Key Conservation Issues that Affect Species and Habitats Statewide

ISSUE 7: Global Climate Change

Climate change is one of the most serious long-term threats to healthy populations of fish and wildlife in Oregon and globally. The effects of global climate change on wildlife and habitats include not only the direct impacts of changing temperatures, but also:

- Earlier arrival of spring conditions and changes in the timing of biological events such as migration, reproduction, and flowering, potentially leading to mismatches in the life cycles of interdependent species;
- Rising sea levels, leading to increased coastal erosion, coastal and river-mouth flooding, saltwater intrusion into coastal freshwater wetlands and water tables, and loss of estuary wetlands and other coastal habitats;
- Arrival of new pests and pathogens and increased insect damage from existing pests in some forest ecosystems;
- Increased introduction, spread, and dominance of invasive plant and animal species;
- Drying of some wetlands and headwater streams, and;
- Acidification of ocean waters and changes in plant photosynthesis as the direct result of increasing levels of carbon dioxide in the atmosphere.

Any or all of these changes have the potential to affect fish and wildlife populations and their habitats. In the face of rapidly changing climate conditions, species will need to shift to new locations or adapt in place to new conditions. Those that fail to move or adapt will decline.

Species that can move to a more suitable location will do so by migrating or shifting their range. Already, shifts in range have been described for many species, including poleward and elevational movements of many insects, birds, fish, and vegetation communities. However, the rapid rate of change and the fragmentation of habitat because of human land uses will make it more difficult for many species to move. Species that stay in place, perhaps because they are not able to shift quickly enough or because suitable habitat is not available elsewhere, will have to alter their behavior to respond to changes in food availability, habitat loss, and other threats. Again, the rapid rate of climate change, compared to past shifts in climate conditions, will make it more difficult for species to adapt. Species that are negatively affected by climate change but cannot move or adapt will decline in numbers and may eventually go extinct or disappear from the state. These will likely include species with very specific habitat requirements and those that depend on high-elevation, coldwater, or wetland habitats. In eastern Oregon, for example, the ranges of small mammals in mountaintop habitats are contracting, and some of the state's native frog species are predicted to become extinct due to the drying of wetlands. In sum, climate change is likely to reduce the abundance and diversity of fish and wildlife species in at least some systems.

Climate Change and Oregon's Species and Habitats

Warming temperatures are already affecting Oregon's fish and wildlife and their habitats. Insects are moving in from states to the south, and significant pest species, such as the mountain pine beetle, are increasing in numbers as a result of warmer winter temperatures. Many bird species are also shifting their ranges to the north and migrating earlier in the year. Warmer temperatures are also causing longer, more intense fire seasons and increased fire damage in some forest types. Spring snowpack in normal weather years has declined across most of the state, affecting the timing, quantity, and quality of water in streams and rivers.
By 2050, scientists predict that:

- Oregon's annual average temperatures will continue to rise an additional 1-5° F, with the potential for even larger increases in the summer months;
- Precipitation patterns will change, with warmer, drier summers, reduced snowpack, an increase in heavy precipitation events, and more intense coastal storms; and

- Sea levels will rise along some parts of the Oregon coast; in other areas, the impacts of rising global sea levels will be offset by an upward shift in land elevation over this timeframe.

Each of these expected changes would cause a cascade of direct and indirect effects in the natural environmental, further stressing systems that have already been impacted by disease, invasive species, habitat loss and fragmentation, land use changes, and rising water demands.

For example, rising temperatures will likely continue to affect the state's forests, exacerbating fire conditions in many forest types, drying soils and increasing some forest pests. This may result in major shifts in the types of vegetation found in some parts of the state, especially where severe fires set the stage for new plant species to move in.

Similarly, warmer temperatures are already reducing spring snowpack. By 2040, early spring snowpacks are expected to decline as much as 40 percent in the Cascade Mountains, resulting in shifts in stream flows that will degrade habitat for native aquatic species. Research has predicted that by 2090 there will be an 8 to 33 percent decrease in trout habitat in the Pacific Northwest, up to a 40 percent loss of salmon habitat in Oregon, and a loss of 22 to 92 percent of bull trout habitat in the Columbia River Basin as a result of climate change. Additionally, changes in precipitation patterns may increase winter floods, which will scour streambeds and reduce spawning habitat for anadromous fish.

