10 THINGS YOU SHOULD KNOW ABOUT CLIMATE CHANGE AND WILDLIFE

Climate change poses profound challenges to human and natural communities that are already seriously threatened by habitat loss, overexploitation of resources and pollution. Understanding what we know about climate change and its impacts, what we still need to learn and what we can do to address the impacts effectively is essential to protecting species, habitats and future generations.

1 Science says: Climate change is real, and we're contributing to it.

The mechanisms by which human activities like burning coal, oil and gas cause climate change are well documented, well understood and accepted by the overwhelming majority of climate researchers. And we've known about these mechanisms for a long time. Scientists discovered in the 1800s that certain gases like carbon dioxide (CO_2) and water vapor form an invisible, heat-trapping "blanket" in our atmosphere (the greenhouse effect) and that a doubling of CO_2 levels would significantly warm the Earth's surface.

2 We're continually refining our understanding of climate change.

In recent decades, we have exponentially increased our ability to measure CO_2 levels, observe global temperature trends and predict climate responses. We're also learning to differentiate between changes caused by greenhouse gases versus fluctuations in solar levels, volcanic activity and other natural occurrences. The implications for human and natural systems have also been well studied and computer-modeled.

Definitive Sources of Information on Climate Change

Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report

Released in 2014, this report is the most comprehensive global assessment of the science, effects, and response options to climate change. It discusses climate science and impacts at a global scale, however, which means it may not be the most useful reference for analyzing and addressing local and regional effects.

National Climate Assessment (NCA)

Published in 2014 by the multi-agency U.S. Global Change Research Program, this is the best source of information specific to the United States about observed and projected climate change impacts. The NCA also provides a useful breakdown of the data for U.S. regions (Southeast, Midwest, etc.) and sectors (such as agriculture, ecosystems and human health).

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3 Climate change is already affecting all of us.

Far from being something for our grandchildren to worry about, the effects of climate change are already happening. And they're likely to worsen over the course of this century, affecting our cities, oceans, coastal regions and forests, and threatening our transportation infrastructure, public health, agriculture and land and wildlife conservation.

4 Climate change has many detrimental impacts on wildlife and habitat.

Most plants and animals are adapted to specific climate and habitat conditions. The examples highlighted below show how change can affect them.

Melting ice and snow

Polar regions are warming at **nearly double the rate** of the rest of the planet. As a result, **Arctic sea-ice extent has been below long-term averages in each of the past 10 years**. The algae that grow along the sea ice and in shallow meltwater pools are a vital part of the food web that sustains the **productive Arctic ecosystem.** The shrinking of this system is problematic for several species of seals and marine fishes, as well as **polar bears** and **walruses**. Less accumulation and faster melting of land-based ice also spells trouble for many **snowmelt-based** stream ecosystems.

Ocean acidification and changes in water chemistry

A substantial proportion of the carbon dioxide released each year ends up dissolving in the world's oceans, making them **slightly more acidic**. Higher levels of acidity interfere with the ability of coral reefs, shellfish, and plankton to develop their calcium-based shells. In addition, as water becomes warmer, **it naturally holds less oxygen,** which is problematic for all species that breathe through gills.

Higher temperatures

Observed temperatures across most of the United States increased by at least 1°F (Fahrenheit) over the past 20 years, compared to the mid-20th century. Higher maximum summer temperatures are a threat to cold-adapted species like the **pika**, a small alpine mammal, and **trout**. Winters are warming, too, and since winter temperature is a **key factor** in determining plant species distribution, warmer winters may lead to complete habitat shifts, like sugar maples disappearing from New England. Wintertime temperatures also influence the survival of many invertebrates, including pine bark beetles and other destructive pests, with implications for **forests** and **wildlife**.

Out-of-sync life cycle events

For many species, life cycle events like migration, breeding and color changes are timed to coincide with variables such as day length, plant emergence and first snowfall. The fur of the snowshoe hare, for example, starts changing from brown to white as the days begin to shorten so that the animal is well camouflaged when the snow arrives. Warmer temperatures can shorten the snowy season, leaving the hares **gleaming white on a background of brown dirt and leaves**—easy targets for predators.

