infrastructure investments such as water and sanitation systems, bridges, and ports are being considered. In these cases, it is likely to be cheaper to make adjustments early, in the design phase of the project, rather than incur the cost and inconvenience of expensive retrofits.
- Early adaptation actions will be justified if they have immediate benefits, for example, by mitigating the effects of climate variability. In addition, adaptation actions that have ancillary benefits such as measures to preserve and strengthen the resilience of natural ecosystems might also be justified in the short-term.

A full accounting of ecosystem services has yet to be done for any ecosystem. Nevertheless, as climate change influences the distribution, extent, and composition of ecosystems, it will also affect the spectrum of services and economic value those ecosystems provide.

WHAT HAPPENS TO TRIBAL IDENTITY IF BIRCH BARK VANISHES?

Photo: John Zasada

Climate change models suggest that by 2100, the paper birch tree may no longer be able to survive in its habitat in the upper Midwest and northeastern United States, from northern Wisconsin to Maine (Prasad et al. 2007). This would be not just an ecological loss, but a devastating cultural loss as well. Some species are so fundamental to the cultural identity of a people through diverse roles in diet, materials, medicine, and/or spiritual practices that they may be thought of as cultural keystone species (Garibaldi and Turner 2004). The paper birch is one such example.

Paper birch bark has been crucial for American Indians throughout the Northeast and Alaska Native tribes since time immemorial. It provided native peoples with transportation, thanks to birch bark canoes. It was used for food storage containers to retard spoilage, earning it the nickname of the “original Tupperware™”. It was a material on which fungi was grown for medicines and for tinder in sacred fires. It is an extremely durable material and is still used as a canvas on which traditional stories and images are etched, contributing to the survival of Native culture and providing a source of revenue. Indeed, birch bark is crucial for the economic health of skilled craftspeople who turn it into baskets and other items for sale to tourists and collectors. Paper birch is central to some of the great legends of the Anishinaabe or Ojibwe peoples (also known as Chippewa).

These rich cultural and economic uses and values are at risk if the paper birch tree disappears from the traditional territories of many U.S. tribes. Already, artisans in the Upper Midwest are concerned about what they believe is a diminishing supply of birch bark.

1.2.4 Adaptation to Climate Change

While addressing the causes of climate change (i.e., mitigation) is absolutely necessary, mitigation will not be sufficient to prevent major impacts due to the amount of GHGs that have already been emitted into the global atmosphere. Society's choices of what actions to take in the face of climate change can either make it harder or easier for our living resources to persist in spite of climate change. Effective action by managers, communities and the public is both possible (see Chapter 3) and crucial.

Adaptation in the climate change context has been specifically defined as an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC WGII 2007). Adaptation in the biological context has a somewhat different meaning. In essence, biological adaptation refers both to the process and the products of natural selection that change the behavior, function, or structure of an organism that makes it better suited to its environment. The factors that control the rate of biological adaptation (e.g., population size, genetic variability, mutation rate, selection pressure, etc.) are rarely under full control of human action. Much as people might like, human intervention will not be able to make species adapt to climate change. But our actions can make such adaptation more or less likely.

The science and practice of adaptation to climate change is an emerging discipline that focuses on evaluating and understanding the vulnerability and exposure that natural resources face due to climate change, and then preparing people and natural systems to cope with the impacts of climate change through adaptive management (Glick et al. 2011a). The ability of populations, species, or systems to adapt to a changing climate is often referred to as their adaptive capacity.

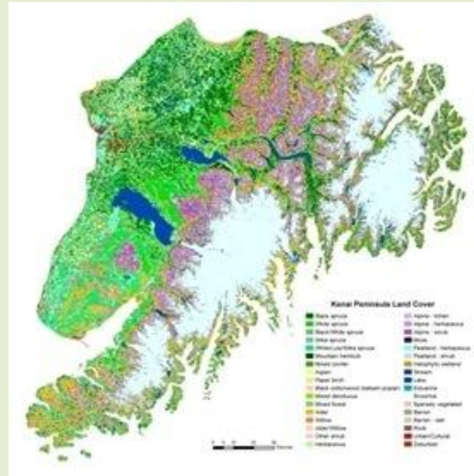
Three general types of adaptation responses illustrate points along a continuum of possible responses to climate change: resistance, resilience, and transformation.

- *Resistance* is the ability of a system to remain essentially intact or unchanged as climate changes.
- *Resilience* is the ability of a system to recover from a disturbance, returning to its original state.
- *Transformation* is the change in a system's composition and/or function in response to changes in climate or other factors.