Coping with Uncertainty

There is a high level of certainty among climate scientists about the direction of some of the changes projected for the future, such as warming temperatures, ocean acidification, and global sea-level rise, but the exact magnitude and timing of these changes and how they will play out in a given location is much less certain. This uncertainty exists not only because of the limitations of climate models, but also because the rate of future greenhouse gas emissions remains unknown. For other types of change, even the direction may be unclear. For example, in the Pacific Northwest, there is much less certainty about how climate change will affect future precipitation patterns, and, in general, the combined effects of all of these changes on fish, wildlife, and plant species are very difficult to anticipate.

Uncertainty has always been a challenge in managing fish and wildlife populations and their habitats, and managers have always needed to consider this when developing long-term management plans and strategies. On-the-ground research and predictive models have helped managers learn more about how habitats, fish and wildlife may react to future conditions. Adaptive management has also been an important tool for managers coping with unpredictable changes in natural and biologic systems.

Identifying management strategies that are likely to be effective under a variety of climate change scenarios is another way of dealing with uncertainty.
The challenges posed by the many uncertainties and broad-based impacts of climate change will require a combination of traditional and innovative management strategies which integrate science, technology and management in new and more effective ways. Lack of certainty about exactly how species or communities will respond to climate change should not prevent managers from identifying and implementing management actions that will help mitigate likely future changes. Given the serious broad-scale and progressive nature of climate change, the time to begin adapting to future climate conditions is now.

Greenhouse Gas Emissions and Climate Change

Natural variability has caused the climate to change throughout history, with corresponding changes to natural systems. However, in recent centuries, humans have also altered the composition of the atmosphere by burning fossil fuels for energy and clearing forests and other natural habitats.

There is clear and growing evidence that our continuing use of fossil fuels and land conversion is increasing the concentration of carbon dioxide and other greenhouse gases in the atmosphere and is a primary contributor to the significant rise in global temperatures that has been observed since about 1950. The concentration of carbon dioxide in the atmosphere in 2010 (about 390 parts per million) is the highest known level in at least 700,000 years – and probably much longer – and it continues to rise rapidly.

In 2007, the Intergovernmental Panel on Climate Change (IPCC), an international science body concluded in that the evidence is "unequivocal" that the earth is warming at an accelerated rate due primarily to human activities and that there have been and will be significant changes to the global climate this century. Rising temperatures and other direct and indirect climate effects of increased greenhouse gases make up the body of interrelated trends referred to as climate change or global warming. These substantial shifts in global climate variables are observable today in today's climate, and they are expected to increase and accelerate through at least the next century or until well after human-caused emissions of greenhouse gases are returned to much lower levels. As a result, climate change will cause irreversible alterations to both human communities and ecological systems.

Climate change will bring significant impacts not only to wildlife and their habitats, but also to working landscapes and rural and urban communities. These impacts will likely include threats to water resources, range degradation due to invasive species and increased drought, and increases in fire and pest outbreaks in forests. Many of available approaches to helping wildlife adapt to climate change can also help human communities cope with these changes.

Responding to Climate Change Oregon

Climate change presents unprecedented challenges for Oregonians and for fish and wildlife managers, but taking pro-active measures to prepare for the impacts on the state's native species and habitats will make these challenges more manageable.

In 2007, the Western Governors' Association established the Wildlife Corridors Initiative, which focuses on maintaining healthy, connected habitats and reducing impacts resulting from a variety of land use practices, including energy development, transportation, and climate change.

Also in 2007, the Oregon legislature established the Global Warming Commission to address the inter-related climate impacts on natural resources, communities, commodities, business and our economy. The Commission brought together representatives from industry, transportation, agriculture, forestry, energy, public health and safety, and other key stakeholder groups.

