

## Eastern Alpine Tundra



### General Description

The *Eastern Alpine Tundra* zone comprises several high elevation areas in Quebec and Newfoundland and Labrador, where alpine and subalpine vegetation occurs. Altogether, the zone totals more than 19,000 km<sup>2</sup> in over 25 separate locations, ranging from south-central Quebec to western Newfoundland to mid-Labrador. This zone includes most occurrences of eastern North American alpine and subalpine vegetation, except for a few locations in the northeastern United States. Cold temperatures, high winds, cloud, fog 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. 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. Because of low overall elevations, patches of krummholtz (wind-stunted trees) often occur in the alpine mosaic. Shrub height rarely exceeds 40 cm, except at subalpine elevations where heights to 2 m can occur. Bedrock and surficial geology, as well as permafrost action, affect vegetation distribution and species composition.

On dry to moist acidic mineral substrates with some winter snow cover, vegetation is dominated by low and dwarf shrubs such as glandular birch (*Betula glandulosa*), bog bilberry (*Vaccinium uliginosum*), early lowbush blueberry (*V. angustifolium*), dwarf bilberry (*V. cespitosum*), mountain cranberry (*V. vitis-idaea*), common Labrador tea (*Rhododendron groenlandicum*), alpine bearberry (*Arctous alpina*), purple, pink and black crowberries (*Empetrum atropurpureum*, *E. eamesii* and *E. nigrum*), alpine azalea (*Kalmia procumbens*), bearberry willow (*Salix uva-ursi*), purple mountain heather (*Phyllodoce caerulea*) and creeping sibbaldia (*Sibbaldia procumbens*). Bigelow's sedge (*Carex bigelowii*) and highland rush (*Oreojuncus trifidus*) are common associates. Various lichens and mosses, especially reindeer lichens (*Cladina* spp.) and rock mosses (*Racomitrium* spp.), are typically present.

Exposed snow-scoured sites are characterized by Lapland diapensia (*Diapensia lapponica*), often with crowberries, bog bilberry and highland rush. Sparse lichen cover (especially map lichens [*Rhizocarpon* spp.]) is typical on rock surfaces.

Graminoid dominated meadows develop on sites where snow accumulates. Common species include Bigelow's sedge, tufted hairgrass (*Deschampsia cespitosa*) and bluejoint reedgrass (*Calamagrostis canadensis*). Boreal forb species often occur in these meadows, including bunchberry (*Cornus canadensis*), Canada burnet (*Sanguisorba canadensis*), large-leaved goldenrod (*Solidago macrophylla*) and yellow clintonia (*Clintonia borealis*). Other snowbed species

include creeping sibbaldia, snowbed willow (*Salix herbacea*) and moss heather (*Harrimanella hypnoides*).

Wetlands associated with late-melting snowbeds and seepage areas are often dominated by tufted clubrush (*Trichophorum cespitosum*). Especially on the high Shield plateaux of Quebec, bogs and fens occur where shallow *Sphagnum* peat deposits have developed on sites with restricted drainage. Plant species composition is similar to that of boreal bogs and fens.

In areas of calcareous substrates, entire-leaved mountain avens (*Dryas integrifolia*), Drummond's mountain avens (*D. drummondii*), Lapland rosebay (*Rhododendron lapponicum*), tufted saxifrage (*Saxifraga cespitosa*), purple mountain saxifrage (*S. oppositifolia*), yellow mountain saxifrage (*S. aizoides*), red-tipped lousewort (*Pedicularis flammea*) and snow draba (*Draba nivalis*) are found.

On serpentine substrates, vegetation cover is very sparse, with only scattered occurrences of species tolerant of the ultramafic geochemistry. The main shrub species are common juniper (*Juniperus communis*) and stunted black spruce (*Picea mariana*) and tamarack (*Larix laricina*). Arctic willow (*Salix arctica*) and grey-leaved willow (*S. glauca*) are sometimes present. Herb/dwarf shrub species that are characteristic of serpentine soils include Aleutian maidenhair fern (*Adiantum aleuticum*), serpentine stitchwort (*Cherleria marcescens*), alpine catchfly (*Viscaria alpina*), small-flowered anemone (*Anemone parviflora*), creeping sandwort (*Arenaria humifusa*), reddish stitchwort (*Sabulina rubella*), sea thrift (*Armeria maritima*) and boreal wormwood (*Artemisia borealis*).