Sea-level rise

Land-based ice (glaciers, ice caps and ice sheets) in Greenland, Antarctica and high-elevation ice fields worldwide are shrinking at a faster rate, adding meltwater to the world's oceans. (Arctic sea ice forms and floats on the ocean and does not affect sea level when it melts). In addition, the **ocean stores** most of the excess heat trapped by greenhouse gases, which, because water expands as it warms, also contributes to sea-level rise. Projections indicate a rise of **one to four feet by 2100**, but **recent research suggests** an even faster rise that could alter and eventually inundate coastal habitat.

More severe storms

Warmer air holds more moisture, and warmer water evaporates more readily—conditions that result in stronger storms. Since the 1980s, the intensity, frequency and duration of **hurricanes** have increased in the Atlantic Ocean. In addition, a greater proportion of annual **precipitation** has fallen as heavy rains. These rains increase flood risk and deposit runoff containing damaging sediments and pollutants in aquatic habitats.

Worse droughts

The same factors that concentrate precipitation into severe events also lead to increased **drought**. Projections indicate that much of the western United States will become drier over the course of this century (severe, extended droughts are already common in Texas, California and elsewhere). Severe droughts parch vegetation, leave trees susceptible to insect infestation and wildfire, and eliminate water resources needed for both aquatic and terrestrial species.

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5 We can–and must–respond to the root causes and impacts of climate change.

There are two major ways to respond to climate change, mitigation and adaptation. **Mitigation** refers to reducing greenhouse gas emissions and/or increasing the rate at which greenhouse gases are removed from the atmosphere—by restoring forests, for example. The international climate change **agreement adopted in Paris** in 2015 focuses mainly on mitigation of climate change. **Adaptation** refers to "adjustment in natural or human systems in response to actual or expected climatic effects, which moderates harm or exploits beneficial opportunities." Long-term conservation of wildlife and habitat will require substantial mitigation of greenhouse gas emissions, but given the ongoing and worsening impacts of climate change, efforts must also be taken immediately to incorporate climate change adaptation principles into conservation and land management.

6 The United States has an impressive policy framework for responding to climate change.

Federal, state, local and tribal governments have made considerable progress in developing and implementing new policies that encourage, mandate or provide resources for advancing climate change mitigation and adaptation programs. For wildlife, one of the most important is the **National Fish, Wildlife and Plants Climate Change Adaptation Strategy**, developed through a partnership of federal and state agencies and tribal governments. Published in 2013, the National Strategy articulates seven goals aimed at helping wildlife adapt to a changing climate, including protecting and connecting wildlife habitat, incorporating climate change into existing management strategies, and reducing other threats to species and their habitats.

7 There is room for improvement in the implementation of climate change policies.

Climate change differs from a typical conservation problem because its root causes and drivers are difficult to address with traditional land and wildlife management plans. Tackling climate change requires an understanding of existing policies and priorities, knowledge of how to assess the various impacts, and creative thinking to develop management strategies. Unfortunately, some land management plans are developed with the fatalistic view that since they can't address global emissions, they can't effectively address climate change and make a difference. Many others fall short by focusing on uncertainty in impacts or management, discussing climate change only in vague and general terms or failing to address all aspects of anticipated changes.

Federal Policies and Agency Directives for a Changing Climate

Department of the Interior

One of the early climate change actions of the current administration was the Secretary of the Interior's order, "**Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources**," which directed all Department of the Interior (DOI) agencies to consider climate change in long-term planning and decision-making. DOI has since incorporated climate change into its departmental manual, and most DOI agencies have released strategic plans for addressing climate change.

Executive Order 13653

President Obama issued an Executive Order on **Preparing the United States for the Impacts of Climate Change** in November 2013. It directs agencies "to complete an inventory and assessment of proposed and completed changes to their land- and water-related policies, programs, and regulations necessary to make the Nation's watersheds, natural resources, and ecosystems, and the communities and economies that depend on them, more resilient in the face of a changing climate."