As part of that effort, the Oregon Department of Fish and Wildlife (ODFW) co-hosted the Fish, Wildlife, and Habitat Subcommittee of the Oregon Global Warming Commission in 2008, which produced "Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change: A Guide for State Adaption Efforts." This document outlined a set of basic guiding principles to assist Oregonians in addressing the impacts of changing climates. The four principles included:

- The maintenance and restoration of key ecosystem processes;
- The establishment of an interconnected network of lands and waters that support fish and wildlife adaptation;
- An acknowledgement and evaluation of the risks of proposed management actions in the context of anticipated climate conditions; and
- The need to coordinate across political and jurisdictional boundaries.

In 2010 and 2011, ODFW and partners hosted a series of expert workshops to identify climate change impacts on Strategy habitats and begin to develop climate change adaptation strategies. These workshops focused on three of the eleven Strategy Habitats: estuary, oak woodland, and sagebrush. The results of the workshops are available on the ODFW Oregon Conservation Strategy website.

Also in 2011, a diverse group of Oregon state agencies, including representatives from natural resource agencies and the departments of Transportation, Energy, and Public Health, developed an interagency framework for climate change adaptation. This document identified key climate impacts and short- and long-term strategies for adapting to these impacts at the state level.

GOALS AND ACTIONS

***Goal:* Use the best available science, technology and management tools to determine the vulnerability of species and habitats to climate change at a landscape scale.**

Climate change is a global issue, and the responses of fish, wildlife, and habitats to changing climate conditions will play out across political boundaries and require a new, more integrated approach to management. As a result, evaluation and planning needs to be done at a landscape scale. Many species will shift range so that they are no longer found within the borders of a particular state or protected area, but efforts to evaluate and mitigate vulnerability should focus on how a species or habitat will respond across the landscape

Actions:

- **Action 7.1. Work with partners to increase information on climate change vulnerability of habitats and species.**

  Building a body of information on climate change impacts and the vulnerability of strategy species and habitats is an important first step to guiding management and policy decisions on climate change. Collaboration with research institutions such as the Oregon Climate Change Research Institute, University of Oregon's Climate Leadership Initiative, and University of Washington's Climate Impacts Group, non-profits, and other government agencies can help increase understanding of climate change vulnerability without overtaxing limited budgets. Many of these institutions have ongoing efforts to identify the most vulnerable species and habitats and develop assessment models for these species.

  Participants in the three habitat-focused workshops identified priority information needs by asking, "What questions do we need answered in order to be able to move forward with climate change adaptation strategies?" A similar approach, based around the information requirements of land and resource managers, would help prioritize research needs.

- **Action 7.2. Support long-term research on climate trends and ecosystem responses.**

  To provide needed information on climate impacts on species and habitats, research and monitoring efforts will need to be conducted over longer time periods than are currently common. Long-term funding and institutional support will be needed to encourage long-term research. Existing long-term ecological research programs, such as Oregon State University's Andrews Forest Long-term Ecological Research site, the U.S. Forest Service's experimental forests, and the ODFW's Lifecycle Monitoring Sites can be a cornerstone of such efforts. The results from these research efforts should be used to inform and adapt management strategies, monitoring protocols, and objectives for strategy species and habitats.

- **Action 7.3. Develop and implement monitoring and evaluation techniques for vulnerable strategy species and habitats.**

  Because of the changes expected under future climates, new decision tools will be needed to help determine appropriate management actions. There is a need to develop monitoring protocols that can quickly detect climate related shifts in populations and habitats, help tie existing and proposed management with on-the-ground results, and inform and refine vulnerability assessments. Evaluating actions will be critical to coping with future climate uncertainties. To make the most efficient use of available funding, monitoring should be coordinated and shared among relevant agencies and organizations. Monitoring across boundaries and jurisdictions will form the basis for decision-making in a variable and rapidly changing environment.

Goal: **Identify, prioritize, and implement conservation strategies to mitigate the negative impacts of climate change on fish, wildlife, and habitats.**

Actions:

- **Action 7.4. Incorporate currently available climate change information into management plans for species and habitats. Focus on strategies that are robust to multiple potential future climates and that maintain or restore key ecosystem functions and processes.**

  Future climate conditions will vary in unpredictable ways; however, waiting for more details is often not the best approach. Instead, it is important to make use of the best currently available science to immediately identify and implement appropriate adaptation strategies for Oregon's species and habitats. Examples of some of these strategies may include improving the connectivity of natural landscapes to better link fish and wildlife populations and allow for range shifts; identifying and protecting cold water rearing and refugia habitat for juvenile salmonids; setting population targets and management goals with future climate conditions in mind; and looking for opportunities to protect species and habitats in their likely future locations (for example, upslope of current estuaries in areas that can accommodate upstream migration of these habitats).

