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A Starting Point for Conserving Biodiversity

Photo: Frank Leung

Taking Nature's Pulse: The Status of Biodiversity in British Columbia provides a comprehensive, science-based assessment of the current condition of biodiversity in British Columbia. The 268-page report was prepared by Biodiversity BC, a partnership of governments and non-government conservation organizations created to improve biodiversity conservation in B.C. The report is available on Biodiversity B.C.'s website (www.biodiversitybc.org) together with two companion documents: *The Biodiversity Atlas of British Columbia* and *Ecological Concepts, Principles and Applications to Conservation*.

Taking Nature's Pulse considers threats to biodiversity due to human impacts following European contact. The report describes the status of terrestrial and freshwater biodiversity in the province as well as the overlap between the marine realm and both the freshwater and terrestrial realms. It does not, however, assess purely marine biodiversity, such as whales and marine phytoplankton, as this falls within the mandate of Fisheries and Oceans Canada. The report concludes with 23 major findings grouped under six themes:

- Ecosystem Diversity
- Key and Special Elements
- Genetic Diversity
- Species Diversity
- Threats to Biodiversity
- Capacity and Knowledge

These findings support the report's conclusion that British Columbia's biodiversity is globally significant because of its variety and integrity, but without immediate action is vulnerable to rapid deterioration, especially in light of climate change.

Biodiversity: Why is it important?

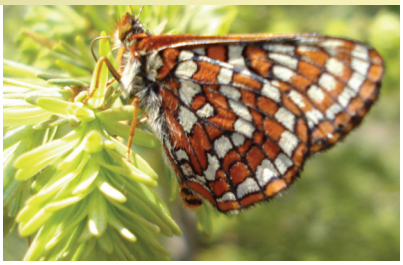


Photo: Jennifer Heron

Biodiversity (short for "biological diversity") refers to the variety of life in all its forms. It includes the diversity of ecosystems, species and genes and the natural processes that link them – an ensemble that many people think of as Nature.

Biodiversity is essential for sustaining both environmental and human well-being. It supports vital ecological processes such as regulating the climate, maintaining adequate oxygen in the atmosphere, filtering and purifying water, pollinating plants, decomposing waste and regulating population abundance.

Biodiversity also provides natural resources that support industries such as forestry, fishing and agriculture, and landscapes that attract residents and tourists to the outdoors for recreational enjoyment and spiritual renewal.

Ecosystem Diversity

Photo: Laure Neish

Ecosystems are complex, dynamic and adaptive systems that are continually evolving. When they become simplified through the loss of component parts or processes, they lose their ecological resilience – the ability to withstand and adapt to natural or human-caused disturbances, including climate change. Simplification can be the result of numerous factors, including human activity (such as settlements, natural resource use, and transportation corridors) and the impact of alien invasive species.

For the purposes of this report, terrestrial ecosystems were assessed at a broad provincial scale using the Biogeoclimatic Ecosystem Classification (BEC) system, which was developed specifically for B.C. Biogeoclimatic zones are broad geographic areas sharing similar climate and vegetation. Twelve of B.C's 16 biogeoclimatic zones are forested, three are alpine and one is dominated by grasses. To date, 611 separate ecological communities have been described in B.C. The assessment of aquatic biodiversity in *Taking Nature's Pulse* is based on the nine Major Drainage Areas into which all surface freshwater in the province flows, feeding large rivers like the Skeena, Taku, Peace and Fraser (which drains roughly one-quarter of the province). Freshwater and terrestrial ecosystems overlap with the marine realm in intertidal zones and estuaries – areas that are both highly productive and important for biodiversity in all three realms.

Species Diversity

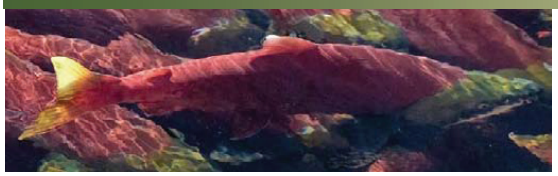


Photo: Robert Koopmans

A species is a genetically distinct group of organisms that are capable of successfully interbreeding. Each species plays a unique role in nature. Of all the Canadian provinces and territories, B.C. is home to the richest diversity of vascular plants, mosses, mammals, butterflies and breeding birds, and the largest number of species of reptiles, tiger beetles and amphibians found in only one province or territory.

