17080

North American Arctic Polygonal Ground Shrub and Tussock Tundra

BpS Model/Description Version: Nov. 2024

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |

Reviewer: Robin Innes

Vegetation Type

Shrubland

Map Zones

67, 68, 69

Geographic Range

This Biophysical Setting (BpS) is typically found in the lowland regions of arctic AK, particularly on the Beaufort Coastal Plain ecoregion (Nowacki et al. 2001) in northern AK and the Kotzebue Sound lowlands of west-central AK, but it also occurs in other scattered locations (such as the Brooks Range) of arctic AK where ice-wedge processes occur.

Biophysical Site Description

Ice-wedge polygons and the thaw lake cycle dominate the Beaufort Coastal Plain ecoregion (Nowacki et al. 2001). The ice-wedge polygons generally occur on level surfaces (0-2 degree slopes), the ice wedges may be 2 m wide at the top, and polygon diameter ranges from several to more than 30 meters. In addition to the Beaufort Coastal Plain, ice-wedge polygons are a common feature on level ground within foothills and mountains, on glacial drift, and on lacustrine and floodplain terrace surficial deposits. Shrub-Tussock dominated sites in this system occur primarily on high-center polygons but may also be found on raised areas along drainages, terraces, and other mesic flat to slightly sloping sites. Sites dominated by tussocks are generally cold, poorly drained, and underlain by mesic, silty mineral soils with a shallow surface organic layer surrounding the tussocks (Viereck et al. 1992). Permafrost is usually present. Patch size is small to large.

Vegetation Description

This tundra system occurs primarily on high-center polygons, raised areas along drainages, terraces, and other mesic flat to slightly sloping sites. Polygon centers are mesic and dominated by either tussocks, tussocks and shrubs, or only shrubs and lichens, and their perimeters are commonly wet, supporting wet sedges. On shrub dominated sites, the combined cover of dwarf-shrubs and low shrubs is >25%, and sedge cover is typically <25%. Some tussocks may occur but are often degenerating. *Eriophorum vaginatum* is the primary tussock-former in most sites, but *Carex bigelowii* may dominate some sites. *Calamagrostis canadensis, Arctagrostis latifolia*, and *Chamerion latifolium* may be common. The open to closed shrub canopy is dominated by *Betula nana* and *Salix pulchra*. Other shrubs include *Cassiope tetragona, Ledum palustre* ssp*. decumbens,* *Vaccinium vitis-idaea, Vaccinium uliginosum*, and *Empetrum nigrum*. Common mosses include *Sphagnum* spp., *Polytrichum strictum*, and *Hylocomium splendens*. The wet perimeters typically support *Carex aquatilis* and *Eriophorum angustifolium*, and *Eriophorum vaginatum* (the latter is often dead). Common mosses include *Sphagnum* spp., *Hylocomium splendens*, and *Aulacomnium turgidum*. Lichens are common.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| BENA | *Betula nana* | Dwarf birch |
| SAPU15 | *Salix pulchra* | Tealeaf willow |
| LEPAD | *Ledum palustre ssp. decumbens* | Marsh labrador tea |
| VAVI | *Vaccinium vitis-idaea* | Lingonberry |
| VAUL | *Vaccinium uliginosum* | Bog blueberry |
| EMNI | *Empetrum nigrum* | Black crowberry |
| ERVA4 | *Eriophorum vaginatum* | Tussock cottongrass |
| CABI5 | *Carex bigelowii* | Bigelow's sedge |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Ice wedge polygons are formed by large ice wedges which grow in thermal contraction cracks in permafrost. High center polygons indicate that erosion, deposition or thawing is more prevalent than the up-pushing of the sediments along the sides of the wedge. Ice-wedge polygons are typically part of a spatially coarser thaw lake cycle.

The time scale on this process is long and probably beyond the scope of this modeling effort. A reviewer noted that shrubs are probably a late successional stage following tussock tundra on high centered polygons.

In 2013, an extensive literature search was done by Fire Effects Information System staff to locate information for a synthesis on fire regimes of Alaskan tundra communities (Innes 2013). The synthesis reported that fire frequency varies geographically and with community composition (Innes 2013). Dry upland sites (including high-centered polygons, see Racine 1979) generally burning more severely than moist lowland sites (Innes 2013).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement |  |  |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires |  |  |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Large patch to Matrix-forming.

