

Mid-Arctic Dwarf Shrub Tundra



General Description

The *Mid-Arctic Dwarf Shrub Tundra* zone encompasses most of the Canadian arctic, covering an area of approximately 1,725,000 km². It includes the northernmost mainland in Nunavut, Quebec and Northwest Territories (NWT), the islands in northern Hudson Bay and the vast majority of the Canadian Arctic Archipelago. Landcover on upland sites is a mosaic of patchy to continuous prostrate vegetation and exposed soil and rock. Wetlands and numerous small water bodies are prevalent in the southern portion of the zone on low relief terrain. The climate is characterized by very long, very cold winters and short, cool summers; annual precipitation is very low for most of the zone. Continuous permafrost actively modifies the surface expression of the landscape and significantly influences vegetation distribution.

Vegetation

Vegetation is distributed according to micro-environmental conditions; cover can be sparse in harsh environments, grading to continuous on favourable sites. It is dominated by dwarf shrubs, graminoids, bryophytes and lichens; forbs are most common and abundant on moist sites. In the northernmost parts of the zone, exposed upland sites are typically barren of vegetation other than patchy cover of crustose lichens. On moist protected sites in these areas, cryptogamic crusts of lichens and cyanobacteria develop in association with bryophyte mats and prostrate (<10 cm tall) dwarf shrubs, graminoids and forbs. In southern parts of

the zone, vascular plant species diversity is richer and shrub height can approach 40 cm on moist, wind-sheltered sites. Permafrost action affects surface substrate expression, which in turn influences vegetation distribution on the landscape. Bedrock and surficial geology affect the species composition.

Especially in northern and western parts of the zone, wind-exposed sites that dry quickly in summer have very sparse vegetation cover. Lichens dominate, including Wulfen's lichen (*Lecidella wulfenii*), false sunken disc lichen (*Megaspora verrucosa*), tundra goldspeck lichen (*Candelariella terrigena*), heath tube lichen (*Hypogymnia subobscura*), rim lichens (*Lecanora* spp.), saucer lichens (*Ochrolechia* spp.), wart lichens (*Pertusaria* spp.), shield lichens (*Parmelia* spp.) and pepper-spore lichens (*Rinodina* spp.). On rock surfaces, species include rocktripe lichens (*Umbilicaria* spp.), tile lichens (*Lecidia* spp.) and map lichens (*Rhizocarpon* spp.). Scattered occurrences of vascular plants include purple mountain saxifrage (*Saxifraga oppositifolia*), polar poppy (*Papaver dahlianum*), arctic willow (*Salix arctica*), northern woodrush (*Luzula confusa*), arctic woodrush (*L. nivalis*), narrow alkaligrass (*Puccinellia angustata*), abbreviated bluegrass (*Poa abbreviata*), reddish stitchwort (*Sabulina rubella*) or Baffin Bay draba (*Draba corymbosa*). On calcareous sites, entire-leaved mountain avens (*Dryas integrifolia*) is the dominant vascular species on dry, snow-scoured sites, typically in association with purple mountain saxifrage and arctic willow; Ellesmere Island draba (*Draba subcapitata*), grey-leaved draba (*D. cinerea*),

nard sedge (*Carex nardina*) and rock sedge (*C. rupestris*) are diagnostic associates on these sites.