More than 50,000 different species (not including single-celled organisms) exist in B.C., but only about 3,800 of these have been assessed for their conservation status. Some parts of the province (primarily unroaded and unsettled areas) have not been surveyed for species occurrence and some taxonomic groups remain largely unstudied.

Some species that have disappeared from other jurisdictions still flourish here. For example, B.C. has the largest population of grizzly bears (estimated at about 17,000) of any province or state apart from Alaska. By contrast, California once had an estimated 10,000 grizzlies and now has none.

Genetic Diversity

Genetic diversity is the foundation of biodiversity. Genes are the functional units of heredity and genetic variation, which enable species to adapt to changing environments. B.C. has a disproportionately high level of genetic diversity relative to its species diversity. The province's glacial history, complex topography and varied climate have contributed to the evolution of a wide variety of adaptations to different environments. As a result, many species occur in the province as geographically distinct subspecies, which differ from each other in appearance, environmental tolerances and behaviour. These differences reflect differences in genetic make-up.

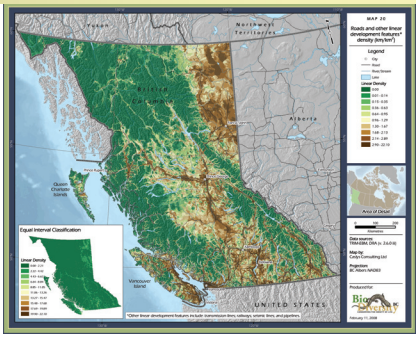
Key and Special Elements

Photo: Virginia Skilton

Key elements are species and ecosystem components and the processes performed by them that have a fundamental or disproportionate influence on how ecosystems function. Examples include pollination (vital to plant reproduction); connectivity within ecosystems (allowing movement of species); the ability of wetlands to filter, cleanse and replenish water supplies; and the important role of broadleaf trees in ensuring forest health.

Special elements are uncommon components that in some cases are found only in B.C. Examples include seasonal concentrations of species, such as stopover points for migrating birds and rookeries where Steller sea lions gather to breed; special communities, such as temperate rainforests and intact large mammal predator-prey systems; and noteworthy features, including karst cave systems, hot springs, saline lakes and fishless lakes, all of which are inhabited by rare and specialized species.

Threats to Biodiversity



Map 20 from Taking Nature's Pulse

B.C.'s biodiversity is in better shape than in many other places on the globe mainly because of the province's relatively short history of largescale development and its mountainous terrain, but the threats to its species and ecosystems are clearly increasing.

Expanding human settlement and development are the most obvious but not the only threats to biodiversity in B.C. today. Settlements are typically located in the valleys where species are most diverse; the agriculture industry focuses on soils that are naturally fertile and grow an abundance of native grasses; the timber industry seeks out forests where trees are largest and, coincidentally, harbour the widest array of species; and transportation corridors crisscross and fragment wildlife habitat and migration routes.

Of the six major stresses that threaten biodiversity in B.C., the three most significant ones are ecosystem conversion, ecosystem degradation and alien species. Ecosystem conversion (the direct and complete conversion of natural ecosystems to landscapes for human uses), has mainly occurred in valley bottoms and coastal regions. Ecosystem degradation (changes to the structure of a natural system from activities such as forest harvesting or water diversion) has occurred throughout B.C. around human settlements, reservoirs and in forested areas. Alien species pervade ecosystems virtually everywhere humans have settled and then move far beyond human settlements to threaten even remote ecosystems. And in addition to all these threats is climate change, the magnitude of which can still not be accurately calculated, but in the end is likely to exceed all the rest.

Though ranked lower, the remaining three stresses can have significant impacts on biodiversity, especially in localized areas. These stresses include environmental contamination (the release of contaminants into natural systems), species disturbance (the alteration of the behaviour of species due to human activities), and species mortality (the direct killing of individual organisms). Climate change is likely to have a bigger and earlier impact on the Pacific Northwest than on many other places on the planet, with the mean average temperature across B.C. expected to rise between 3 and 4.8 degrees Celsius by 2080.

Capacity and Knowledge

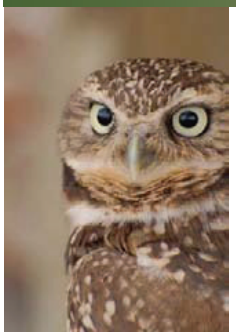


Photo: Jason Doucette

Thousands, if not tens of thousands, of species in B.C. have not been scientifically described or are not documented as being present in the province. Species groups for which such information is particularly lacking include most of the invertebrates and non-vascular plants. This taxonomic knowledge gap is currently being made worse by an 'extinction of experience' as the scientists with the knowledge, skills and inclination to do the work required to fill the gaps are retiring and often are not being replaced.

