17040

Alaska Arctic Permafrost Plateau Dwarf-Shrub Lichen Tundra

BpS Model/Description Version: Nov. 2024

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| --- | --- | --- | --- |
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Vegetation Type

Upland Shrubland

Map Zones

68, 72

Geographic Range

This Biophysical Setting (BpS) is found in arctic AK on the Yukon-Kuskokwim Delta and the Kotzebue Sound lowlands ecoregions (Nowacki et al. 2001) but not on the Beaufort Coastal Plain.

Biophysical Site Description

This system occurs on flat permafrost plateaus and gently sloping terrain (Talbot et al. 1985; Jorgenson et al. 1997; Boggs et al. 2008). Soils are poorly drained and acidic, typically with a well-developed peat layer (Boggs et al. 2008). Permafrost is present.

Vegetation Description

Dwarf and low-shrub cover is >25% and lichen cover is >25%. Fruticose lichen species (e.g. *Cladina* and *Cladonia* spp.) co-dominate with *Betula nana* and *Ledum palustre* ssp. *decumbens*. Other possible shrubs include *Empetrum nigrum, Chamaedaphne calyculata, Vaccinium uliginosum, Salix pulchra, Spiraea stevenii, Vaccinium vitis-idaea* and *Arctostaphylos* spp. Graminoids usually have <10% cover and may include *Eriophorum* spp., *Carex aquatilis* and *Carex microchaeta*.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| CLADI3 | *Cladina spp.* | Reindeer lichen |
| CLADO3 | *Cladonia spp.* | Cup lichen |
| BENA | *Betula nana* | Dwarf birch |
| LEPAD | *Ledum palustre ssp. decumbens* | Marsh labrador tea |
| EMNI | *Empetrum nigrum* | Black crowberry |
| CHCA2 | *Chamaedaphne calyculata* | Leatherleaf |
| VAUL | *Vaccinium uliginosum* | Bog blueberry |
| SAPU15 | *Salix pulchra* | Tealeaf willow |

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

Disturbance Description

This system generally occurs as a late-seral stage created by permafrost uplift within the thaw pond cycle (described below) but could also develop due to permafrost uplift outside the thaw-pond cycle (Boggs et al. 2008). Experts at the Arctic Modeling Meeting (April 08) recommended modeling this type independent from the thaw pond cycle because of the long duration of the seral stages within the cycle and because it can occur outside of that cycle.

This is a late-seral stage in the thaw pond cycle which starts with the collapse of a permafrost plateau resulting in a wet depression often with open water. This is colonized by marsh species or Sphagnum species or a combination of both. Sedges eventually invade, and the wet sedge-Sphagnum system develops. If organic matter buildup or permafrost uplift the surface, then this system may be seral to the dwarf-shrub-Sphagnum system. In turn, this system may be seral to the permafrost plateau-dwarf-shrub-lichen system. The seral sequence may not be unidirectional, and the timeframe is unclear, possibly taking hundreds of years.

Charcoal sediment-based estimates of fire frequency for the Yukon-Kuskokwim Delta for low-shrub tundra vary from 141 to nearly 5,904 years (Sae-Lim et al. 2019).

Fire regime syntheses conducted by Fire Effects Information Systems staff for Alaskan tundra communities (Innes 2013) and wet and mesic herbaceous communities (Innes 2015) contain information on historical and contemporary fire regimes relevant to this BpS. The tundra review notes that lichens can establish within a few years post-fire, but recovery can take more than 100 years on severely burned sites (Innes 2013). Labrador tea and dwarf birch can sprout readily after fire (Innes 2013). Innes 2015 found little published information on fire frequency in herbaceous peatlands of Alaska.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 498 | 100 |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 498 | 100 |  |  |

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

Small to large patch.

Adjacency or Identification Concerns

Issues or Problems

Fire history studies in Alaskan wet and mesic herbaceous systems are scarce, and our knowledge is incomplete (Innes 2015). Participants in the virtual Tundra Work Session held in the winter 2022 indicated that fire frequencies for tundra vary considerably across its geographic range and that the fire regime may be driven more by the climate than the vegetation or fuel type.

LANDFIRE models estimated the portions of replacement, surface, and mixed-severity fires likely in wet and mesic herbaceous BpSs but did not include ground fire, which is an integral fire type in many wet and mesic herbaceous systems.

Native Uncharacteristic Conditions

Innes 2013 and 2015 include sections on Contemporary Changes in Fuels and Fire Regimes relevant to this BpS.

Comments

1/2023 Kori Blankenship added replacement fire to the model based on reviewer feedback. Existing estimates for fire frequency in this BpS vary widely making it difficult to choose a replacement fire frequency for the model.

10/2021 This description was updated by NatureServe staff and Kori Blankenship based on the updated Ecological Systems classification for Alaska. Edits focused on adjusting the Geographic Range, Biophysical Site Descriptions, and Vegetation Description sections.

For LANDFIRE National, this model was created by Kori Blankenship and Keith Boggs based input from experts who attended the LANDFIRE Arctic Modeling Meeting (April 2008) and the draft Arctic Ecological Systems description (Boggs et al. 2008).

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 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | 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** |
| CLADI3 | *Cladina* spp. | Reindeer lichen | Upper |
| CLADO3 | *Cladonia* spp. | Cup lichen | Upper |
| BENA | *Betula nana* | Dwarf birch | Upper |
| LEPAD | *Ledum palustre* ssp*. decumbens* | Marsh labrador tea | Upper |

Description

Immediately post-fire, deciduous shrubs and graminoids begin to recover. Shrub cover returns to pre-burn levels about 10 years after fire (Frost et al. 2020). Lichens continue to increase with time but may not reach pre-burn levels more than 40 years post fire (Frost et al. 2020).

*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** |
| Replacement Fire | Mid1:ALL | Mid1:ALL | 0.002 | 500 | Yes | 0 |

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