In northern parts of the zone, wind-protected upland sites with moderate winter snow cover, or sites that receive some snowmelt seepage in the growing season, have greater plant cover. Vegetation is dominated by prostrate dwarf shrubs, forbs and bryophytes. Common vascular species include arctic willow, polar willow (*Salix polaris*), entire-leaved mountain avens, northern woodrush, arctic woodrush, alpine foxtail (*Alopecurus magellanicus*), wide-leaved polargrass (*Arctagrostis latifolia*), two-glumed rush (*Juncus biglumis*), purple mountain saxifrage, nodding saxifrage (*Saxifraga cernua*), tufted saxifrage (*S. cespitosa*), leafy stem saxifrage (*Micranthes foliosa*), polar poppy, mountain-sorrel (*Oxyria digyna*) and long-stalked starwort (*Stellaria longipes*). Bryophytes and lichens often form patches of continuous cover. Frequently occurring bryophyte species include mountain groove moss (*Aulacomnium turgidum*), frostwort (*Gymnomitrium corallioides*), alpine haircap moss (*Polytrichastrum alpinum*), rock mosses (*Racomitrium* spp.), flexible cow-hair moss (*Ditrichum flexicaule*) and erect-fruited iris moss (*Distichium capillaceum*). In addition to the species noted above, lichens include reindeer lichens (*Cladina* spp.), clad lichens (*Cladonia* spp.), snow lichens (*Flavocetraria* spp.), Iceland lichens (*Cetraria* spp., *Cetrariella delisei*), whiteworm lichens (*Thamnia* spp.), arctic butterfingers lichen (*Dactylina arctica*), zoned dust lichen (*Lepraria neglecta*) and green witch's hair lichen (*Alectoria ochroleuca*).

More continuous vegetation occurs on moist to wet sites, often with fine-textured soils, that are associated with late-melting snowbeds, seepage slopes, valley bottoms and river floodplains. In addition to species mentioned above, dwarf hairgrass (*Deschampsia sukatschewii*), icegrass (*Phippsia algida*), narrow-leaved cottongrass (*Eriophorum angustifolium*), fragile sedge (*Carex membranacea*), short-leaved sedge (*C. fuliginosa*), Canada arctic draba (*Draba oblongata*), alpine draba (*D. alpina*), arctic cinquefoil (*Potentilla hyparctica*), alpine bistort (*Bistorta vivipara*), long-stalked starwort (*Stellaria longipes*) and snow buttercup (*Ranunculus nivalis*) occur in these communities.

Wetland mosses are usually prominent, including golden erect-capsule moss (*Orthothecium chryseum*), golden fuzzy fen moss (*Tomenthypnum nitens*), rusty hook moss (*Scorpidium revolvens*), twiggy spear moss (*Warnstorfia sarmentosa*), sickle moss (*Sanionia uncinata*), Holmen's bloom moss (*Schistidium holmenianum*) and stairstep moss (*Hylocomium splendens*).

Four-angled mountain heather (*Cassiope tetragona*) is characteristic of late-melting snowbeds on acidic mineral substrates (e.g., Shield-derived till), often in association with arctic willow, polar willow and snowbed willow (*Salix herbacea*). Entire-leaved mountain avens dominates sites with calcareous substrates. On sites with permafrost-derived earth hummocks, entire-leaved mountain avens typically dominates the tops of hummocks with four-angled mountain heather in the depressions.

In the southernmost portions of the zone, on upland wind-protected sites that receive some winter snow cover, vegetation includes erect low shrubs and erect forms of dwarf shrubs (up to 40 cm tall). On acidic substrates, species include arctic dwarf birch (*Betula nana*), glandular birch (*B. glandulosa*), net-veined willow (*Salix reticulata*), grey-leaved willow (*S. glauca*), bog bilberry (*Vaccinium uliginosum*), mountain cranberry (*V. vitis-idaea*), black crowberry (*Empetrum nigrum*), four-angled mountain heather and northern Labrador tea (*Rhododendron tomentosum*). On dry to mesic calcareous substrates, entire-leaved mountain avens dominates in association with red bearberry (*A. rubra*), tufted saxifrage, purple mountain saxifrage, Lapland rosebay (*Rhododendron lapponicum*), net-veined willow, arctic willow and several sedge (*Carex* spp.) and lousewort species (*Pedicularis* spp.).

On moist sites with better nutrient status and winter snow cover in southern areas, erect shrubs include Richardson's willow (*Salix richardsonii*), grey-leaved willow, diamond-leaved willow (*S. pulchra*) and Alaska willow (*S. alaxensis*). Here, willows can form thickets up to 2 m tall along stream margins.

