16822

North American Arctic Scrub Birch-Ericaceous Shrubland - Infrequent Fire

BpS Model/Description Version: Nov. 2024

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| --- | --- | --- | --- |
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Reviewer: Robin Innes

Vegetation Type

Shrubland

Map Zones

67, 68, 69, 70, 71, 72, 73, 74, 76

Model Splits or Lumps

This Biophysical Setting (BpS) was split into frequent and infrequent fire variants so regional differences in fire frequency could be represented. The frequent fire variant applies to map zone 68 within level 2 ecoregions (Nowacki et al. 2001): Intermontane Boreal and Bering Tundra. In all other areas the infrequent fire variant applies.

Geographic Range

This BpS is found in arctic AK except within ecoregions 4, 5, 7 and south of the Brooks Range in ecoregion 3 (Nowakii et al. 2001). It is also found in MZ76.

Biophysical Site Description

This system is found on mesic mountain and hill slopes and flats predominantly above treeline. The soils are mesic and generally mineral with a well-decomposed organic layer (Viereck et al. 1992, II.C.2.c). Permafrost is normally present (Viereck et al. 1992, II.C.2.c).

Vegetation Description

The following information was slightly modified from the draft Arctic Ecological Systems description (Boggs et al. 2008):

The total low- and tall-shrub cover is >25%, and *Betula nana, Vaccinium uliginosum* or *Ledum palustre* ssp*. decumbens* typically dominate or co-dominate. *Salix* spp. (such as *Salix pulchra*) do not dominate but may co-dominate. This system does not include tussock-dominated (>35% tussocks) sites. Dwarf-shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low-shrub layer. Herbaceous species are sparse but may include *Arctagrostis latifolia, Poa arctica, Senecio congests,* and *Carex bigelowii*. Feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*) and lichens may be common.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| BENA | *Betula nana* | Dwarf birch |
| VAUL | *Vaccinium uliginosum* | Bog blueberry |
| LEPAD | *Ledum palustre ssp. decumbens* | Marsh labrador tea |
| SAPU15 | *Salix pulchra* | Tealeaf willow |
| SABA3 | *Salix barclayi* | Barclay's willow |
| EMNIN | *Empetrum nigrum ssp. nigrum* | Black crowberry |
| VAVI | *Vaccinium vitis-idaea* | Lingonberry |
| HYSP70 | *Hylocomium splendens* | Splendid feather moss |

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

Disturbance Description

Expert input at the Arctic Modeling meeting (April 08) estimated a mean fire return interval (MFRI) for this type of about 1000yrs. Racine et al. (1983) found a MFRI of 612yrs for Noatak River watershed (all vegetation types) based on post-1900 records. Racine et al (1985) found a 611yr fire rotation for Noatak River watershed (all vegetation below 600m which is predominantly tundra) based on post-1900 records.

In 2013 an extensive search was done by FEIS staff to locate information for a synthesis on fire regimes of Alaskan tundra communities (Innes 2013). This synthesis found that studies providing information on fire frequency in tundra ecosystems generally do not differentiate among plant communities and that for tundra types MFRIs from 50 to >1,000 years were reported (Innes 2013). When fires burn, stand-replacing crown fires are common (Innes 2013).

Viereck et al. (1992) indicated that this community appears to be stable over time (Viereck et al. 1992, II.C.2.c) but this model includes successional dynamics related to infrequent fire.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 252 | 100 |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 252 | 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

Large patch or matrix

Adjacency or Identification Concerns

This type tends to grade into tussock shrub communities as moisture increases or dwarf shrub fellfields as moisture decreases with wind exposure (Viereck et al. 1992, II.C.2.c).

Issues or Problems

Experts at the Arctic meeting agreed on the model classes, but they noted that there is no solid data to support either fire frequencies or the frequency of open vs. closed classes. In this draft model, alternate succession probabilities were set to create a ratio of open to closed classes that approximately matched Torre Jorgenson's estimate that this type would be 20% closed in the Seward/Yukon-Kuskokwim Delta regions (frequent fire model) and 5% closed on the North Slope (infrequent fire model).

