A photograph of several monarch butterflies with their characteristic orange and black wings, perched on tall, slender stems of purple flowers. The background is a soft-focus green field. The text is overlaid on the right side of the image.

Preface

Our climate is changing, and these changes are already impacting the nation's valuable natural resources and the people, communities, and economies that depend on them.

These impacts are expected to increase with continued changes in the planet's climate system, putting many of the nation's valuable natural resources at risk. Action is needed now to reduce these impacts (including reducing the drivers of climate change) and help sustain the natural resources and services the nation depends on.

The observed changes in climate have been attributed to the increasing levels of carbon dioxide (CO₂) and other greenhouse gases (GHGs) in the atmosphere, which have set in motion a series of changes in the planet's climate system. Far greater changes are inevitable not only because emissions will continue, but also because CO₂ stays in the atmosphere for a long time. Even if further GHG emissions were halted today, alterations already underway in the Earth's climate will last for hundreds or thousands of years. If GHG emissions continue, as is currently more likely, the planet's average temperature is projected to rise by 2.0 to 11.5 degrees Fahrenheit by the end of the century, with accompanying major changes in extreme weather events, variable and/or inconsistent weather patterns, sea level rise, and changing ocean conditions including increased acidification.

Safeguarding our valuable living resources in a changing climate for current and future generations is a serious and urgent problem. Addressing the problem requires action now to understand current impacts, assess future risks, and prepare for and adapt to a changing climate. This *National Fish, Wildlife and Plants Climate Adaptation Strategy* (hereafter *Strategy*) is a call to action—a framework for effective steps

that can be taken, or at least initiated, over the next five to ten years in the context of the changes to our climate that are already occurring, and those that are projected by the end of the century. It is designed to be a key part of the nation's larger response to a changing climate, and to guide responsible actions by natural resource managers, conservation partners, and other decision makers at all levels. The *Strategy* was produced by federal, state, and tribal representatives and has been coordinated with a variety of other climate change adaptation efforts at national, state, and tribal levels.

The overarching goal of the Strategy is a simple one: to inspire, enable, and increase meaningful action that helps safeguard the nation's natural resources in a changing climate.

The overarching goal of the *Strategy* is a simple one: to inspire, enable, and increase meaningful action that helps safeguard the nation's natural resources in a changing climate. Admittedly, the task ahead is a daunting one, especially if the world fails to make serious efforts to reduce emissions of GHGs. But we can make a difference. To do that, we must begin now to prepare for a future unlike the recent past.

Because the development of this adaptation *Strategy* will only be worthwhile if it leads to meaningful action, it is directly aimed at several key groups: natural resource management agency leaders and staff (federal, state, and tribal); elected officials in both executive and legislative government branches (federal, state, local, and tribal); leaders in industries that depend on and can impact natural resources, such as agriculture, forestry, and recreation; and private landowners, whose role is crucial because they own more than 70 percent of the land in the United States.

The *Strategy* should also be useful for decision makers in sectors that affect natural resources (such as agriculture, energy, urban development, transportation, and water resource management), for conservation partners, for educators, and for the interested public, whose input and decisions will have major impacts on safeguarding the nation's living resources in the face of climate change. The *Strategy* also should be useful to those in other countries dealing with these same issues and those dealing with the international dimensions of climate adaptation.



Executive Summary

FISH, WILDLIFE, AND PLANTS PROVIDE jobs, food, clean water, storm protection, health benefits and many other important ecosystem services that support people, communities and economies across the nation every day. The observed changes in the climate are already impacting these valuable resources and systems. These impacts are expected to increase with continued changes in the planet's climate system. Action is needed now to help safeguard these natural resources and the communities and economies that depend on them.

"...develop a national, government-wide strategy to address climate impacts on fish, wildlife, plants, and associated ecological processes."

—DEPARTMENT OF THE INTERIOR, ENVIRONMENT, AND RELATED AGENCIES APPROPRIATIONS ACT, 2010

Measurements unequivocally show that average surface air temperatures in the United States have risen two degrees Fahrenheit (°F) over the last 50 years. The science strongly supports the finding that the underlying cause of these changes is the accumulation of heat-trapping carbon dioxide (CO₂) and other greenhouse gases (GHG) in the atmosphere. If GHG emissions continue unabated, the planet's average temperature is projected to rise by an additional 2.0 to 11.5 °F by the end of the century, with accompanying increases in extreme weather events, variable and/or inconsistent weather patterns, sea levels and other factors with significant impacts

on natural environments and the vital services they provide.