Wetlands are common, especially in the southern portion of the zone. Drainage of meltwater can be impeded both by topography and by permafrost, and depressions in bedrock or frozen ground collect

water throughout the growing season. Fens and shallow marshes are the predominant wetland classes, although nutrient-poor fens occur in southern areas where peat accumulation can be significant. Cryogenic features (e.g., low-centre polygons) are typical of wet terrain and affect the distribution of vegetation communities by influencing drainage patterns and substrate forms. Hummocky terrain often contains wetland vegetation on the wetter microsites, while vegetation favouring drier conditions occurs on the elevated microsites.

Shallow marshes and wetter fens are typically dominated by graminoids and bryophytes. Graminoids include water sedge (*Carex aquatilis*), pendant grass (*Arctophila fulva*), Fisher's tundra grass (*Dupontia fisheri*), narrow-leaved cottongrass, Scheuchzer's cottongrass (*Eriophorum scheuchzeri*), Chamisso's cottongrass (*E. chamissonis*), sheathed cottongrass (*E. vaginatum*), fragile sedge and wide-leaved polargrass. In southern areas, creeping sedge (*C. chordorrhiza*) and tufted clubrush (*Trichophorum cespitosum*) are often present. Other vascular species include arctic willow, alpine bistort, yellow marsh saxifrage (*Saxifraga hirculus*), nodding saxifrage, long-stalked starwort, Regel's chickweed (*Cerastium regelii*), Sudeten lousewort (*Pedicularis sudetica*) and Nyman's bittercress (*Cardamine polemonoides*). Mosses are usually prominent components of these communities, including mountain groove moss, yellow starry fen moss (*Campylium stellatum*), golden fuzzy fen moss, flexible cow-hair moss, golden erect-capsule moss, northern lantern-moss (*Cinclidium arcticum*), giant spear moss (*Calliergon giganteum*), rusty hook moss and sickle moss.

Especially in southern parts of the zone, peat mosses (*Sphagnum* spp.) dominate wet sites with acidic chemistry, leading to shallow (<50 cm) peat accumulations in some areas. Vegetation on these sites includes sheathed cottongrass along with prostrate dwarf shrub species like arctic dwarf birch, bog bilberry, mountain cranberry, black crowberry, northern Labrador tea and cloudberry (*Rubus chamaemorus*).

Coastal shorelines, beaches, tidal flats and salt marshes are dominated by salt-tolerant species such

as Hoppner's sedge (*Carex subspathacea*), creeping alkaligrass (*Puccinellia phryganodes*), saltmarsh starwort (*Stellaria humifusa*), Greenland silverweed (*Potentilla anserina* ssp. *groenlandica*), marsh groundsel (*Tephroses palustris*), oysterleaf (*Mertensia maritima*) and seabeach sandwort (*Honckenya peploides*).

Climate

The *Mid-Arctic Dwarf Shrub Tundra* zone occurs across a wide range of latitudes in the Canadian arctic (approximately 62°N to 83°N). At the northern extent of the zone, it occurs on islands that are surrounded by pack ice for most (or all) of the year. In southern areas, summer ice-free periods exist in ocean waters adjacent to the zone.

Overall, the climate is very cold and dry, with an extremely short growing season and persistent snow for at least 10 months of the year. Mean annual temperatures vary from approximately -18°C in the north to -9°C in the south. In northern mountainous areas, summer temperatures average around 0°C. Growing degree days above 5°C vary from <30 at Alert on the northern tip of Ellesmere Island to approximately 200 in southern parts of the zone. The short growing season is enhanced by long daylengths; however frost or snow can occur any day of the year. Mean annual precipitation is generally <150 mm, except in eastern coastal areas where it averages >200 mm and can exceed 400 mm along the Atlantic coast. Most precipitation falls as snow.

