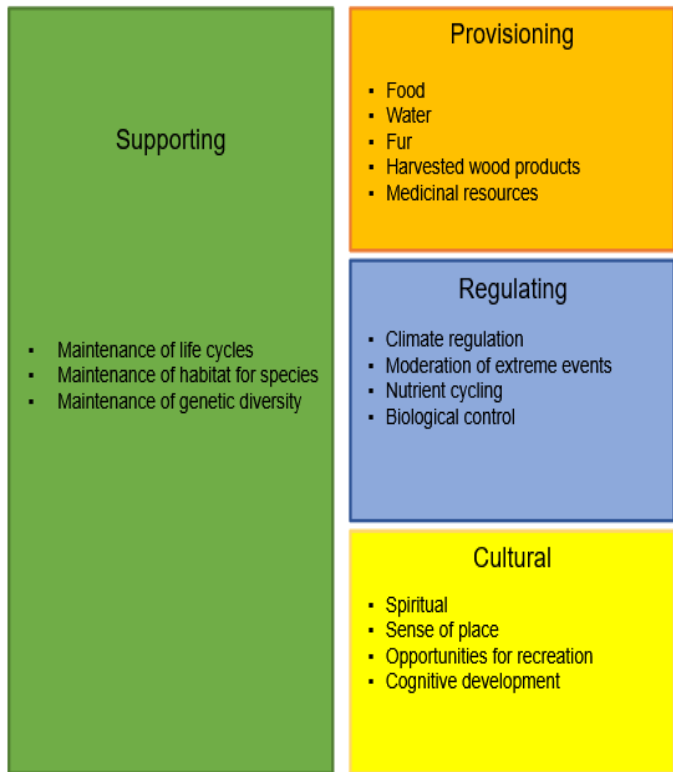


# Ecosystem Services Under Climate Change

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Climate change impacts are projected to increase within the next decades and can lead to shifts in the range of ecosystems and species and the loss of the ecosystem services they provide (Fettig et al., 2013).



Ecosystem services are crucial for people's livelihood and culture, especially for aboriginal people. Dakeh people of north-central British Columbia have intimate relationships with the environment and use plants and wildlife for food, medicine, and cultural purposes.

Following the Millennium Ecosystem Assessment framework, ecosystem services can be categorized as (1) provisioning services such as food, water, or timber, (2) regulating services such as pollination, carbon sequestration, and biological control, (3) cultural services, which are non-material benefits such as recreation and sense of place, and perhaps the most important, (4) supporting services, those that maintain essential ecosystem services such as habitat for plants and wildlife. Note that many services can be included in multiple categories.

BEC zones provide supporting services for specific animals and plants, both of which provide provisioning and cultural services. Trees provide

supporting services for wildlife, regulate climate by storing carbon and provide wood for timber and other products. At the same time, the SBS provides innumerable cultural services such as opportunities for recreation (fishing, hiking, climbing, canoeing, skiing) and research.

## Definitions

- *Ecosystem service (ES)* – all benefits that an ecosystem provides to people.
- *Provisioning Services* - food, materials and energy, which are directly used by people.
- *Regulating Services* - those that cover the way ecosystems regulate other environmental media or processes.
- *Cultural Services* - those related to the cultural or spiritual needs of people.
- *Supporting Services* - ecosystem processes and functions that underpin other three types of services.
- *Climate Change Vulnerability* - susceptibility of a species, system, or resource to the negative effects of climate change and other stressors. Includes three components: the level of exposure to changed conditions, the sensitivity of a system to change, and the adaptive capacity to recover or adjust following change. It is common to combine exposure and sensitivity as risk of potential impacts.
- The Intergovernmental Panel on Climate Change (IPCC) defines mitigation as "a human intervention to reduce the sources or enhance the sinks of greenhouse gases" and adaptation as "the process of adjustment to actual or expected climate and its effects. [...]. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects". Both are complementary tactics that differ from place to place and are dependent on the climate change-induced risks and uncertainties to the ecosystem and the magnitude and intensity in which humans and nature interact."

