16821

North American Arctic Scrub Birch-Ericaceous Shrubland - Frequent Fire

BpS Model/Description Version: Nov. 2024

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

Vegetation Type

Shrubland

Map Zones

68

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 within Nowakii et al. (2001) ecoregions 4, 5, 7 and the south side of the Brooks Range (ecoregion 3).

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 dominates or co-dominates. *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 include *Arctagrostis latifolia, Poa arctica, Senecio congestus,* 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

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, mean fire-return intervals from 50 to >1,000 years were reported (Innes 2013). When fires burn, stand-replacing crown fires are common (Innes 2013).

Selected fire return interval estimates for this BpS include:

-There is little information about fire regimes in the arctic region of Alaska (Viereck and Schandelmeier 1980).

-According to lake-core records, the fire-return interval is approximately 240yrs on the Seward Peninsula, and 1,000yrs+ on the Beaufort Coastal Plain (Jennifer Allen pers. comm.).

-260yr (s.d. 170) fire return interval for past 1500yrs for Noatak National Preserve (preliminary data from Higuera et al. 2008)

-612yrs for Noatak River watershed (all vegetation types; Racine et al. 1983, based on post-1900 records)

-611yr fire rotation for Noatak River watershed (all vegetation below 600m which is predominantly tundra; Racine et al. 1985, based on post-1900 records)

Racine et al. (1987) studied low shrub tundra post-fire vegetation recovery on the Noatak and Seward Peninsulas and found the following:

-Postfire increases in soil thaw in tussock tundra stabilized or returned to pre-fire levels within 5-6yrs.

-Bryophyte cover increased rapidly, reaching 75-100% in 2-3 yrs.

-Dominant species, not present in unburned low shrub tundra, included *Ceratodon purpureus, Marchantia polymorpha, Polytricum* spp*., Arctagrostis latifolia, Poa arctica, Senecio congests,* and *Carex bigelowii* became established.

-Shrub recovery ranged from nearly 0-100% within in eight years, with willows recovering at one site.

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

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 559 | 100 |  |  |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 559 | 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 forming.

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).

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

11/2024: K. Blankenship changed the model to ensure at least 1% in class A. This changed the all FRI from 906 years to 555 years.

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.

For LANDFIRE National, this model was based on input from the experts who attended the LANDFIRE 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 1 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. Low shrubs can resprout following fire, quickly regaining dominance of a site. This class may persist for more than 5yrs if fire severity is high enough to remove the organic layer.

*Maximum Tree Size Class*  
None

Class B 88 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 stage. 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,* orother *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 11 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 class 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 | 0.001 | 1000 | Yes | 0 |
| Alternative Succession | Late1:OPN | Late2:CLS | 0.0001 | 10000 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0018 | 556 | Yes | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |

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