16300

Western North American Boreal Wet Black Spruce-Tussock Woodland

BpS Model/Description Version: Nov. 2024

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| **Modelers** |  | **Reviewers** |  |
| Kori Blankenship | kblankenship@tnc.org | Lisa Saperstein | Lisa\_Saperstein@fws.gov |
| Robert Lambrecht | Robert\_Lambrecht@fws.gov | Stuart Chapin | fffsc@uaf.edu |
| None | None | None | None |

Reviewer: Lindsey Flagstad, Janet Fryer, Blaine T. Spellman, Anjanette Steer

Vegetation Type

Forest and Woodland

Map Zones

68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78

Geographic Range

This Biophysical Setting (BpS) is found throughout interior Alaska from the southern slopes of the Brooks Range to southcentral AK (but not including the boreal transition) and west to the limit of coniferous tree growth (NatureServe 2008, Viereck 1983).

Biophysical Site Description

This BpS is found on north-facing slopes, gentle hills, and inactive alluvial surfaces underlain by shallow and ice-rich permafrost (NatureServe 2008; Viereck et al. 1992). Soils are poorly drained and consist of tussocks over peat or mineral soil (Jorgenson et al. 2001; Boggs and Sturdy 2005). Shallow, ice-rich permafrost retards the infiltration of surface water causing soil saturation and ponding. Active layer depth (i.e., depth of seasonal thaw) ranges from 20-40 inches below the ground surface. The live moss, duff, and organic soil layers may be up to 20 inches (50 cm) thick (Viereck 1973). In the Yukon Flats region, the surrounding hills partially isolate the *Picea mariana* lowlands from weather systems that moderate the climate of other regions of Interior Alaska. Comparatively warmer summers and cooler winters maintain a cold and continuous distribution of permafrost, which supports the development of black spruce tussock tundra.

Vegetation Description

A woodland system with *Picea mariana* is the dominant tree species. Permafrost soils often result in the stunted and chlorotic growth of black spruce. The tussock-forming sedge *Eriophorum vaginatum* contributes at least 25% of the vegetation cover (NatureServe 2008). Common understory shrubs include *Betula nana* (including *B. glandulosa*), *Chamaedaphne calyculata, Empetrum nigrum, Ledum palustre* ssp*. decumbens, Ledum groenlandicum, Vaccinium uliginosum* and *V. vitis-idaea*. Less common shrubs include *Alnus viridis* ssp*. crispa, Salix pulchra,* and *S. arbusculoides*. Associated herbaceous species include *Carex bigelowii* and *Rubus chamaemorus* (NatureServe 2008; Foote 1983; NMSU 2022). Mosses and lichens are usually abundant in the ground layer (Jorgenson et al. 2001; Boggs and Sturdy 2005). Dominant mosses include *Sphagnum* spp., *Hylocomium splendens, Tomentypnum nitens, Pleurozium* *schreberi, Polytrichum juniperinum,* and *Ptilium crista-castrensis*. Dominant lichens include *Cladonia* spp. and *Peltigera aphthosa* (Viereck 1983; Viereck et al. 1992).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIMA | *Picea mariana* | Black spruce |
| BENA | *Betula nana* | Dwarf birch |
| LEPAD | *Ledum palustre ssp. decumbens* | Marsh Labrador tea |
| VAUL | *Vaccinium uliginosum* | Bog blueberry |
| VAVI | *Vaccinium vitis-idaea* | Lingonberry |
| ERVA4 | *Eriophorum vaginatum* | Tussock cottongrass |
| CABI5 | *Carex bigelowii* | Bigelow's sedge |
| RUCH | *Rubus chamaemorus* | Cloudberry |

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

Disturbance Description

Fire is the primary disturbance in this system (Foote 1983). Fire severity is generally sufficient to kill the overstory (Foote 1983; Lutz 1956; Todd and Jewkes 2006) and follows two basic scenarios – low and high severity burns.

It has been noted that fires in this type of system in the Yukon Flats region are thought to be more complex (Johnstone et al. 2008). Lethal surface fire can occur alone but is most common in combination with crown fire. The soil organic layer is often consumed during crown and lethal surface fires (Johnstone 2003; Lutz 1960; Viereck 1983; Wein 1983). High combustion of the organic layer (high fire severity) led to increased densities of deciduous seedlings but not black spruce and had a positive influence on aboveground biomass of all species (Johnstone et al. 2020).

Low severity fires, however, only remove the non-graminoid cover and the disturbance provides nutrients for tussocks, and tussocks become more productive (Viereck et al. 1992). Generally, black spruce is successful at replacing itself after fire on moister sites and sites burned at a low or moderate severity level where some level of organic layer is left unconsumed (Johnstone et al. 2010). Much of the land that burned in the 2004 Taylor Complex Fire region of interior AK are black spruce communities. Research between 2005 and 2016 in this fire complex showed low severity burn sites generally had the highest woody fuel loading and understory community composition correlated with multiple factors including moss depth, canopy cover, elevation, and aspect (Hammond et al. 2019).