To attain the landscape percentages desired, modelers had to use a very low alternate succession probability. A better solution would have been to restrict the age at which alternate succession can occur to around age 25, since it is expected that most sites will close in at that age or not at all. But this solution violates LANDFIRE modeling rules, so modelers used a very low probability of alternate succession instead.

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

The current conditions should be similar to the reference condition. 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 2015, reviewer Innes suggested that the geographic range for the Alaska Arctic Scrub Birch-Ericaceous Shrubland - Infrequent Fire and Alaska Arctic Scrub Birch-Ericaceous Shrubland - Frequent Fire models should be re-evaluated. Reviewer feedback is needed to refine the geographic range of the frequent and infrequent fire model variants.

During LANDFIRE National, this system was created for the AK Arctic region and did not receive review for other regions in the state. This model was based on input from the experts who attended the LANDFIRE National Fairbanks Arctic (April 08) modeling meeting and refined by Colleen Ryan, Kori Blankenship, and Keith Boggs.

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 | B | B | B | B | B | B | B | C | C | C |
| Shrub | 0.5-1.0 | B | B | B | B | B | B | B | C | C | C |
| Shrub | 1.0-3.0 | B | B | B | B | B | B | B | C | C | C |
| Shrub | >3.0 | B | B | B | B | B | B | B | C | C | C |
| Tree | 0-5 | B | B | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | B | B | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | B | B | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | B | B | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | B | B | 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 2 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| FEAL | *Festuca altaica* | Altai fescue | Upper |
| HIAL3 | *Hierochloe alpina* | Alpine sweetgrass | Upper |
| CACA4 | *Calamagrostis canadensis* | Bluejoint | Upper |
| CHAN9 | *Chamerion angustifolium* | Fireweed | Upper |

Description

After fire, herbaceous species such as *Festuca altaica* and *Hierochloe alpina* typically dominate. This class may persist for more than 5yrs (up to 25yrs) on some sites, but this possibility was not included in this draft of the model.

*Maximum Tree Size Class*  
None

Class B 75 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | *Betula nana* | Dwarf birch | Upper |
| VAUL | *Vaccinium uliginosum* | Bog blueberry | Upper |
| LEPAD | *Ledum palustre* ssp*. decumbens* | Marsh labrador tea | Upper |
| SALIX | *Salix* spp. | Willow | Upper |

Description

This class represents an open shrub class. Under appropriate conditions, the canopy can close around age 25, causing a transition to Class C, but most sites will remain open indefinitely. This class is dominated by shrubs, often *Betula nana. Vaccinium uliginosum, Ledum decumbens, Salix pulchra, S. barclayi*, or other *Salix* spp. may also be common (Viereck 1979, Viereck et al. 1992). Dwarf shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low shrub layer.

*Maximum Tree Size Class*  
None

Class C 23 Late Development 2 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | *Betula nana* | Dwarf birch | Upper |
| VAUL | *Vaccinium uliginosum* | Bog blueberry | Upper |
| LEPAD | *Ledum palustre* ssp*. decumbens* | Marsh labrador tea | Upper |
| SALIX | *Salix* spp*.* | Willow | Upper |

Description

This class represents a mature closed canopy shrub stage that may occur on a minority of sites where conditions are appropriate. The canopy will close in around age 25. This class is dominated by shrubs, often *Betula nana. Vaccinium uliginosum, Ledum decumbens, Salix pulchra, S. barclayi,* or other *Salix* spp. may also be common (Viereck 1979; Viereck et al. 1992). Dwarf shrubs such as *Empetrum nigrum* and *Vaccinium vitis-idaea* may be common under the low shrub layer.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Late1:OPN | 4 |
| Late1:OPN | 5 | Late1:OPN | 999 |
| Late2:CLS | 25 | Late2:CLS | 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 | Early1:ALL | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Alternative Succession | Late1:OPN | Late2:CLS | 0.0012 | 833 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |

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