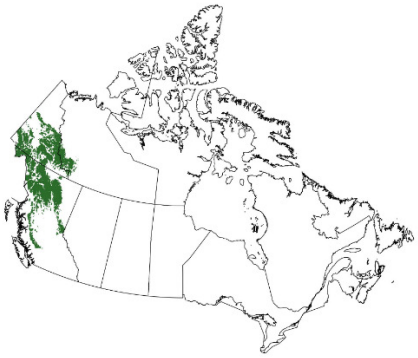
Western Boreal Alpine Tundra



General Description

The *Western Boreal Alpine Tundra* zone covers an area of approximately 186,000 km² near and above treeline on high elevation plateaux and mountains in central and northern British Columbia (BC), southern Yukon and southwestern Northwest Territories (NWT). This zone represents the Canadian portion of boreal alpine tundra and subalpine shrubland in western North America, extending into Alaska. Cold temperatures and wind characterize the climate. Landcover is a mosaic of patchy to continuous low vegetation, exposed soil and rock, snow or ice, and scattered small water bodies. Discontinuous permafrost occurs sporadically.

Vegetation

Vegetation is distributed according to micro-environmental conditions; cover can be sparse in harsh environments, grading to continuous on favourable sites. It is characterized by a mixture of low and dwarf shrubs, graminoids, forbs, bryophytes and lichens. In the alpine, shrub height is variable, depending on elevation, site fertility and wind exposure, but rarely exceeds 40 cm. Subalpine shrublands are taller, up to 1 m (>1 m in moist ravines or at lower elevations). Bedrock and surficial geology, as well as permafrost action, affect vegetation distribution and species composition.

On dry to moist mineral soils with some winter snow cover, net-veined willow (*Salix reticulata*) and small-awned sedge (*Carex macrochaeta*) are usually dominant, often in association with mountain sagewort (*Artemisia norvegica* ssp. *saxatilis*), northern rough fescue (*Festuca altaica*), small black-tip ragwort (*Senecio lugens*) and moss campion (*Silene acaulis*). Various lichens and mosses, including crinkled snow lichen (*Flavocetraria nivalis*), stairstep moss (*Hylocomium splendens*) and mountain groove moss (*Aulacomium turgidum*), are often present. At higher elevations, polar willow (*Salix polaris*) and crinkled snow lichen dominate.

Drier sites are characterized by northern rough fescue, often occurring with mountain sagewort, short-leaved fescue (*Festuca brachyphylla*), spiked woodrush (*Luzula spicata*), alpine bistort (*Bistorta vivipara*) and creeping sibbaldia (*Sibbaldia procumbens*). On these sites, haircap mosses (*Polytrichum* spp.), clad lichens (*Cladonia* spp.) and reindeer lichens (*Cladina* spp.) are common. Sparse lichen cover (e.g., rocktripe lichens [*Umbilicaria* spp.], map lichens [*Rhizocarpon* spp.]) is typical on rock surfaces. In the driest climates, or in the Rocky Mountains where calcareous soils occur, entire-leaved mountain avens (*Dryas integrifolia*) is dominant, while Alaska mountain avens (*D. alaskana*) is common in Yukon and northern BC, and Hooker's mountain avens (*D. hookeriana*) in northwestern BC.

On exposed snow-scoured sites, typical species include entire-leaved mountain avens, mouse-tail bog sedge (*Carex myosuroides*), inflated locoweed (*Oxytropis podocarpa*), purple mountain saxifrage (*Saxifraga oppositifolia*), three-toothed saxifrage (*S. tricuspidata*), moss campion and lichens (e.g., crinkled snow lichen). On high alpine ridges with some snow cover, moss campion is the main species, often occurring with mountain sagewort, spiked woodrush, alpine bluegrass (*Poa alpina*) and haircap mosses.

On cold aspects with permafrost, vegetation is dominated by net-veined willow, entire-leaved mountain avens, small-awned sedge and yellow marsh saxifrage (*Saxifraga hirculus*). These sites typically have a deep turfy moss layer of stairstep moss and wrinkle-leaved moss (*Rhytidium rugosum*). Heath vegetation occupies sites where snow accumulates; white mountain heather (*Cassiope mertensiana*) and partridgefoot (*Luetkea pectinata*) are common heath species in the south, while four-angled mountain heather (*C. tetragona*) is the dominant species in northern areas (often occurring with polar willow). Where deeper snow accumulates on unstable scree and talus, providing growing season moisture, mountain-sorrel (*Oxyria digyna*) occurs, sometimes associated with moss campion or small-rooted sedge (*Carex micropoda*).