## Major Risks of Potential Impacts

### 1. *A shift of the climatic envelope of ecological zones.*

Climate change projections indicate a high potential for replacement of the current sub-boreal ecosystems with the expansion of the Interior Douglas-fir (IDF) and Ponderosa Pine (PP) climate regions throughout the interior plateau (Hamann and Wang, 2006). It is also likely that a mismatch between current and future climate conditions creates novel ecosystems rather than the expansion of other BEC zones (Mahony et al., 2018).

Plants provide both food and habitat for other organisms. A shift in species composition is likely to change the life cycles, habitat for specialist species, and a loss in genetic diversity.



Moose are cold-adapted mammals that are highly sensitive to warmer conditions and changes in snow.

Warmer temperatures and other stressors can increase the susceptibility to ticks and diseases. Predation risk is also likely to occur with a changing climate (Price and Daust, 2016).

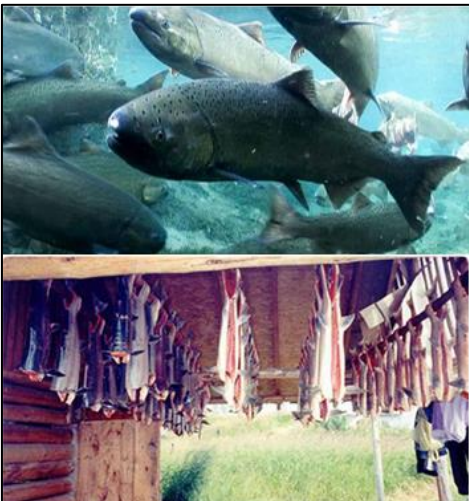


The shifting in forest composition will significantly impact the presence, quality, and quantity of medicinal plant species that currently inhabit the SBS forests' understory.

Labrador tea, soapberry, huckleberry, and Devil's club are four essential plants for the Tl'azt'enne for their medicinal use (Shae and Young, 2012). As opposed to other medicinal plants such as juniper and kinnikinnic, these plants are not found in the understory of different BEC zones (DeLong et al., 1993).

### 2. *Freshwater systems are trending towards more rain and less snowpack-dominated watersheds.*

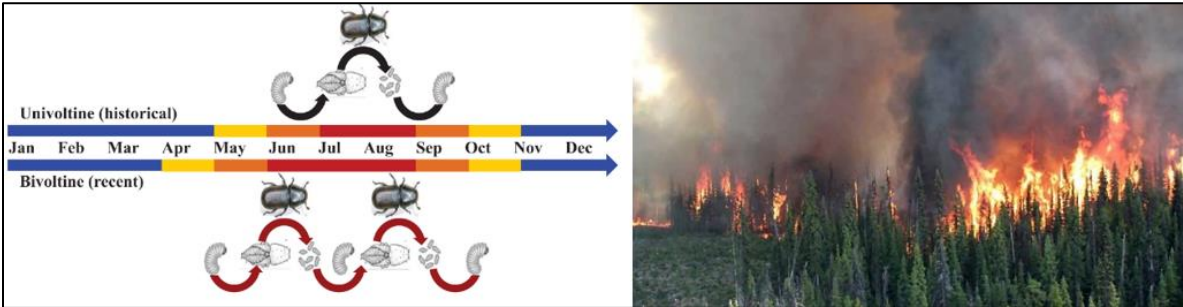
The increase in winter rain and smaller snowpack leads to higher precipitation intensity, increasing landslides that can carry large amounts of sediments. It can also alter the timing of river flow, cause extreme winter flooding events, streambed scouring, and degrading water quality. Higher temperatures also increase water evaporation and reduce water flow.



Coho, chinook, chum, steelhead, and sockeye provide a valuable economic and nutritional resource. With an increase in the ocean's water temperature, the salmon metabolic demand is likely to increase. However, the available zooplankton will be limited. The lack of synchronicity with plankton blooms will negatively affect salmon survival. Likewise, the predicted increase in freshwater temperatures will require more energy reserved in salmon, decreasing swim performance, survival, and egg viability (Grant et al., 2019). Warmer water holds less oxygen and can exacerbate disease and parasite issues for fish and other aquatic organisms. In a warmer climate, traditional food preparation and storage methods may be less effective in preventing the growth or introduction of pathogens that cause illness.

