
# Climate Change and Fisheries

## What it means to tribes and how we can adapt

### Tribes and Fisheries

Tribal fisheries play a vital role in the economies, cultures and subsistence lifestyles of many indigenous groups in the United States. In several regions of the US, tribal fisheries have been severely impacted by Euro-American land management practices, habitat destruction and resource exploitation. Activities such as the construction of hydroelectric dams, the introduction of non-native species, overharvesting, and the deforestation of stream banks, have dramatically reduced the health and abundance of tribal fisheries. Climate change is likely to exacerbate the detrimental impacts to tribal fisheries by further altering fresh and saltwater ecosystems[1].

### Climate Projections – Implications for Fisheries

#### *Rising Temperatures*

One of the primary climate change impacts threatening fisheries is rising water temperatures. As climate change leads to increased ambient air temperatures, water temperatures in streams, lakes and oceans become elevated[2] through thermal exchange processes. This may benefit and expand the range of warm water fish, however it poses a severe threat to species that depend on cold water to spawn and carry out their life cycles, such as salmon and trout[1]. In the Great Lakes region, for instance, populations of cold water fish such as brook trout, lake trout, and whitefish are likely to decline, while warm water smallmouth bass and bluegill are expected to thrive[2]. These impacts are troublesome for cold water fish as well as the species that feed on them. Additionally, as water temperatures rise, so too does the spread of diseases and water-borne pathogens, which can be detrimental to aquatic species.

#### *Freshwater Quality and Quantity*

Changing water temperatures may also have impacts on water quality. Warmer waters can extend and intensify thermal stratification in large, deep bodies of water, which can ultimately lead to oxygen depletion[2]. Warmer waters may facilitate the process of eutrophication - excess accumulation of chemical nutrients - by increasing the rates of algal and bacterial growth and decay, which in turn result in oxygen depletion and diminished water quality[2]. Climate change is expected to affect water quantity in a variety of ways. Precipitation extremes and prolonged drought periods are likely to increase throughout most of the country, affecting seasonal streamflow. Streamflow may also be impacted by decreased snowpack, diminishing glaciers, and earlier and faster spring snowmelt. For example, reduced stream volumes affect the ability of some fish species, like the tribally-significant Pacific Northwest salmon, to reach their spawning beds[3] and it reduces the thermostability of affected waterways. Finally, strong winter storms may lead to extreme flooding, which can disrupt gravel spawning beds and wash away fish eggs[3] of species that dig shallow redds.

#### *Ocean Impacts*

Sea levels are projected to rise in response to continued glacial melting and ocean water expansion as temperatures increase - this trend, which varies regionally, may severely damage or even destroy existing estuarine habitats. Another threat to estuarine habitats is that of increased storminess, which could lead to accelerated erosion of coastal zones. This is of particular concern to tribes, because these habitats are vital to the life cycle of culturally important species, such as salmon and shellfish.

The elevated levels of atmospheric carbon dioxide ($CO_2$) are affecting oceans by chemically interacting with seawater and reducing its pH – a process known as ocean acidification[4]. Ocean acidification affects a host of biological processes including fertilization, development, calcification, and respiration in everything from seaweed to fish and shellfish. For instance, lower ocean pH creates conditions that become corrosive to calcifiers - species that use mineral calcium carbonate to build their shells, skeletons or other vital body parts. For Washington tribes that rely on calcifiers such as oysters and clams for subsistence, ceremonial and economic purposes, ocean acidification poses a serious threat[4].

In Alaska, the cold water and sea ice that many fisheries depend on are already being impacted by climate change-driven factors such as such as rising air and water temperatures[2]. Furthermore, the retreat of sea ice affects the location and abundance of plankton blooms, which form the base of the marine food web and therefore determine the presence and abundance of many species that are crucial to Alaska Natives[2]. In the face of these impacts, traditional diets and practices may become difficult to sustain, leading to serious health and cultural repercussions.

## What can Tribes do?

Climate change is especially threatening for aquatic species that are already vulnerable due to other impacts, human or otherwise. For this reason, some of the most immediate proactive measures that can be undertaken by tribes to protect fisheries involve the moderation or reduction of impacts that aren't necessarily related to climate change. However, some tribal initiatives are going beyond habitat restoration, and are exploring innovative ways to compensate for the impacts of climate change on fisheries. For example, in response to early snowmelt, the Tulalip Tribes in Washington are exploring the construction of artificial wetlands in the uplands to help slow runoff, provide salmon refuges, and increase infiltration. The tribe is also exploring innovative techniques to address ocean acidification, such as the use of seaweed culture which can uptake excess carbon dioxide.

Partnerships with other tribes and non-tribal organizations can strengthen tribal fisheries initiatives. Additionally, federally recognized tribes can improve fisheries management by engaging in meaningful government-to-government relationships with relevant federal agencies.

The Nooksack Indian Tribe in Washington is collaborating with the EPA Office of Research and Development in the initiation of a pilot project for evaluating, designing, and implementing restoration tools in the South Fork Nooksack River. The project will address climate change impacts, including the anticipated increase in stream temperatures, loss of glacial melt waters, decreased baseflows, and increased wintertime flows, all of which adversely affect fish populations and habitat. In Alaska, various Native groups have entered into fisheries co-management agreements with the NOAA's National Marine Fisheries Service. For instance, the Alaska Beluga Whale Committee, formed and run by Alaska Native beluga whale hunters, brought together beluga hunting communities, local, state, and Federal governments, and researchers to discuss conservation issues, the biology of belugas, and future research needs[5].

Tribes seeking to initiate fisheries climate change adaptation initiatives can begin by conducting a climate change vulnerability assessment to identify potential impacts on important fisheries species and guide future management decisions via the development of an adaptation plan. The National Wildlife Federation has created a useful vulnerability assessment guide that can be found at (http://www.nwf.org/What-We-Do/Energy-and-Climate/Climate-Smart-Conservation/Assessing-Vulnerability.aspx ). To learn more about tribal climate change initiatives and the development of adaptation plans, please visit the Tribes & Climate Change website at http://www4.nau.edu/tribalclimatechange/index.asp.

**Resources**


1) Intergovernmental Panel on Climate Change (IPCC), Climate Change 2007- Working Group II - Impacts, Adaptation and Vulnerability - Agriculture, Forestry and Fisheries: http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch14s14-4-4.html
2) US Global Change Research Program Impacts by Sector and Regional Climate Impacts: http://www.globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009
3) National Wildlife Federation (NWF), Salmon and Global Warming: http://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Effects-on-Wildlife-and-Habitat/Salmon.aspx
4) Washington State Blue Ribbon Panel on Ocean Acidification (WSBRPOA), Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response: https://fortress.wa.gov/ecy/publications/SummaryPages/1201015.html
5) NOAA Fisheries, National Marine Fisheries Service- Alaska Regional Office: Alaska Beluga Whale Committee Named Environmental Heroes: http://www.fakr.noaa.gov/newsreleases/2002/beluga_enviroheroes.htm


⇒ For the complete reference list that informed this fact sheet, refer to the Tribal Climate Change Adaptation Framework: http://tribalclimate.uoregon.edu/publications/


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UNIVERSITY OF OREGON *This fact sheet was developed in collaboration with the University of Oregon and with support from the USDA Forest Service's Rocky Mountain and Pacific Northwest Research Stations.*

*April 2013*