At lower elevations, in the transition to high montane forests, shrublands and open woodlands are the dominant vegetation. In sheltered areas (e.g. ravines), trees can be taller than 5 m, but in exposed areas they are stunted and often occur only as patches of krummholtz in the lee of boulders or ridges. The main tree species are balsam fir (*Abies balsamea*), white spruce (*Picea glauca*) and black spruce. Generally, fir and white spruce are dominant on sites with richer soils, better wind shelter or deeper snowbeds, while black spruce is prevalent on exposed sites and sites with shallow or nutrient-poor soils. Tamarack and heart-leaved birch (*Betula*

*cordifolia*) are occasionally present at treeline and in krummholtz patches in the alpine tundra. The most common shrub species include green alder (*Alnus viridis*), glandular birch, bog bilberry, Bartram's serviceberry (*Amelanchier bartramiana*), tea-leaved willow (*Salix planifolia*) and Labrador willow (*S. argyrocarpa*). Subalpine meadows on the Gaspé Peninsula are usually dominated by graminoids (especially tufted hairgrass and bluejoint reedgrass) and often include high abundance of fern species, including common lady fern (*Athyrium filix-femina*), common oak fern (*Gymnocarpium dryopteris*) and interrupted fern (*Osmunda claytoniana*).

## Climate

At high elevations in proximity to the Atlantic Ocean, the climate is characterized by very high wind velocities and heavy orographic snowfall. Prolonged cloud (fog) immersion is a feature of many of these sites (especially those closest to the ocean), which contributes to the overall moist environment and also results in the accumulation of rime ice that damages exposed vegetation. The wind, snow and ice regimes combine to create treeline conditions at elevations where montane forests would otherwise prevail.

Mean annual temperatures are below 0°C (-1.4°C at the Chic-Choc and McGerrigle Mountains in the Gaspé Peninsula; between -1.9°C and -4.3°C at the Mealy Mountains in Labrador). Growing degree days above 5°C vary from <700 in the Mealy Mountains to >900 in the mountains of Gaspésie, but frost can occur at any time in the growing season. Mean annual precipitation is typically >1000 mm (>2000 mm in the Mealy Mountains), with over half of total precipitation falling 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; 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 majority of the *Eastern Alpine Tundra* zone occurs in the James and Laurentian physiographic regions of the east-central Precambrian Shield, including the Groulx, Otish and Mealy Mountains as well as the Laurentides. South and east of the Shield, in the Appalachian physiographic region, alpine and subalpine conditions occur on western Newfoundland (including the Long Range Mountains and Gros Morne) and at the highest elevations of the Chic-Choc and McGerrigle Mountains of the Gaspé Peninsula. The lower elevation of the zone varies among locations: approximately 500 – 650 mASL at the Mealy Mountains, the Long Range Mountains and Gros Morne; 900 – 1000 mASL at the Groulx, Otish and Blanche Mountains; 1000 – 1150 at the Chic-Choc and McGerrigle Mountains.

The geology of the Shield consists of Precambrian sedimentary and crystalline rocks. The Appalachian physiographic region is more diverse, with many subdivisions. Highland and mountainous areas on the Gaspé Peninsula and in western Newfoundland are rugged, often deeply dissected plateaux with steep slopes, developed in Precambrian or Paleozoic rocks. In some areas, carbonate-rich strata or serpentine intrusions dominate the geochemistry. Most highland landforms are characterized by

erosion-resistant rocks; alpine locations typically occur on high plateaux with rounded summits.

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 initiated by torrential rainfall events.

All of the zone was affected by late Pleistocene glaciation. The predominant 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. Mineral soils are mostly Brunisols or Regosols; Cryosols occur in areas with permafrost. Shallow (<1 m) peat deposits with Organic soils occur in poorly drained locations.

### **Notes**

The *Eastern Alpine Tundra* zone is mostly bounded at lower elevations by the *Eastern Boreal Forest*. The southernmost occurrences are surrounded by the *Eastern Temperate Mixed Forest*, and the northernmost by the *Northern Boreal Woodland* and the *Subarctic Woodland-Tundra*. In southern Newfoundland, the low elevation *Atlantic Maritime Heathland* abuts the *Eastern Alpine Tundra* zone in a few locations.