The majority of species in B.C. have not been assessed for their conservation status and the global ranks for many species that have been assessed are out of date. The ecology of most species and the distributions of all but a very few are poorly understood. Coarse-scale ecosystem classifications are complete in B.C., but information at a finer ecosystem scale is incomplete, as is ecosystem information from neighbouring jurisdictions. Trend monitoring is extremely limited and data on distribution and population size are lacking for many species. Information about impacts on biodiversity is generally incomplete or out of date.

Major Findings

1. **At the broad scale, four biogeoclimatic zones, representing approximately 5% of British Columbia's land base, are of provincial conservation concern.**

   B.C.'s three dry-forest biogeoclimatic zones (Coastal Douglas-fir, Interior Douglas-fir and Ponderosa Pine) and one grassland zone (Bunchgrass) are of conservation concern. The three alpine zones, while not currently of conservation concern, are expected to change dramatically in response to climate change and, in many places, will disappear entirely, along with the species that presently inhabit them.

2. **At the fine scale, more than half of the ecological communities described in British Columbia are of provincial conservation concern.**

   Ecological communities of conservation concern are found in every one of the province's biogeoclimatic zones with the highest proportion occurring in the four zones of conservation concern (Major Finding 1) and in the Coastal Western Hemlock zone.

3. **British Columbia has a majority of the global range for six of the 16 biogeoclimatic zones that occur in the province.**

   The Coastal Douglas-fir, Interior Cedar–Hemlock, Montane Spruce and Mountain Hemlock zones have more than half of their global range in B.C and the Sub-boreal Pine–Spruce and Sub-boreal Spruce zones occur nowhere else in the world. All of these zones are relatively intact with the exception of the Coastal Douglas-fir zone.

4. **The Coastal Douglas-fir biogeoclimatic zone is the rarest biogeoclimatic zone in British Columbia and is of great conservation concern.**

   The Coastal Douglas-fir zone has the highest density of species that are of both provincial and global conservation concern. It also has the highest proportion of areas covered by roads or other linear development and has experienced the highest level of ecosystem conversion.

Major Findings (continued)

5. **Low-elevation grassland communities are the rarest land cover type in British Columbia and are concentrated in the biogeoclimatic zones of conservation concern.**

   Grasslands occupy less than 1% of the provincial land base, but are home to a disproportionate number of species of conservation concern. They are located primarily in the Bunchgrass, Ponderosa Pine and Interior Douglas-fir zones. A large percentage of grasslands have been lost due to ecosystem conversion and fire suppression. They are also being impacted by motorized recreation, livestock grazing, and alien species.

Photo: Bruno Delesalle

6. **Significant areas of wetlands in British Columbia have been converted or degraded, particularly in the two Major Drainage Areas of greatest conservation concern.**

   Wetlands are among the most biologically diverse and productive of all ecosystems. They provide habitat for many species and fulfill a broad range of ecological functions. Wetlands are particularly impacted in the two of B.C.'s nine Major Drainage Areas that are of greatest conservation concern – those of the Columbia and Fraser rivers. In the Lower Fraser Valley more than half of the original wetland area has disappeared and in the south Okanagan, which is part of the Columbia River drainage, about 85% of the original wetland area has disappeared.

7. **Estuaries are of concern in British Columbia because of their rarity and the level of human impacts to them.**

   Estuaries occur where freshwater systems meet the sea. Even though they account for less than 3% of the province's coastline, an estimated 80% of all coastal wildlife relies on estuary habitat. Estuaries have experienced significant degradation as a result of human activities and are highly vulnerable to projected sea-level rise due to climate change.

8. **Of the species assessed to date in British Columbia, 43% are of provincial conservation concern and these are concentrated in the four biogeoclimatic zones of conservation concern.**

   The number of species of provincial conservation concern is increasing as more species are assessed and as populations of previously secure species decline. Taxonomic groups with the highest proportion of species of provincial conservation concern include mosses, reptiles and turtles, and ferns and fern allies. A disproportionate number of B.C.'s species of conservation concern are concentrated in southern, low-elevation areas. Six percent of the species assessed to date in B.C. are also of global conservation concern.

9. **British Columbia is known to have a majority of the global range for 99 species.**

   Of the species assessed to date, 3% have a majority of their global range in B.C. Of the 99 species that have a majority of their global range in B.C., 15 are found nowhere else and 30 are of global conservation concern. Most of B.C.'s species of conservation concern are shared with other jurisdictions.