  One way of coping with uncertainties about future climates and the responses of species and habitats is to focus on identifying and implementing management approaches that are likely to be successful under several likely climate scenarios. For example, scientists have a very high level of confidence that temperatures in the Pacific Northwest will continue to rise over the next several decades, probably on the order of 1-5° F by mid-century. However, it is less clear whether or how precipitation patterns are likely to change. Efforts to identify robust adaptation strategies for a particular species or habitat might involve considering two or more climate scenarios with different degrees of warming and drier or wetter conditions. Management actions that are likely to be successful under multiple scenarios are preferable to those that only make sense under a narrow range of future conditions.

  Because future climate conditions may not support the same fish, wildlife, and plant species found in Oregon today, another promising approach is to focus on restoring abiotic as well as biotic conditions in ecosystems. These might include actions that improve water quality and quantity, increase natural water storage on the landscape, maintain nutrient cycling processes, promote an ecologically appropriate disturbance regime, or protect soil health. Some researchers have even suggested that conservation planning should be based on geophysical classes rather than biological communities.

- **Action 7.5. Minimize other threats.**

  Many of the best available climate change adaptation strategies involve managing other threats to species and habitats. Because rapidly-changing climate conditions will interact with – and may exacerbate – the other key conservation issues described in the Oregon Conservation Strategy, working to reduce these other threats is a good way of moderating the effects of climate change on fish, wildlife, and habitats. Reducing non-climate threats also tends to be a low-risk approach with a relatively high likelihood of success, because many non-climate threats are better understood, managers have more experience in applying management responses, and the actions taken are not as dependent on the accuracy of future climate predictions.

  For example, protecting a representative network of natural and semi-natural lands for long-term conservation management is one of the most effective tools for coping with both climate change and other conservation threats, because relatively intact ecosystems are more likely to be more

resilient to climate shocks, will better sustain fish and wildlife populations facing climate threats, are more likely to facilitate migration, and may even transition more smoothly to future climate conditions.

- **Action 7.6. Develop regional and local partnerships to coordinate responses to climate change across political, cultural, and jurisdictional boundaries.**

  Climate change is a global phenomenon, and it greatly increases the importance of working across traditional boundaries to more effectively manage fish, wildlife, and natural systems. Coping with the challenges of a rapidly changing and less predictable climate will require stronger working relationships with both traditional and new partners at a variety of scales. Some opportunities include:

  Using the work of regional and national efforts such as the Western Governors Association's Corridor Initiative and the Association of Fish and Wildlife Agency's Subcommittee on Climate Change to identify policy options and goals for multiple agencies and organizations to address common concerns related to local, regional, national impacts of climate change.

  Working with agencies and stakeholders from different sectors to develop consensus-based regional policies that inform and direct local decisions on climate change. Both the causes and effects of climate change are closely linked to human communities, and the impacts of climate change on natural communities cannot be successfully managed in isolation from human systems.

  Developing comprehensive education and outreach tools for the public on the impacts of climate change on wildlife and their habitats. Providing information on climate change and its impact on both human and natural communities will help solidify public support for adaptation efforts. Local and regional governments and citizen-based nonprofits and organizations (SWCDs, Watershed Councils, etc.) can help develop and deliver these educational materials to their constituents.

  Strengthening current partnerships and collaborations and developing new ones to pool funding and resources and encourage cost-effective strategies for addressing climate change impacts and adaptation.

  Continuing collaborations with the U.S. Geologic Survey and its Forest and Rangeland Ecosystem Science Center and Climate Science Centers, U.S. Fish and Wildlife Service, Bureau of Land Management and other state and federal agencies, Department of Interior Landscape Conservation Cooperatives, academic institutions, and non-government organizations to establish mutual goals for managing species and habitats in response to climate change. Developing interagency and intra-agency strategies to identify research needs, establish database capacities, and share data can help reduce costs and avoid duplicative efforts.

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