Faced with a future climate that will be unlike that of the recent past, the nation has the opportunity to act now to reduce the impacts of climate change on its valuable natural resources and resource-dependent communities and businesses. Preparing for and addressing these changes in the near term can help increase the efficiency and effectiveness of actions to reduce negative impacts and take advantage of potential benefits from a changing climate (climate adaptation). In 2009, Congress recognized the need for a national government-

wide climate adaptation strategy for fish, wildlife, plants, and ecosystems, asking the Council on Environmental Quality (CEQ) and the U.S. Department of the Interior (DOI) to develop such a strategy. CEQ and DOI responded by assembling an unprecedented partnership of federal, state, and tribal fish and wildlife conservation agencies to draft the document. More than 90 diverse technical, scientific, and management experts from across the country participated in drafting the technical content of the document.

The result is *The National Fish, Wildlife and Plants Climate Adaptation Strategy* (hereafter *Strategy*). The *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. It is designed to inspire and enable natural resource managers, legislators,

and other decision makers to take effective steps towards climate change adaptation over the next five to ten years. Federal, state, and tribal governments and conservation partners are encouraged to read the *Strategy* in its entirety to identify intersections between the document and their mission areas and activities.

The *Strategy* is guided by nine principles. These principles include collaborating across all levels of government, working with non-government entities such as private landowners and other sectors like agriculture and energy, and engaging the public. It is also important to use the best available science—and to identify where science and management capabilities must be improved or enhanced. When adaptation steps are taken, it is crucial to carefully monitor actual outcomes in order to adjust future actions to make them more effective, an iterative process called adaptive management. We must also link efforts within the U.S. with

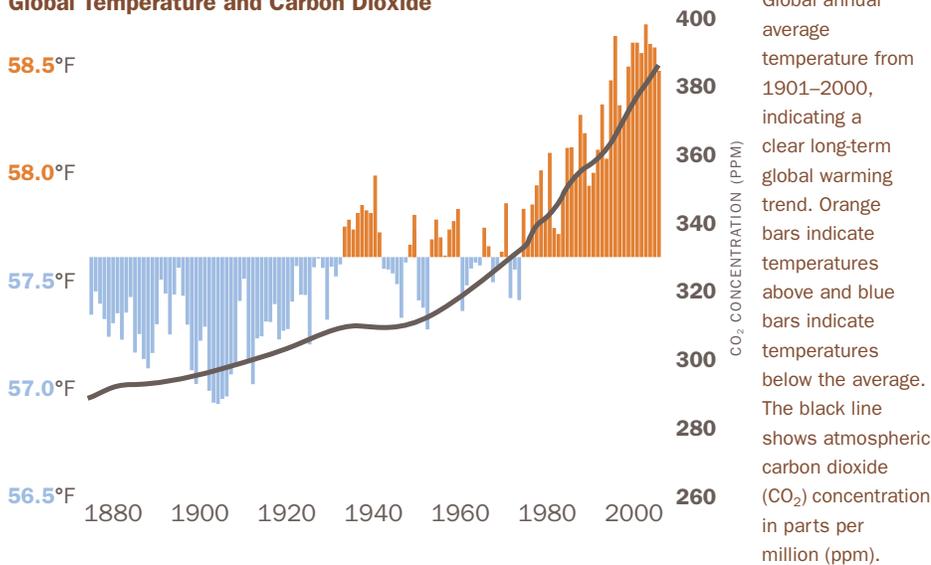
efforts internationally to build resilience and adaptation for species that migrate and depend on areas beyond U.S. borders. Finally, given the size and urgency of the challenge, we must begin acting now.

Climate Change Impacts on Natural Systems

The *Strategy* details the current and expected future impacts of climate change on the eight major ecosystem types in the United States (Chapter 2). For example, warmer temperatures and changing precipitation patterns are expected to cause more fires and more pest outbreaks, such as the mountain pine beetle epidemic in western forests, while some types of forests will displace what is now tundra. Grasslands and shrublands are likely to be invaded by non-native species and suffer wetland losses from drier conditions, which would decrease nesting habitat for waterfowl. Deserts are expected to get hotter and drier, accelerating existing declines in species like the Saguaro cactus.