Adjacency or Identification Concerns

Issues or Problems

Most of the fire regime literature available for tundra ecosystems in Alaska is from the Seward Peninsula and Noatak River Watershed where fire occurs more frequently than other regions of the state (Innes 2013). Little is known about fire history in arctic tundra communities in northern and northwestern Alaska (Innes 2013).

Native Uncharacteristic Conditions

According to Innes 2013: “Because most of the area occupied by tundra in Alaska is sparsely populated and has little road access, fire regimes in tundra may not differ much from historical regimes [Chapin et al. 2000; DeWilde and Chapin 2006; Heinselman 1981]. As of 2006, about 66% of interior Alaska was considered to have an essentially "natural" fire regime, with few human ignitions, negligible suppression activity, and many large, lightning-caused fires.” Innes 2013 provides information about climate change and Alaska tundra communities.

Comments

In 2021 NatureServe merged Alaska Arctic Polygonal Ground Mesic Shrub Tundra (BpS 1700), Alaska Arctic Polygonal Ground Tussock Tundra (BpS 1707), and Alaska Arctic Polygonal Ground Shrub-Tussock Tundra (BpS 1708) into one Ecological System: North American Arctic Polygonal Ground Shrub and Tussock Tundra. These BpS were lumped for BpS modeling during LANDFIRE National, but Pat Comer and Kori Blankenship updated the description document to reflect the new Ecological System concept.

During LANDFIRE National this model was created by Kori Blankenship and Keith Boggs based on the draft Arctic Ecological Systems description. Minor additions were made to the description as a result of review comments.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | A | A | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | A | A | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | A | A | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | A | A | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | A | A | UN | UN | UN | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 100 Mid Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | *Betula nana* | Dwarf birch | Upper |
| SAPU15 | *Salix pulchra* | Tealeaf willow | Upper |
| ERVA4 | *Eriophorum vaginatum* | Tussock cottongrass | Upper |
| CABI5 | *Carex bigelowii* | Bigelow's sedge | Upper |

Description

Polygonal ground shrub-tussock tundra community.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Mid1:ALL | 0 | Mid1:ALL | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |

References

Chapin, F. S., III; McGuire, A. D.; Randerson, J.; Pielke, R., Sr.; Baldocchi, D.; Hobbie, S. E.; Roulet, N.; Eugster, W.; Kasischke, E.; Rastetter, E. B.; Zimov, S. A.; Running, S. W. 2000. Arctic and boreal ecosystems of western North America as components of the climate system. Global Change Biology. 6(Supplement 1): 211-223.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, C. Nordman, M. Pyne, M. Reid, M. Russo, K. Schulz, K. Snow, J. Teague, and R. White. 2003-present. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe, Arlington, VA.

DeWilde, La'ona; Chapin, F. Stuart, III. 2006. Human impacts on the fire regime of interior Alaska: interactions among fuels, ignition sources, and fire suppression. Ecosystems. 9(8): 1342-1353.

Heinselman, Miron L. 1981. Fire intensity and frequency as factors in the distribution and structure of northern ecosystems. In: Mooney, H. A.; Bonnicksen, T. M.; Christensen, N. L.; Lotan, J. E.; Reiners, W. A., technical coordinators. Fire regimes and ecosystem properties: Proceedings of the conference; 1978 December 11-15; Honolulu, HI. Gen. Tech. Rep. WO-26. Washington, DC: U.S. Department of Agriculture, Forest Service: 7-57.

Innes, Robin J. 2013. Fire regimes of Alaskan tundra communities. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us

/database/feis/fire\_regimes/AK\_tundra/all.html [2016, June 28].

Nowacki, G., P. Spencer, M. Fleming, T. Brock and T. Jorgenson. 2001. Unified ecoregions of Alaska. U.S. Department of the Interior, U.S. Geological Survey. Open file-report 02-297. 2 page map.

Racine, Charles H. 1979. The 1977 tundra fires in the Seward Peninsula, Alaska: effects and initial revegetation. BLM-Alaska Technical Report 4. Anchorage, AK: U.S. Department of the Interior, Bureau of Land Management, Alaska State Office. 51 p.

Racine, Charles; Allen, Jennifer L.; Dennis, John G. 2006. Long-term monitoring of vegetation change following tundra fires in Noatak National Preserve, Alaska. Report No. NPS/AKRARCN/NNTR-2006/02. Fairbanks, AK: U.S. Department of the Interior, National Park Service, Alaska Region, Arctic Network Inventory and Monitoring Program. 37 p.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. General Technical Report PNW-GTR286. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 278 pp.