

Pacific Alpine Tundra



General Description

The *Pacific Alpine Tundra* zone covers an area of approximately 35,000 km² above treeline in the Coast and Cascade Mountains of British Columbia (BC), and on Vancouver Island and Haida Gwaii. This zone represents the central portion of North American Pacific alpine tundra, extending from northern California to the Aleutian Islands. The climate is characterized by wind, high snowfall and cold temperatures. Landcover is a mosaic of patchy to continuous low vegetation, exposed soil and rock, snow or ice, and scattered small water bodies.

Vegetation

Vegetation is distributed according to micro-environmental conditions; cover can be sparse in harsh environments, grading to continuous on favourable sites. It typically consists of a mixture of low and dwarf shrubs, graminoids, forbs, bryophytes and lichens. Shrub height is variable, depending on elevation, site fertility and wind exposure, but rarely exceeds 40 cm. Bedrock and surficial geology affect species composition.

Because of the snowy climate, heath vegetation is characteristic of this zone, mostly comprising moss heathers (*Cassiope* spp.) and mountain heathers (*Phyllodoce* spp.). A variety of bryophytes (e.g., curly heron's-bill moss [*Dicranum fuscescens*] and alpine haircap moss [*Polytrichastrum alpinum*]) occur with the heaths. White mountain heather (*Cassiope mertensiana*) and pink mountain heather

(*Phyllodoce empetriformis*) dominate the heaths of the southern portion of the zone. The north is typified by Alaska moss heather (*Harrimanella stellariana*), together with white mountain heather. On Haida Gwaii, heaths are dominated by yellow mountain heather (*Phyllodoce glandulifera*). Black crowberry (*Empetrum nigrum*), bog bilberry (*Vaccinium uliginosum*) and partidgefoot (*Luetkea pectinata*) are common associates.

Dry, rocky sites are dominated by lichens and mosses, including yellow map lichen (*Rhizocarpon geographicum*), greater salted rocktripe (*Umbilicaria proboscidea*) and awned haircap moss (*Polytrichum piliferum*). Snow-scoured rock outcrops and ridgetops can also include Davidson's beardtongue (*Penstemon davidsonii*) and stunted clumps of common juniper (*Juniperus communis*).

Meadows are common at lower elevations on moist sites that often have mobile soils, through processes like soil creep, ravelling or bioturbation, that limit establishment of heath species and encourage herb growth. These communities are dominated by showy sedge (*Carex spectabilis*), often with Sitka valerian (*Valeriana sitchensis*).

Wetlands are associated with late-melting snowbeds and seepage areas. Black alpine sedge (*Carex nigricans*) dominates shallow hollows that accumulate snow and remain wet well into the growing season. Areas with the latest snowmelt are characterized by snow rustwort (*Marsupella brevisissima*). Seeps are characterized by white marsh

marigold (*Caltha leptosepala*), leather-leaved saxifrage (*Leptarrhena pyrolifolia*) and deer cabbage (*Nephrophyllidium crista-galli*), along with black alpine sedge. Drummond's rush (*Juncus drummondii*), Tolmie's saxifrage (*Micranthus tolmiei*), creeping sibbaldia (*Sibbaldia procumbens*) and Piper's woodrush (*Luzula piperi*) occur on rocky slopes below areas of snow accumulation (i.e., nivation slopes).

Scattered stunted trees occur at lower alpine elevations on sites with less snow deposition (e.g., steep slopes). Mountain hemlock (*Tsuga mertensiana*) is the characteristic tree species, although subalpine fir (*Abies lasiocarpa*) and yellow-cypress (*Callitropsis nootkatensis*) also occur.

Climate

At high elevations in the coastal mountains of BC, wet Pacific air masses generate very heavy orographic snowfall, resulting in the deep long-lying snowpacks that characterize the *Pacific Alpine Tundra* zone. These snow conditions effectively lower the treeline by shortening the growing season at elevations where trees would otherwise prevail, as is the case inland where snowpacks are not as deep. In general, the maritime alpine climate is cold, windy and wet. Local climates vary, though, and the hypermaritime portions of the zone on Haida Gwaii and the outer mainland coast are characterized by very wet conditions, warmer temperatures and longer growing seasons.

Mean annual temperatures vary between -4°C and 4°C. Growing degree days above 5°C are mostly <600, but are generally higher in the hypermaritime portions of the zone. In most locations, frost can occur at any time during the growing season. Mean annual precipitation varies between 1800 and 4700 mm over most of zone, but can be up to 7100 mm in hypermaritime areas. Generally, almost 3/4 of total precipitation falls as snow, except in hypermaritime areas where snow accounts for less than half of the total. In many locations, rain can occur in the winter months.

The alpine environment is windy, and snow is significantly redistributed from exposed locations. Snow cover provides protection for vegetation from

extreme winter cold and abrasion by wind-driven ice particles, but heavy snowpacks can also crush plants. Slope, aspect and wind exposure control site-scale patterns of insolation, snow deposition and melting. Southerly and westerly aspects are warmer; snowmelt on these sites occurs earlier in the spring. Northerly and easterly aspects are cooler; wind deposition of snow is often greater and snowmelt occurs later, delaying the onset of the growing season. Consequently, there is considerable variation in the temperature, moisture and growing season length at the scale of microsites.

Physiography, Geology, Topography and Soils

This zone occurs in the westernmost Cordillera of Canada, where it occupies the windward portions of the Coast Mountains in BC, including the Pacific Ranges, the Kitimat Ranges and the Boundary Ranges. It also occurs in the insular mountains of Vancouver Island and Haida Gwaii. A minor portion of the zone occurs in the Cascade Mountains of southwestern BC and the St. Elias Mountains of northwestern BC. The lower elevation of the zone is approximately 1600 mASL in the south, 1000 mASL in the north, and about 850 mASL on Haida Gwaii.

The geology of the Coast, Cascade and St. Elias Mountains is primarily crystalline igneous and metamorphic rocks. The Vancouver Island and Queen Charlotte Ranges comprise mostly folded and faulted volcanic and sedimentary Tertiary rocks. The terrain is a complex of high mountains (some >4000 mASL) and ice fields.

High mountain terrain is generally steep and rugged; rock, ice and snow dominate much of the landscape. Wetlands and small water bodies (tarns) occur in poorly drained topographic depressions. On steep slopes where deep snowpacks exist, avalanches are common. Steep slopes also result in other mass substrate movement, such as landslides or talus deposition.

All of the zone was affected by late Pleistocene glaciation, mostly by alpine rather than continental glaciers. Many alpine glaciers still exist in the Coast Mountains. The prevalent parent material is shallow, stony glacial till, often modified with fragments of

weathered bedrock or colluvium. The cold climate results in frequent freeze-thaw cycles that can churn the soil (cryoturbation) or cause rocks to fracture. Permafrost is not present in this zone. Soils are mostly Folisols, Brunisols and Regosols.

Notes

The *Pacific Alpine Tundra* zone is bounded at lower elevations by the *Pacific Montane Forest*. At alpine

elevations on the leeward side of the Coast Mountains, it adjoins the *Western Boreal Alpine Tundra* (in the north) and the *Cordilleran Alpine Tundra* (in central and southern areas). To the south and northwest, it continues into the United States.

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