**3. Tree-killing pests and wildfire severity are likely to increase**

The projected changes in climate within BC will favor bark beetle conditions to reproduce and it is likely that other tree-killing pests and diseases that are currently limited will find climatic conditions that favor their growth. Warming temperatures speed up bark beetle reproductive cycle doubling the historical mountain pine beetle number of generations per year (Mitton and Ferrenberg, 2012). This can cause landscape-scale host tree mortality and contribute to the accumulation of coarse woody debris and severe wildfires.



**4. It is likely that traditional knowledge of the land will be lost.**

Indigenous Peoples rely heavily on the environment for their survival, have a spiritual connection to the land, and are very respectful of the fish they catch, animals they kill, and plant material they harvest. For the Tl'azt'enne, specific sites provide a sense of place. A culture that relies in traditional seasonality cues for fishing, hunting, and harvesting is likely to be greatly affected by climate change impacts (Heikkilä and Fondahl, 2010).



Climate change poses the greatest global threat of the 21st century. The Cinnabar Research Station and the University of Northern British Columbia have the opportunity to identify and implement on-the-ground adaptation strategies to incorporate climate change considerations into natural resource management actions to reduce climate risks in the dry sub-boreal spruce forests.

## References

- Carroll, A.L., Taylor SW, Régnière J, Safranyik L. 2003. Effects of climate change on range expansion by the mountain pine beetle in British Columbia. In: Shore TL, Brooks JE, Stone JE, editors. Mountain Pine Beetle Symposium: Challenges and Solutions. Victoria, BC: Report BC-X-399, Canadian Forest Service, Pacific Forestry Centre; 223–232.
- DeLong, C., Tanner, D, Jull, M.J. 1993. Field guide for site identification and interpretation for the southwest portion of the Prince George Forest Region. Land management handbook No. 24. Canada.
- Fettig, C.J., Reid, M.L., Bentz, B.J., Sevanto, S., Spittlehouse, D.L., Wand, T. 2003. Changing Climates, Changing Forests: A Western North American Perspective. *Journal of Forestry* 111(3), 214–228.
- Grant, S.C.H., MacDonald, B.L., and Winston, M.L. 2019. State of Canadian Pacific Salmon: Responses to Changing Climate and Habitats. *Can. Tech. Rep. Fish. Aquat. Sci.* 3332. ix+ 50p.
- Hamann, A., and Wang, T. 2006. Potential effects of climate change on ecosystem and tree species distribution in British Columbia. *Ecology* 87(11), 2773–2786.
- Heikkilä, K. and Fondahl, G. 2010. Indigenous toponyms as pedagogical tools: reflections from research with Tl' azt' en Nation, British Columbia. *Fennia* 188 (1), 105–122.
- IPCC, 2014: Summary for Policymakers. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.
- Mahony, C.R., MacKenzie, W.H., Aitken, S.N. 2018. Novel climates: Trajectories of climate change beyond the boundaries of British Columbia's forest management knowledge system. *Forest Ecology and Management* 410, 35–47.
- Mekis, É., Vincent, L.A., Shephard, M.W., Zhang, X. 2015. Observed Trends in Severe Weather Conditions Based on Humindex, Wind Chill, and Heavy Rainfall Events in Canada for 1953–2012. *Atmosphere-Ocean* 53(4), 383–397.
- Mitton, J.B. and Ferrenberg, S.M. 2012. Mountain pine beetle develops an unprecedented summer regeneration in response to climate warming. *The American Naturalist* 179(5), 163–171.
- Nitschke, C.R., and Innes, J.L. 2008. Climatic change and fire potential in South-Central British Columbia, Canada. *Global Change Biology* 14, 841–855.
- Price, K. and Daust, D. 2016. *Climate Change Vulnerability of BC's Fish and Wildlife: First Approximation*. BC Ministry of Forests, Lands, and Natural Resource Operations.
- Shaw, L.R., and Young, J.P. 2012. Ethnobotany of Tl' azt' en Nation: Plant Use and Gathering Site Characteristics. *Ethnobiology Letters* 3,1–12.
- van Mantgem, P.J., Stephenson, N.L., Byrne, J.C., Daniels, L.D., Franklin, J.F., Fulé, P.Z., Harmon, M.E., Larson, A.J., Smith, J.M., Taylor, A.H., Veblen, T.T. 2009. Widespread Increase of Tree Mortality Rates in the Western United States. *Science* 323(5913), 521–524.