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FACTSHEET

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Marine

Climate Change on Canada's Pacific Coast

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Tufted Puffin on Triangle Island, British Columbia

Impacts and Vulnerabilities

Canada's rich and productive Pacific marine ecosystems are facing the impacts of global environmental change caused by greenhouse gas emissions. Climate-related changes, some of which are already taking place, are expected to be felt at local, regional and system-wide levels.

In 2012, WWF-Canada and the Canadian Parks and Wilderness Society (CPAWS) commissioned a report assessing the vulnerability of Canada's Pacific marine waters to climate change. The findings, highlighted here, are intended to assist planners and regulators in their efforts to understand and reduce the vulnerability of the Pacific region to anticipated climate changes.

Climate-related Changes

The climate-related changes expected to occur in Canada's Pacific marine waters are both physical and biological. Expected physical changes include increases in precipitation, ocean temperature, and ocean acidity; a rise in sea level and increased turbidity; and an increase in maximum wave heights. Also expected are declines in dissolved oxygen, decreased salinity, as well as changes in currents, upwelling patterns, and characteristics of El Niño-Southern Oscillation (ENSO) events.

Biological changes are expected to result from these physical ones. These include a poleward shift in the ranges of species and alterations to food webs and life cycles. Certain physiological stresses on species – such as those experienced by Pacific salmon in response to ocean temperature shifts – may also increase. Other changes include the reduction of suitable habitat for various species, increased algal blooms, and an increased vulnerability of ecosystems to other stressors such as overfishing and pollution.

Most Vulnerable Habitats and Areas

Shallow rocky reefs, eelgrass and kelp beds, and hard and soft shelf habitats are the most vulnerable habitats in Pacific Canada, particularly when considering their exposure and sensitivity to climate change in combination with human stressors. For bottom habitats, the most significant potential impact of temperature changes is expected in the shallow (< 200 m) regions of three ecosections: Queen Charlotte Sound, Dixon Entrance, and Vancouver Island Shelf. The impacts of acidification on these habitats will be most prominent for the Continental Slope, Johnstone Strait, and Juan de Fuca Strait ecosections. Hecate Strait may be more sheltered from the effects of acidification because of its geographic characteristics. The shallowest bottom habitats (< 30 m) in the Juan de Fuca Strait ecosection are most susceptible to impacts from UV change.

Surface waters in all ecosections appear to be equally vulnerable to temperature changes. Changes to UV levels will also affect surface waters more or less equally among ecosections, with the exception of Johnstone Strait and Queen Charlotte Strait. These areas are expected to be less affected.

Ecosections that are exposed to high levels of human stressors, namely the Strait of Georgia, Queen Charlotte Strait, Johnstone Strait, and Juan de Fuca Strait, have a compromised capacity to adapt to climate change, making them highly vulnerable overall.

Potential climate change effects in each ecosection are outlined in Table 1.

SHALLOW ROCKY REEFS, EELGRASS AND KELP BEDS, AND HARD AND SOFT SHELF HABITATS ARE THE MOST VULNERABLE HABITATS IN PACIFIC CANADA.

Table 1. Some potential climate change effects in each Pacific marine ecosection.

Marine Ecosection	Potential Major Climate Change Effects
Dixon Entrance	Increased runoff and stratification. Reduced salinity and associated changes to the buoyancy-driven flow. Ocean warming. Sea-level rise.
Hecate Strait	Ocean warming. Sea-level rise. Changes in runoff and salinity.
North Coast Fjords	Ocean and continental warming. Increase in runoff. Decrease in salinity. Increased stratification and likely intensification of anoxia.
Queen Charlotte Sound	Ocean warming. Intrusion of anoxic and acidic waters into canyons.
Queen Charlotte Strait	Ocean and continental warming. Increase in runoff. Decrease in salinity.
Johnstone Strait	Changes in currents, salinity, temperature, and productivity.
Continental Slope	Acidification and anoxia in the deep layers. Ocean warming. Changes to ocean currents.
Vancouver Island Shelf	Ocean warming. Changes to nearshore buoyancy-driven flow and offshore ocean circulation.
Juan de Fuca Strait	Changes in currents, productivity, temperature, salinity, oxygen and acidity.
Continental Slope	Acidification and anoxia in deep layers. Ocean warming. Changes to ocean currents.
Strait of Georgia	Increased temperature. Changes in runoff and currents. Acidification and deoxygenation.
Subarctic Pacific	Freshening of surface waters. Increased stratification. Change in productivity. Decreased oxygen concentrations.
Transitional Pacific	Freshening of surface waters. Increased stratification. Change in productivity. Decreased oxygen concentrations.

