Cordilleran Alpine Tundra

General Description

The *Cordilleran Alpine Tundra* zone covers an area of almost 29,000 km² above treeline on high elevation plateaux and mountains in central and southern British Columbia (BC) and southwestern Alberta. This zone represents the northern portion of temperate North American Cordilleran alpine tundra found throughout the Rocky Mountains and Intermountain West region of North America, extending south to New Mexico. Cold temperatures, wind and snow 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.

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.

Heath vegetation characterizes much of this zone, absent only from areas where the climate is driest. White mountain heather (*Cassiope mertensiana*), pink mountain heather (*Phyllodoce empetriformis*) and woolly pussytoes (*Antennaria lanata*) are the typical species. In snowier areas, partridgefoot (*Luetkea pectinata*) also occurs, sometimes with yellow mountain heather (*Phyllodoce glandulifera*. Bryophytes include leafy liverworts (*Barbilophozia* spp.) and broom mosses (*Dicranum* spp.).

On exposed snow-scoured sites, typical species include moss campion (*Silene acaulis*), alpine stitchwort (*Cherleria obtusiloba*), dwarf cinquefoils (*Potentilla* spp.), spotted saxifrage (*Saxifraga bronchialis*) and nard sedge (*Carex nardina*). Rocky substrates are characterized by lichens and mosses, including yellow map lichen (*Rhizicarpon geographicum*), rocktripe lichens (*Umbilicaria* spp.), crinkled snow lichen (*Flavocetraria nivalis*), orange chocolate chip lichen (*Solorina crocea*), haircap mosses (*Polytrichum* spp.), rock mosses (*Racomitrium* spp.) and sidewalk screw moss (*Syntrichia ruralis*).

Grasslands occur frequently in dry climates, mostly on well-developed soils with a light snowpack. Species composition is variable, but timber oatgrass (*Danthonia intermedia*) and short-leaved fescue (*Festuca brachyphylla*) usually dominate. Associated graminoids include Rocky Mountain fescue (*F. saximontana*), spike trisetum (*Trisetum spicatum*), alpine bluegrass (*Poa alpina*), single-spike sedge (*Carex scirpoidea*) and black-and-white-scale sedge (*C. albonigra*). Hooker's mountain avens (*Dryas hookeriana*) is common in drier regions on calcareous parent materials, often occurring with dwarf snow willow (*Salix nivalis*).

Meadows are common on warm slopes with moderate snow conditions and generally include a diversity of tall forbs with showy flowers. Common species include Sitka valerian (*Valeriana sitchensis*), arrow-leaved ragwort (*Senecio triangularis*), wandering fleabane (*Erigeron peregrinus*), paintbrushes (*Castilleja* spp.) and Indian hellebore (*Veratrum viride*). Floristics vary geographically: showy sedge (*Carex spectabilis*) can be abundant in meadows of snowier areas, western pasqueflower (*Pulsatilla occidentalis*) often dominates in the Rocky Mountains, and arctic lupine (*Lupinus arcticus*) is characteristic of areas in the lee of the Coast Mountains. 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.

Avalanche tracks are usually initiated in the alpine zone. Vegetation in the upper portions of avalanche tracks is similar to that of alpine meadows, often comprising Sitka valerian, showy sedge, Indian hellebore and fireweed (*Chamaenerion angustifolium*).

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. Seeps are characterized by white marsh marigold (*Caltha leptosepala*) and white globeflower (*Trollius albiflorus*). On fine-textured slopes below areas of snow accumulation (i.e., nivation slopes), Piper's woodrush (*Luzula piperi*) occurs with haircap mosses.

Scattered stunted trees occur at lower alpine elevations just above treeline. Species include subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), whitebark pine (*Pinus albicaulis*) and subalpine larch (*Larix lyallii*).

Climate

In general, the continental alpine climate is cold and windy. Within the *Cordilleran Alpine Tundra* zone there is considerable variation in annual precipitation. Areas of high orographic precipitation result when westerly air flows are forced over the mountains of interior BC and the Rocky Mountains. In the lee of these mountain ranges, as well as the Coast Mountains, rain shadow effects create relatively dry conditions. These climatic differences result in significant variation in snowpack depth and density across the zone.

Mean annual temperatures vary from -3°C to 1°C. The growing season is generally short, but frost can occur at any time; growing degree days above 5°C are typically <500. Mean annual precipitation varies between about 650 mm and 3500 mm, with the driest areas occurring in the southern portion of the zone. 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 redistributed 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

This zone occurs in southern portions of the Cordilleran physiographic region, including the Columbia Mountains, the southern Rocky Mountains, the southern Omineca and Skeena Mountains, and the eastern sides of the Cascade and southern Coast Mountains. The lower elevation of the zone ranges from approximately 2400 – 2500 mASL in southern dry climate areas to about 1800 mASL in the north.

The Coast and Omineca Mountains consist predominantly of crystalline igneous and metamorphic rocks, while the rest of the Interior and Eastern Systems of the Cordillera comprise faulted and folded Paleozoic, Mesozoic or Tertiary sedimentary, and often carbonate-rich, rocks. The terrain is a complex of high mountains (up to 3900 mASL), 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.

All of the zone 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.

Permafrost is not present in this zone. Soils are mostly Brunisols, Regosols and Podzols.

Notes

The *Cordilleran Alpine Tundra* zone is bounded at lower elevations by the *Cordilleran Montane Forest*. At alpine elevations, it abuts the *Pacific Alpine Tundra* on the leeward slopes of the Coast Mountains and the *Western Boreal Alpine Tundra* along its northern boundary. To the south, it continues into the United States.