10. **British Columbia has a high level of genetic diversity within species, which is critical for adaptation and resilience.**

    Genetic diversity within species is critical for their persistence in changing environments. For example, there are more than 400 genetically distinct populations among five species of Pacific salmon. This variability has allowed these species to use all available stream systems in B.C. and provides resilience to salmon and the functions they perform.

Major Findings (continued)

11. The flow of water in lakes, streams, wetlands and groundwater systems is being seriously impacted in British Columbia by dams, water diversions, logging, stream crossings and climate change.

Dams and water diversions directly affect lakeshore, streamside and aquatic ecosystems and the organisms that live in them. The disruption of connectivity in stream systems can prevent fish passage and the flow of nutrients and sediments. Climate change is already having noticeable effects on streamflow patterns in some areas of B.C., and projected changes associated with warmer temperatures will likely affect all fresh-water systems within the province.

Photo: Bruce Harrison

12. The natural disturbance processes that shape British Columbia's forests are being disrupted by human activities.

The province's forested ecosystems have been shaped by topography and climate, as well as by disturbance regimes such as fire, insect infestations, wind storms, landslides and flooding. Human activities can affect all of these disturbance processes. In B.C.'s temperate rainforests, logging of old-growth stands is the greatest concern. In the province's other forests, the major concerns are fire suppression, logging and monoculture replanting. In addition to disrupting natural disturbance processes, these human activities also have other impacts on biodiversity, such as effects on soils, hydrology and individual species. Climate change has already begun to exacerbate these impacts (e.g., the current mountain pine beetle outbreak owing in large part to the warming of winter minimum temperatures) and will continue to do so.

13. British Columbia's mainland coast features a number of interconnected key and special elements of biodiversity: intact temperate rainforest, an intact large mammal predator-prey system, glacially influenced streams and salmon-driven nutrient cycling.

British Columbia has approximately one-fifth of the world's remaining temperate rainforest, the majority of which is located along the middle and northern sections of the mainland coast. The mainland coast is also the largest contiguous area in the province with intact large mammal predator-prey systems (i.e., all native large mammals are present). Anadromous salmon play a critical role in nutrient cycling on the mainland coast (and throughout the rest of their B.C. range) by serving as a key food source for many predators and scavengers and providing important nutrients to aquatic and terrestrial ecosystems. As in other places, these key and special elements of biodiversity are susceptible to cumulative impacts from human activity, particularly climate change. One way that climate change is expected to affect salmon is through impacts on glacier-fed streams. In the short term, melting glaciers will likely discharge more water into some B.C. streams and rivers, which may damage salmon habitat. In the longer term, salmon may be affected by reduced water volume, and possibly temperature change, in glacier-fed streams and rivers, especially during the summer months.

14. The majority of British Columbia has intact or relatively intact predator-prey systems, but a major threat to them is motorized access and associated human activities.

B.C. is globally significant for its richness of large carnivore and ungulate species and the fact that most of the province has intact, or mostly intact, large mammal predator-prey systems, which provide critical ecosystem services. Large mammal predator-prey systems are directly impacted by the disturbance and fragmentation associated with motorized access, including access for off-road vehicles. Roads fragment populations, reduce gene flow and provide access that can result in increased direct mortality due to hunting, poaching, motor vehicle collisions and wildlife-human conflicts. Motorized access also causes disturbance, which displaces species from their habitats.

Major Findings (continued)

15. British Columbia has many significant seasonal concentrations of species that are vulnerable to human impacts.

Seasonal concentrations of species are vulnerable to human and non-human impacts. In B.C., seasonal concentrations often involve migratory species, including birds travelling along the Pacific Flyway and salmon migrating through coastal marine waters. Migratory species are affected by conditions throughout their range and B.C. has a responsibility for species that migrate through the province. Many estuaries along the B.C. coast and wetlands in the interior provide critical habitat for seasonal concentrations of migrating shorebirds, waterfowl and other birds. Other seasonal concentrations of species include seabird nesting colonies on coastal islands and prenesting or wintering aggregations. Island seabird populations are particularly threatened by alien species.

16. Ecosystem conversion from urban/rural development and agriculture has seriously impacted British Columbia's biodiversity, especially in the three rarest biogeoclimatic zones.