Climate change is expected to be especially dramatic in the Arctic. Temperature increases in northern Alaska would change tussock tundra into shrublands, leading to increased fire risk. In addition, the thawing of frozen organic material in soils would release huge amounts of GHGs, contributing to climate change. In coastal and marine areas, the loss of sea ice and changing ocean conditions are threatening key species such as walrus, ice seals and polar bears as well as the lifestyles and subsistence economics of indigenous peoples.

Global Temperature and Carbon Dioxide



SOURCE: USGCRP 2009. GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES.



Executive Summary

Rivers, streams, and lakes face higher temperatures that harm coldwater species like salmon and trout, while sea level rise threatens coastal marshes and beaches, which are crucial habitats for many species, such as the diamondback terrapin and the piping plover.

Since water can absorb CO₂ from the air, the rising levels of the gas in the atmosphere and accompanying absorption into the oceans have caused ocean waters to become 30 percent more acidic since 1750. Acidification is already affecting the reproduction of organisms such as oysters. As the pH of seawater continues to drop, major impacts on aquatic ecosystems and species are expected.



USFWS/JOEL GARLICH-MILLER

Loss of arctic ice means loss of valuable habitat for many marine species.

Climate Change Adaptation Strategies and Actions

The *Strategy* describes steps that can be taken to address these impacts and help conserve ecosystems and make them more resilient (Chapter 3). Proposed strategies and actions along with checklists to monitor progress are organized under seven major goals in the *Strategy*:

- 1 | Conserve and connect habitat
- 2 | Manage species and habitats
- 3 | Enhance management capacity
- 4 | Support adaptive management
- 5 | Increase knowledge and information
- 6 | Increase awareness and motivate action
- 7 | Reduce non-climate stressors

Many proposed actions describe types of conservation activities that management agencies have traditionally undertaken but that will continue to be useful in a period of climate change. Other actions are designed specifically to respond to the new challenges posed by climate change.

An extremely important approach for helping fish, wildlife, and plants adapt to climate change is conserving enough suitable habitat to sustain diverse and healthy populations. Many wildlife refuges and habitats could lose some of their original values, as the plants and animals they safeguard are forced to move into more hospitable climates. As a result, there is an urgent need to identify the best candidates for new conservation

areas (including refugia and corridors of habitat that allow species to migrate), and areas where habitat restoration can promote resiliency and adaptation of species and ecosystem functions.

In addition to traditional habitat restoration and protection efforts, this *Strategy* envisions innovative opportunities for creating additional habitat. For example, the U.S. Department of Agriculture (USDA) works with farmers and ranchers to cost-share conservation practices that benefit at-risk, threatened, or endangered species, such as the lesser prairie chicken. These efforts may be useful in responding to climate change as well as other existing conservation challenges. Similarly, adjusting rice farming practices in Louisiana could provide valuable new resources for a variety of waterfowl and shorebirds whose habitat is now disappearing because of wetland loss and sea level rise.

It is also possible to use applied management to make habitats and species more resistant to climate change so they continue to provide sustainable cultural, subsistence, recreational, and commercial uses. For example, managing stream corridors to preserve functional processes and reconnect channels with well-vegetated floodplains may help to ensure a steady supply of groundwater recharge that maintains coldwater species even when air temperatures rise. Floodplains serve as vital hydrologic capacitors, and may become even more important in many parts of the country as more precipitation falls as rain instead of snow. Protecting and restoring stream habitats to maintain more narrow and deep stream beds and riparian shade cover can also help keep water temperatures cool in a warming climate.