Meadows are characterized by mountain monkshood (*Aconitum delphiniifolium*), mountain sagewort, large-awned sedge (*Carex macrochaeta*), woolly geranium (*Geranium erianthum*), Asian forget-me-not (*Myosotis asiatica*), fringed grass-of-Parnassus (*Parnassia fimbriata*), western buttercup (*Ranunculus occidentalis*), Canada burnet (*Sanguisorba canadensis*), arrow-leaved ragwort (*Senecio triangularis*), Sitka valerian (*Valeriana sitchensis*) and Wormskjold's alpine speedwell (*Veronica wormskjoldii*). Meadows occur 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.

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. Tussock cottongrass (*Eriophorum vaginatum*) and spruce muskeg sedge (*Carex bigelowii* ssp. *lugens*) occur in the northern part of the zone. Peat mosses (*Sphagnum* spp.), golden fuzzy fen moss (*Tomentypnum nitens*), ribbed bog moss (*Aulacomnium palustre*), hook mosses (*Drepanocladus* spp.) and tufted fen moss (*Paludella squarrosa*) are often present. Seeps are characterized by white marsh marigold (*Caltha leptosepala*) or arctic sweet coltsfoot (*Petasites frigidus*). River beauty (*Chamaenerion latifolium*) and fountain apple moss (*Philonotis fontana*) occur in snowmelt rivulets.

Shrublands, together with patches of stunted trees, dominate at lower elevations in the transition to high montane forests and woodlands. Arctic dwarf birch (*Betula nana*) and glandular birch (*B. glandulosa*) are the most common species, although grey-leaved willow (*Salix glauca*) and arctic willow (*S. arctica*) can also occur. Associated species in shrublands include northern rough fescue, mountain sagewort, black crowberry (*Empetrum nigrum*) and feathermosses (especially stairstep moss and red-stemmed feathermoss [*Pleurozium schreberi*]). Tree species include subalpine fir (*Abies lasiocarpa*), white spruce (*Picea glauca*) and Yukon lodgepole pine (*Pinus contorta* var. *yukonensis*), depending on location.

Climate

In general, the continental boreal alpine climate is cold and windy. Overall, precipitation is low to moderate and snowpacks are light. However, latitudinal and orographic influences significantly modify climatic characteristics across the zone, generating highly variable regional to local climates.

Mean annual temperatures vary from -5°C to -1°C. The growing season is generally short, but frost can occur at any time; growing degree days above 5°C are <400. Mean annual precipitation varies between about 750 mm and 2200 mm, with the driest areas occurring in the northern portion of the zone in Yukon and NWT. Over half of total precipitation falls as snow.

The alpine environment is windy; snow, which provides protection for vegetation from extreme winter cold and abrasion by wind-driven ice particles, is significantly re-distributed from exposed locations. 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, Soils and Land Cover

The *Western Boreal Alpine Tundra* zone occurs in north-central portions of the Cordilleran physiographic region, including the Selwyn, Wernecke, Pelly, Omineca, Cassiar and northern Rocky Mountains of BC, Yukon and NWT, as well as on the Stikine and Yukon plateaux of northwestern BC and central Yukon. The lower elevation of the zone lies between 1600 and 2000 mASL in BC, and between 750 and 1450 mASL in Yukon and NWT.

Although there are some rocks of volcanic origin (e.g., the Omineca Mountains), the geology is mostly faulted and folded Paleozoic, Mesozoic or Tertiary sedimentary, often carbonate-rich, rocks. The terrain is a complex of high mountains (up to 3000 mASL) with intervening plateaux and hill systems.

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; debris flows can be exacerbated by melting permafrost.

All of the zone, except a small portion in west-central Yukon, was affected by late Pleistocene glaciation. 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. Discontinuous permafrost occurs at many locations. Soils are mostly Brunisols, Regosols and Cryosols.

Notes

The *Western Boreal Alpine Tundra* zone is mostly bounded at lower elevations by the *Northwestern Boreal Forest*, except in the south where it occurs above the *Cordilleran Montane Forest*. At alpine elevations, it abuts the *Pacific Alpine Tundra* on the leeward slopes of the Coast Mountains, the *Cordilleran Alpine Tundra* along its southern boundary, and the *Subarctic Alpine Tundra* along its northern boundary. To the northwest, it continues into Alaska.