Application of the adaptation approaches described in this *Strategy* must carefully consider whether the desired outcome in any given situation should be to try to increase the resistance of a natural system to climate change, to attempt to make it more resilient in the face of climate change, or to assist its transformation into a new and different state—or to achieve some combination of all three outcomes (Hansen and Hoffman 2011).

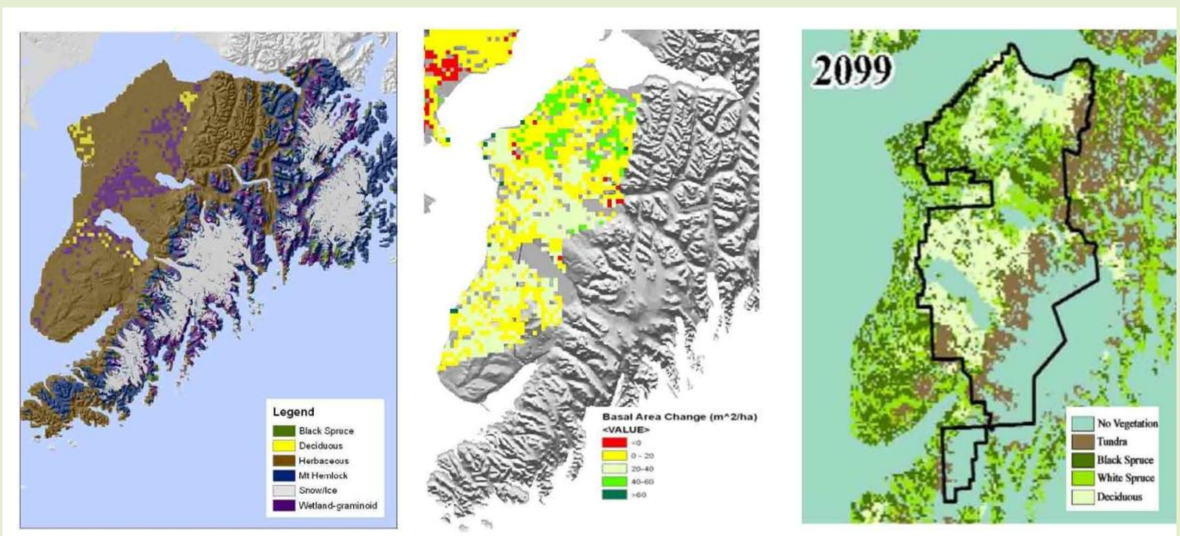
CLIMATE CHANGE IN THE KENAI PENINSULA

For a glimpse of the dramatic changes that a warming climate may bring to the entire nation, look no farther than Alaska's seven million-acre Kenai Peninsula. Here, warmer temperatures have increased overwinter survival and boosted populations of spruce bark beetle, enabling the pest to devastate four million acres of forest on the peninsula and south-central Alaska over a 15-year period (Berg et al. 2006). Meanwhile, the treeline has risen an unprecedented 150 feet (Dial et al. 2007); the area of wetlands has decreased by six to 11 percent (Klein et al. 2005, Berg et al. 2009, Klein et al. 2011); the Harding Icefield, the largest glacial complex in the United States, has shrunk by five percent in surface area and 60 feet in height (Rice 1987, Adageirsdottir et al. 1998); and available water has declined 55 percent (Berg et al. 2009). The fire regime is also changing: late summer canopy fires in spruce are being replaced by spring fires in bluejoint grasslands, and a 2005 wildfire in mountain hemlock was far different from any previous fire regime (Morton et al. 2006).



Current Kenai Landscape (2006)

While these changes are already sobering, even greater changes lie ahead, according to projections from spatial modeling. As the climate continues to warm and dry, the western side of the peninsula could see an almost catastrophic loss of forest. Salmon populations—and the communities that depend on salmon—are projected to suffer because of higher stream temperatures and increased glacial sediment. Overall, roughly 20 percent of species may vanish from the peninsula.