The arctic environment is windy, and snow is significantly re-distributed from exposed locations. Snow cover protects vegetation from extreme winter cold and abrasion by wind-driven ice particles, and snowmelt provides moisture into the growing season. Slope, aspect and wind exposure control site-scale patterns of insolation, snow deposition and melting. Southerly aspects are warmer; snowmelt on these sites occurs earlier in the spring and microclimatic thermal conditions favour the survival of plant species at their northern range limits. Late-lying snowbeds are important sources of water for vegetation during 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 occupies all of the Arctic Lowland and portions of the Innuitian and Arctic Coastal Plain physiographic regions. Most of the eastern and south-central portions of the zone lie on the Precambrian Shield, occurring in the Kazan, James and Davis regions.

The northern extent of the zone lies on the Eureka and Parry Plateaux of the Innuitian region. Geology is dominated by Mesozoic and Paleozoic sedimentary rocks. Topography is mostly a series of ridged and dissected plateaux with elevations <1000 mASL. The Arctic Coastal Plain, occurring on western Banks Island, is an undulating lowland with elevations <100 mASL.

The Arctic Lowlands lie in the centre of the zone, between the Arctic Coastal Plain and the Innuitian Region to the north and west, and the Shield to the south and east. Geology of the Lowlands is dominated by level Paleozoic sedimentary, often calcareous, rocks. Topography is mostly a series of undulating lowlands and low plateaux, often dissected by river valleys and erosion channels, with elevations generally <400 mASL. The Shaler Mountains in central Victoria Island reach 750 mASL.

In the northern and eastern portions of the zone, mountain ranges on Baffin, Ellesmere and Axel Heiberg Islands can exceed 2000 mASL. In the highest areas, permanent ice fields and valley glaciers exist. Most of the geology is Precambrian crystalline rocks, part of the Davis region of the Shield, but the northernmost Grantland and Axel Heiberg Mountains lie in the Innuitian region and consist mainly of folded Mesozoic and Paleozoic strata. Local relief is extremely rugged, in places >1000 m, and the terrain is deeply dissected with long fjords reaching inland from the sea. The western part of Baffin Island slopes gradually to the southwest from mountains in the northeast.

On the Precambrian Shield in southern Nunavut and northern Quebec, the Kazan and James Uplands

exhibit characteristic Shield landscapes, with broad expanses of rolling terrain containing numerous wetlands and lakes, and local relief rarely exceeding 100 m. The Davis region is more rugged, including the Baffin, Frobisher and Hall Uplands of Baffin Island and the Melville Plateau, in addition to the arctic mountain ranges. The geology comprises Precambrian sedimentary and crystalline rocks.

The entire zone has been glaciated, either in the latest Pleistocene event or during previous glaciations. The surficial landscape expression is mostly dominated by glacial features and bedrock-controlled terrain. Typically, exposed bedrock and shallow till veneers prevail on upland sites, while deeper deposits of glacial drift fill landscape depressions. Tills are often modified by permafrost action on soils and frost-shattering of exposed rocks. In mountainous areas, till is often modified with fragments of colluvium. Soils are frequently calcareous in areas not underlain by Shield bedrock. After the last glaciation, coastal areas were inundated. On the coastal plains of Banks Island and the NWT mainland, fluvial and marine sediments generally occur at elevations <60 mASL. In southern parts of the zone, peat accumulates wherever there is standing water during most of the growing season; peat depths are usually <50 cm. Mineral and organic soils are predominantly Cryosols. Numerous small water bodies are a characteristic of the landscape, especially in southern areas.

All portions of the zone are underlain by continuous permafrost, which creates variable patterns within the surface mineral and organic substrates. In many places, surficial expression is strongly modified by permafrost features such as sorted and non-sorted circles and stripes; hummocks and mounds; and ice wedge, low-centre and high-centre polygons. Depth to permafrost affects the temperature of the active soil layer and thus, the effective growing season for vegetation.

Notes

The *Mid-Arctic Dwarf Shrub Tundra* zone is primarily bounded by the *Low Arctic Shrub Tundra* to the south, while the *High Arctic Sparse Tundra* is situated to the northwest. Otherwise, the coastlines

of the Beaufort Sea, Arctic Ocean, Atlantic Ocean
and Hudson Bay form the zone boundaries.

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