Effects on Species Groups

Increased ocean temperature is expected to result in reduced primary production and changes to the phytoplankton community. This may, in turn, lead to changes to the zooplankton community that sequentially affect higher trophic levels – such as filter feeders, forage fishes, and marine birds and mammals. Increased temperature can also lead to changes in timing of zooplankton life stages. This can cause mismatches between development of zooplankton and that of their food supply or predators.

At higher trophic levels, temperature-related effects include increased susceptibility to disease, decreasing reproductive success, and increased competition for food. Increased temperature will also result in poleward shifts of some species. In some cases, this can result in predatory species from warmer waters, such as Pacific mackerel and Humboldt squid, replacing existing species. Higher temperatures can cause more frequent toxic algal blooms, and result in changes to marine mammal ranges and migratory patterns.

Ocean acidification is known to affect shelled invertebrates, sea cucumbers, sea urchins, and their larvae. Sea level rise can inundate marine bird nesting habitats and pinniped haul-outs on offshore rocks, and waterbird feeding grounds in intertidal areas. The response of ecological communities to climate change is expected to be largely determined by effects on key species such as eelgrasses, kelps, and sea stars and other predators.

Potential Effects on Fished Species

An increase in average temperature on the west coast of Vancouver Island could lead to lower availability of salmon, herring and resident hake, and increased availability of migratory hake, mackerel and tuna. Exploited populations are expected to be more vulnerable to climate change due to the additional stress posed by overfishing. Slow-growing, longer-lived species are more resilient in the short term but more vulnerable in the long term, because they are slower to adapt.

Preliminary Recommendations to Reduce Vulnerability to Climate Change

Build ecosystem resilience

- Protect the key physical and biological ecosystem components underpinning ecosystem function and strengthening buffering capacity.
- Reduce non-climate stressors on key species, areas or life stages (e.g., on nursery and juvenile rearing habitats; in areas through which migrating species transit in high numbers; and on habitats with higher vulnerability to warming).
- Implement well-connected reserve systems.

Increase monitoring

- Assess key climate-related changes and ecological responses (e.g., changes in larval settlement patterns and shifts in species distributions).
- Track catch rates, fishing patterns, and population health to ensure that stressed commercial stocks are sufficiently protected as they adapt to changing physical conditions.
- Track catch rates, fishing patterns, and population health to identify when key ecological thresholds are approached.

Allow for adaptation

- Protect key areas that may facilitate adaptation under future conditions.
- Identify and protect climate refugia (areas that are naturally buffered from strong climate change effects) and areas that connect them.
- Protect transition zones between current and future habitat.

Build an understanding of adaptation strategies

- Develop research designed to assess feasibility, risks and benefits of assisted migration of vulnerable species (e.g., sedentary and rare species) or life stages.
- Research the feasibility, risks and benefits of promoting migration of habitat types, such as encouraging eelgrass bed establishment upland as sea level rises.

Develop climate-smart management approaches

- Implement fisheries management strategies that address and assess climate-related risks.
- Plan for shifts to harvesting species that are less susceptible to climate change effects.

Further recommendations to address vulnerabilities are being developed by WWF-Canada and CPAWS.

RESOURCES

This information has been synthesized from the following detailed report, which includes references to primary sources and descriptions of analytical methods:

Okey et al. 2012. Climate change impacts and vulnerabilities in Canada's Pacific marine ecosystems. CPAWS BC and WWF-Canada: Vancouver.

An online tool to explore climate change vulnerability in Pacific Canada is available at wwf.ca/pacific.

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