Future scenarios of the landscape on Kenai National Wildlife Refuge, Alaska using three modeling approaches: climate envelope, fire regime shift, and forest dynamics (USFWS/John Morton)

Is adapting to this rapidly changing climate possible? Some communities are already taking positive steps. For instance, state and local agencies are replanting beetle-killed areas that have become grasslands with white spruce and non-native lodgepole pine to reduce fire hazards for nearby cities and communities. The National Park Service, the Forest Service, the University of Alaska Anchorage, and other agencies and groups are also exploring additional adaptation options for the Kenai Peninsula. Kenai National Wildlife Refuge will host a workshop in early 2012 to develop interagency strategies for developing reactive and anticipatory options specifically for the Kenai Peninsula. The geographic discreteness of the peninsula, the substantial lands under federal management, and the documentation of dramatic climate change impacts combine to make Kenai an ideal laboratory to explore the effectiveness of various adaptation measures.

1.3 About the *Strategy*

As discussed previously, species and habitats are already displaying changes consistent with a warming climate (Parmesan 2006). What society can or even should do about these changes is a complicated question, and involves much more than science. Deciding what to do requires considering the way existing conservation institutions describe, classify, and value nature and natural resources. It requires examining the institutions, laws, regulations, policies, and programs that our nation has developed to maintain these resources and the many benefits they provide. It requires evaluating the management techniques that the conservation profession and other sectors (such as agriculture, energy, transportation, and urban development) have developed over time, as well as considering new approaches where necessary. Perhaps most of all, it requires communicating our shared social values for wild living things and the ecosystems they live in. Those social values can form the basis of cooperative intervention.

This *Strategy* is the first joint effort of three levels of government (federal, state, and tribal) that have primary authority and responsibility for the living resources of the United States to identify what must be done to help these resources become more resilient, adapt to, and survive a warming climate. The timeframe for this first effort focuses on actions that can be taken or initiated in the next decade to help fish, wildlife, and plants adapt to changes that are currently projected to occur over the next century. Although there is great certainty about the fact of climate change, uncertainty remains about its scale, pace, and regional effects. Because new information will become available in the coming years, this adaptation strategy should be revisited, refreshed, and as necessary, revised preferably within a year or so of each successive National Climate Assessment (NCA).

Jurisdiction of State, Tribal, and Federal Agencies

Jurisdiction for conservation of fish and wildlife in the United States is shared among state, tribal, and federal governments. State governments generally have responsibility for conservation of resident fish and wildlife. For example, New York State asserts ownership and control of all fish, game, wildlife, shellfish, crustacean, and protected insects under its Environmental Conservation Law (11-0105). Other states derive their jurisdiction for fish and wildlife conservation from similar statutes or from their State Constitutions.

Tribes recognized by the United States generally have primacy for conservation of resident fish and wildlife on tribal reservation lands. In some instances, tribes also have reserved rights for harvest of fish and wildlife on non-tribal lands. Tribal jurisdiction and rights are articulated in treaties between the individual sovereign tribes and the United States.

The federal government jurisdiction for fish and wildlife conservation focuses on migratory birds, threatened and endangered species, and inter-jurisdictional and federal fisheries. The authority comes from the U.S. Constitution and such federal statutes as the Migratory Bird Treaty Act, the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), the Magnuson-Stevens Fishery Conservation and Management Act, and the Coastal Zone Management Act. However, with the exception of the MMPA, Congress has affirmed in these statutes that state jurisdiction for fish and wildlife remains concurrent with the federal jurisdiction.

Ownership and jurisdiction for conservation of plants is shared among governments and private landowners. Plants are generally owned by the underlying landowner, and landowners are essential partners for plant conservation. Many state governments and the United States government provide some protection, usually regulating the sale of plants listed as threatened or endangered under the federal ESA or various state statutes.

1.3.1 Purpose, Vision, and Guiding Principles

In 2009, the FWS launched a series of Conservation Leadership Forums to bring together leaders in the conservation community to discuss what a *Strategy* should include and how it should be developed. That effort, and others, produced a purpose, a vision, and guiding principles for developing this first national climate change adaptation strategy.

Purpose: The purpose of the *Strategy* is to inspire and enable natural resource professionals and other decision makers to take action to conserve the nation's fish, wildlife, plants, and ecosystem functions, as well as the human uses and values these natural systems provide, in a changing climate.

Vision: Ecological systems will sustain healthy, diverse, and abundant populations of fish, wildlife, and plants. Those systems will continue to provide valuable cultural, economic, and environmental benefits in a world impacted by global climate change.

Guiding Principles for the development of this *Strategy*: An unprecedented commitment to collaboration and communication is required among federal, state, and tribal governments to effectively respond to climate impacts. There must also be active engagement with conservation organizations, industry groups, and private landowners.