Although only about 2% of the province's land base has been converted to human uses, the magnitude of conversion is dramatically higher in the three rarest biogeoclimatic zones: Coastal Douglas-fir, Bunchgrass and Ponderosa Pine. Ecosystem conversion related to agriculture is most intensive in areas with rich soil, such as floodplains and valley bottoms. Urban and rural development is concentrated in these same areas, particularly in the lower Fraser River Valley, on southeastern Vancouver Island and in the Okanagan. The most immediate impact of urban and rural development is the conversion of natural landscapes to buildings, parking lots and playing fields, resulting in loss of species and ecosystems, along with impairment of ecosystem functions.

17. Ecosystem degradation from forestry, oil and gas development, and transportation and utility corridors has seriously impacted British Columbia's biodiversity.

Forestry-related activities affect species and ecosystems in various ways, including habitat fragmentation and alteration of natural forest condition. Ecosystem degradation associated with oil and gas exploration and extraction is mainly concentrated in the Boreal White and Black Spruce biogeoclimatic zone in the northeastern B.C. Ecosystem degradation associated with transportation corridors, seismic lines and other linear features includes fragmentation, alteration of the hydrology of water courses and increased sedimentation in water bodies. High densities of transportation and utility corridors occur in the Coastal Douglas-fir, Ponderosa Pine, Bunchgrass and Interior Douglas-fir zones.

18. Alien species are seriously impacting British Columbia's biodiversity, especially on islands and in lakes.

Alien species can have many impacts, including alteration of forest fire cycles, nutrient cycling and hydrology, displacement of populations of native plants and animals, competition for resources, predation, disease introduction, and facilitation of the spread of other non-native species. Climate change and ecosystem conversion and degradation facilitate the invasion of alien species.

19. Climate change is already seriously impacting British Columbia and is the foremost threat to biodiversity.

The impacts of climate change on biodiversity in B.C. are predicted to be both extensive and intensive, and will be exacerbated by non-climate factors such as land-use changes, pollution and resource use. Climate change is already underway, however the full extent of its impact has yet to be felt. As the effects of climate change become more pronounced, some species will be lost and the ranges of others will change. B.C.'s proportion of the global range of many species is likely to increase due to northward shifts in distributions; this is already occurring for some species. In addition, all of B.C.'s biogeoclimatic zones will be either changed or eliminated as a result of climate change.

Major Findings (continued)

Photo: Karen Wipond

20. The cumulative impacts of human activities in British Columbia are increasing and are resulting in the loss of ecosystem resilience.

The cumulative impacts of human activities are greater than the sum of their individual effects. Compromised ecosystems and populations are more vulnerable to impacts than those that are pristine. The density of roads and other linear development features in an area is the single best index of the cumulative impact of human activities on biodiversity. In B.C., the highest densities of roads are found in the four biogeoclimatic zones of highest conservation concern: Coastal Douglas-fir, Ponderosa Pine, Bunchgrass and Interior Douglas-fir.

21. Connectivity of ecosystems in British Columbia is being lost and, among other impacts, this will limit the ability of species to shift their distributions in response to climate change.

The degree of connectivity and the characteristics of linkages in natural landscapes vary, depending on topography, hydrology and natural disturbance regime. Linear features such as roads, hydro transmission corridors, seismic lines, pipelines and railways affect connectivity when they are built along valley bottoms, and when they cross streams, preventing the movement of terrestrial and aquatic organisms. Besides limiting the ability of species to shift their distributions in response to climate change or habitat change, loss of connectivity also makes populations more vulnerable to extirpation as a result of chance events or the damaging effects of genetic drift and inbreeding.

22. Gaps in our knowledge of biodiversity in British Columbia create major challenges for effective conservation action.

Knowledge about species and ecosystems and the processes of which they are a part is lacking in several key areas including conservation status of species (approximately 8% completed), species population and distribution, genetic analyses, fine-scale ecosystem classification, comparisons with neighbouring jurisdictions and the effects of individual and cumulative human impacts. Addressing these gaps will provide valuable information to help improve biodiversity conservation.

23. The capacity to address some of the gaps in our knowledge of biodiversity in BritishColumbia is being impacted by the loss of already limited taxonomic expertise.

Thousands, if not tens of thousands, of species in B.C. have not been scientifically described. This taxonomic knowledge gap is currently being exacerbated by an ‘extinction of experience’ as the scientists with the knowledge, skills and inclination to do the work required to fill the gaps are retiring and often are not being replaced.

Contact us at info@biodiversitybc.org

Bio Diversity BC
CONSERVING THE VARIETY OF LIFE