Climate change adaptation requires new ways of assessing information, new management tools and professional skills, increased collaboration across jurisdictions, and review of laws, regulations, and policies to ensure effectiveness in a changing world. Climate change impacts are occurring at scales much larger than the operational scope of individual organizations and agencies, and successful adaptation demands strong collaboration among all jurisdictions. Landscape Conservation Cooperatives (LCCs), migratory bird and other Joint Ventures (JVs), National Fish Habitat Partnerships (NFHPs), and other existing and emerging partnerships are useful vehicles to promote diverse collaboration across larger scales. Because of the dependence of Native Americans, Alaska Natives and other groups on their natural resources for their economic and cultural identity, climate change is a threat not only to those natural resources, but also to the traditions, the culture, and ultimately, the very health of the communities themselves. Indigenous communities possess traditional ecological knowledge (TEK) and relationships with particular resources and homeland areas, accumulated through thousands of years of history and tradition, which make them highly sensitive to, and aware of, environmental change. Alaska provides an excellent example of not only how TEK can be successfully integrated into management activities, but also how this knowledge can be collected, used, and protected in a respectful and culturally-sensitive manner, benefitting both indigenous and non-indigenous communities.

Reducing existing stressors on fish, wildlife, and plants may be one of the most effective, and doable, ways to increase resilience to climate change.

It will frequently be difficult to predict how individual species and ecosystems will react to climate change. Adaptation in the face of uncertain impacts requires coordinated observation and monitoring, information management and decision support systems, and a commitment to adaptive management approaches. Coordinated information management systems, such as the National Ecological Observatory Network and the Integrated Ocean Observing System, that link and make available the data developed by separate agencies or groups have a critical role to play in increasing access to and use of this information by resource managers, planners, and decision makers. Vulnerability assessments are key steps to help managers develop and prioritize adaptation efforts and inform management approaches.

Additional research and modeling efforts are needed to increase knowledge about the specific impacts of climate change on fish, wildlife, plants, and habitats and their adaptive capacity to respond. The use of models has already produced valuable information for planning for climate change impacts, and more refined models at temporal and spatial scales appropriate to adaptation are required. Methods to objectively quantify the value

of ecosystem services provided by well-functioning ecosystems also are needed. For example, there may be fewer salmon for commercial and recreational harvest, as well as for traditional ceremonial and cultural practices of indigenous peoples.

Adaptation efforts will be most successful if they have broad support and if key groups are motivated to take action themselves. Efforts to increase awareness and motivate action should be targeted toward elected officials, public and private decision makers, groups that are interested in learning more about climate change, private landowners, and natural resource user groups. Engaging these stakeholders early and repeatedly to increase awareness of climate change, to develop integrated adaptation responses, and to motivate their participation is key to making this *Strategy* work.

Reducing existing stressors on fish, wildlife, and plants may be one of the most effective, and doable, ways to increase resilience to climate change. Many existing non-climate stressors may be exacerbated by climate change. In particular, avoiding, reducing and addressing the ongoing habitat degradation (e.g., pollution, loss of open space) associated with human development is critical and requires collaboration with land-use planners and private land owners. Taking steps to reduce stressors not related to climate, such as fighting invasive species like water hyacinth, can help natural systems cope with the additional pressures imposed by a changing climate.



Integration and Implementation

The *Strategy* emphasizes that actions to help fish, wildlife, plants, and natural systems adapt to climate change can be coordinated with measures taken in other sectors, such as agriculture, energy, water, and transportation, to increase the benefits for all sectors (Chapter 4). One example of an action that benefits multiple sectors and ecosystems is better management of stormwater runoff, which not only reduces risks of flooding in cities, but also reduces the threat that toxic algal blooms will affect aquatic ecosystems.

The *Strategy* is designed to build upon and complement the growing number

of adaptation and conservation efforts and programs (Chapter 5) at local, state, regional and national levels. Examples include the U.S. Global Change Research Program (USGCRP), which produces the National Climate Assessment (NCA) every four years; the Interagency Climate Change Adaptation Task Force (ICCATF) that provides a venue to communicate and help coordinate U.S. federal agency adaptation efforts; State Wildlife Action Plans; EPA regional initiatives such as the Great Lakes Restoration Initiative; and the work of the LCCs. Implementing the *Strategy* will require coordination and collaboration among these and many other entities. The *Strategy* calls for creation of a coordination body to oversee its implementation and engage with conservation partners.



The *Strategy* is a call to action. We can take effective action to reduce risks and increase resiliency of valuable natural resources. Unless the nation begins a serious effort to undertake this task now, we risk losing priceless living systems—and the benefits and services they provide—as the climate changes.

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