NEPA Climate Guidance

The Council on Environmental Quality has issued **draft guidance** on considering both greenhouse gas emissions and the effects of climate change in federal planning processes under the National Environmental Policy Act.

Climate Action Plan

The **President's Climate Action Plan**, released in June 2013, covers three main areas: 1) cutting carbon pollution in the United States; 2) preparing for the impacts of climate change; and 3) leading the international community on climate change mitigation and adaptation. The Action Plan also includes several natural resource and ecosystem-related goals, including conserving land and water, managing drought and reducing wildfire risks.

U.S. Forest Service

The Forest Service has released **several documents** outlining its response to climate change. These include a roadmap, scorecard and adaptation plan. The **2012 Planning Rule** for national forests and grasslands requires all units to consider climate change as one of the drivers of forest plan revisions.

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8 Land and wildlife managers can develop plans that adequately address all likely threats, impacts and vulnerabilities related to climate change, but only if they fully understand them.

Resource managers must think both specifically and comprehensively about projected impacts in an area and what effects they will likely have on wildlife and habitat. For instance, a management plan for a coastal wetland must analyze the threat of sea-level rise, but should also discuss impacts from extreme heat, flooding, drought and changes in water chemistry. The plan must also take into consideration the interactions between climate change and other threats such as habitat loss, declining water quality and disease.

Assessing Vulnerability

Vulnerability is a function of ***exposure*** to climate change—the magnitude, intensity and duration of the changes experienced—the ***sensitivity*** of the species or community to these changes, and the ***capacity of the system to adapt*** to these changes. Many resources are available to help managers to assess vulnerability, i.e., predict changes they may need to address and identify the species that may be affected.

Tools available for assessing vulnerability include the **Climate Change Vulnerability Index** (CCVI) and the **System for Assessing Vulnerability of Species** (SAVS), which provides a simple visualization of projected temperature and precipitation change. The **Sea Level Affecting Marshes Model** (SLAMM) simulates marsh loss to sea level rise. **Integrating Climate Change Vulnerability Assessments into Adaptation Planning**, a case study by Defenders of Wildlife, offers extensive guidance for land managers.

Additional repositories of data, case studies and adaptation planning and implementation reports are available at the **National Snow and Ice Data Center**, **data.gov**, the **Climate Adaptation Knowledge Exchange** and the **Climate Adaptation and Mitigation E-Learning** center. Many federal and state agencies also maintain clearinghouses of climate information.

"Climate change challenges everything we have ever known about conservation. This is a time for great vision, innovation and creativity."

—Jamie Rappaport Clark
President and CEO, Defenders of Wildlife

9 Effective management plans include strategies to help species and ecosystems adapt to climate change.

With a clear understanding of likely impacts, managers can design and implement adaptation strategies. These generally fall into three categories based on how much the system changes.

Resistance strategies attempt to keep a system unchanged or intact, despite changing conditions. The goal is to reduce the exposure of a species or habitat to climate-related stresses. Examples include restoring streamside vegetation to minimize changes in water temperature, shading sea turtle nests to reduce incubation temperature, and pinpointing and protecting likely **"climate refugia"**—areas expected to undergo less change over time.

Resilience strategies capitalize on the ability of a system to "bounce back" from a disturbance and return to a structurally and functionally similar state. The goal is to reduce the sensitivity of the species or habitat to climate change. **Management examples** include reducing the likelihood of catastrophic fire, improving wetland function, alleviating competition from invasive species and adding artificial nest boxes to boost reproduction.

Transformation strategies produce a fundamental change in a system's structure and/or function. The goal is to increase the adaptive capacity of the system by allowing it to respond in new ways, such as increasing connectivity to allow species and habitats to shift ranges and conserving areas that models identify as likely future range. An example is addressing sea level rise by facilitating the **transition of a freshwater wetland to a saltmarsh**, while restoring additional freshwater wetland farther inland. More aggressive and controversial transformation strategies, such as **moving a species** to areas outside its historical range, require careful consideration.

10 It's important to monitor the actions we take to address climate change and evaluate their effectiveness.

Only by continually monitoring the effects of actions taken to address climate change impacts can managers determine whether or not they're working and adapt accordingly.