In light of these considerations, the development of this *Strategy* was guided by the following principles:

1. **Build a national framework for cooperative response.** Provide a framework for collective action that promotes collaboration across sectors and levels of government so they can effectively respond to climate impacts.
2. **Foster communication and collaboration across government and non-government entities.** Create an environment that supports the development of cooperative approaches to adapting to climate change while respecting jurisdictional authority.
3. **Engage the public.** To ensure success and gain support for adaptation strategies, a high priority must be placed on public outreach, education, and engagement in adaptation planning and natural resource conservation.
4. **Adopt a landscape/seascape based approach that integrates best-available science and adaptive management.** Strategies for natural resource adaptation should employ: ecosystem-based management principles; species-habitat relationships; ecological systems and function; strengthened observation and monitoring systems; model-based projections; vulnerability and risk assessment; and adaptive management.
5. **Integrate strategies for natural resources adaptation with those of other sectors.** Adaptation planning in sectors including agriculture, energy, human health, and transportation may support and advance natural resource conservation in a changing climate.
6. **Focus actions and investments on natural resources of the United States and its Territories.** But also acknowledge the importance of international collaboration and information-sharing, particularly across our borders with Canada and Mexico. International cooperation is important to conservation of migratory resources over broad geographic ranges.
7. **Identify critical scientific and management needs.** These may include new research, information technology, training to expand technical skills, or new policies, programs, or regulations.
8. **Identify opportunities to integrate climate adaptation and mitigation efforts.** Strategies to increase natural resource resilience while reducing GHG emissions may directly complement each other to advance current conservation efforts, as well as to achieve short- and long-term conservation goals.
9. **Act now.** Immediate planning and action are needed to better understand and address the impacts of climate change and to safeguard natural resources now and into the future.

1.3.2 Risk and Uncertainty

Climate change presents a new challenge to natural resource managers and other decision makers. The future will be different from the recent past, so the historical record cannot be the sole basis to guide conservation actions. More is being learned every year about how the climate will change, how those changes will affect species, ecosystems, and their functions and services, and how future management and policy choices will exacerbate or alleviate these impacts. This uncertainty is not a reason for inaction, but rather a reason for prudent action: using the best available information while striving to improve our understanding over time.

An important approach for dealing with risk and uncertainty is the iterative process of adaptive management. Adaptive management is a structured approach toward learning, planning, and adjustment where continual learning is built into the management process so that new information can be incorporated into decision-making over time without delaying needed actions. Carefully monitoring the actual outcomes of management actions allows for adjustments to future activities based on the success of the initial actions.

A variety of tools and approaches can help reduce uncertainty and inform managers about how climate change may affect particular systems or regions. Improved climate modeling and downscaling can help build confidence in predictions of future climate, while climate change vulnerability assessments can help to identify which species or systems are likely to be most affected by climate changes. Well-designed monitoring of how species and natural systems are currently reacting to climate impacts and to adaptation actions will also be a critical part of reducing uncertainty and increasing the effectiveness of management responses. These tools and approaches can all inform scenario planning, which involves anticipating a reasonable range of future conditions and planning management activities around a limited set of likely future scenarios. In addition, other approaches aim to identify actions that are expected to succeed across a range of uncertain future conditions such as reducing non-climate stressors or managing to preserve a diversity of species and habitats.

Another important component of managing uncertainty is to better integrate existing scientific information into management and policy decisions. This requires that research results be accessible, understandable, and highly relevant to decision makers. In addition, decision support tools that help connect the best available science to day-to-day management decisions should continue to be developed, used, and improved, and research priorities should be linked to the needs of managers on the ground.

It is important to remember that natural resource management has always been faced with uncertainty about future conditions and the likely impacts of a particular action. The adaptation strategies and actions in this *Strategy* are intended to help natural resource managers make proactive climate change-related decisions today, recognizing that new information will become available over time that can then be factored into future decisions.

Risk Assessment:
A risk assessment is the process of identifying the magnitude or consequences of an adverse event or impact occurring, as well as the probability that it will occur (Jones 2001).

Vulnerability Assessment:
Vulnerability assessments are science-based activities (research, modeling, monitoring, etc.) that identify or evaluate the degree to which natural resources, infrastructure, or other values are likely to be affected by climate change.

Adaptive Management:
Adaptive management involves defining explicit management goals while highlighting key uncertainties, carefully monitoring the effects of management actions, and then adjusting management activities to take the information learned into account (CCSP 2009b).