In a literature review, Fryer (1994a) reported mean fire return intervals (MFRI) of 73-113 years from fire history studies in boreal AK black spruce communities (Drury and Grissom 2008; Fastie et al. 2002; Kasischke et al. 2008; Kurkowski et al. 2008; Lloyd et al. 2005; Yarie 1981). Detailed information about fire disturbance in this BpS can be found in the “Fire regimes of Alaskan black spruce communities” (Fryer 2014a) and “*Picea mariana*” species review (Fryer 2014b).

Under appropriate conditions, this system can originate from a very late seral stage of the Boreal Black Spruce Dwarf-tree Peatland system.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 115 | 87 |  |  |
| Moderate (Mixed) | 773 | 13 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 100 | 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 (small patch)

Adjacency or Identification Concerns

This system tends to occur on a continuum between the Boreal Black Spruce Dwarf-tree Peatland system and the Boreal Low Shrub-Tussock Tundra system. Boreal Wet Black Spruce-Tussock Woodland occurs on sites that are slightly drier than tussock-shrub sites and slightly lower and wetter than wet black spruce sites.

The herb and shrub classes of this system are similar in structure and composition to the herb and shrub classes of the Boreal Low Shrub-Tussock Tundra system, but the Boreal Low Shrub-Tussock Tundra system occurs where site conditions prevent trees from invading.

Issues or Problems

With information dating back to the 1940s, Alaska’s fire history records provide limited information on recent fire history (Viereck and Schandelmeier 1980).

Native Uncharacteristic Conditions

Comments

This BpS concept is similar to the Ecological Site Description: [Boreal Woodland Loamy Frozen Plain Wet](https://edit.jornada.nmsu.edu/catalogs/esd/232X/XA232X02Y217) (ECOLOGICAL SITE XA232X02Y217).

The modeled fire severity in this BpS is mostly replacement severity because LANDFIRE defines replacement severity as >75% top-kill of the upper layer lifeform. Some reviewers of this system described the severity as low because fire generally killed the trees but did not kill the tussocks or ericaceous shrubs.

2022 - Attendees of the Boreal Forest BpS Review Work Session in February 2022 agreed that a fire frequency of approximately 100 years was appropriate for this BpS.

2015 - Fryer noted that the original modeled All Fire MFRI of 124 years was outside of the range found in the literature (i.e. 73-113 years). Blankenship adjusted the replacement fire frequencies, resulting in an All Fire MFRI of 100 years.

More information on black spruce forest can be found in the Fire Effects Information System Synthesis: [Fire regimes of Alaskan black spruce communities](http://www.fs.fed.us/database/feis/fire_regimes/AK_black_spruce/all.html) (Fryer 2014a); and in the species review: [Picea mariana](http://www.fs.fed.us/database/feis/plants/tree/picmar/all.html) (Fryer 2014b).

During LANDFIRE National, this model was created for the boreal region of AK and did not receive review for other parts of the state. This model was based on input from the experts who attended the LANDFIRE Fairbanks (Nov. 07) modeling meeting and refined by Robert Lambrecht. Torre Jorgenson provided some information on the relationships between this system and adjacent systems.

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 | B | B | B |
| Shrub | 0.5-1.0 | B | B | B | B | B | B | B | B | B | B |
| Shrub | 1.0-3.0 | B | B | B | B | B | B | B | B | B | B |
| Shrub | >3.0 | B | B | B | B | B | B | B | B | B | B |
| Tree | 0-5 | C | C | C | C | C | C | C | C | C | C |
| Tree | 5-10 | C | C | C | C | C | C | C | C | C | C |
| Tree | 10-25 | C | C | C | C | C | C | C | C | C | C |
| Tree | 25-50 | C | C | C | C | C | C | C | C | C | C |
| Tree | >50 | C | C | C | C | C | C | C | C | C | C |

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 8 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ERVA4 | *Eriophorum vaginatum* | Tussock cottongrass | Upper |
| CABI5 | *Carex bigelowii* | Bigelow's sedge | Upper |
| RUCH | *Rubus chamaemorus* | Cloudberry | Upper |

Description

This class is characterized by tussock forming sedges. Common species include *Eriophorum vaginatum, Carex bigelowii* and *Rubus chamaemorus.*

*Maximum Tree Size Class*  
None

Class B 27 Mid Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | *Betula nana* | Dwarf birch | Upper |
| LEPAD | *Ledum palustre* ssp*. decumbens* | Marsh Labrador tea | Upper |
| VAUL | *Vaccinium uliginosum* | Bog blueberry | Upper |
| VAVI | *Vaccinium vitis-idaea* | Lingonberry | Upper |

Description

Shrubs resprout quickly after fire, becoming the dominant, upper-level canopy layer in 6-25 years (Viereck 1983). Common species include *Betula nana, Ledum palustre* ssp*. decumbens*., *Vaccinium uliginosum* and *V. vitis-idaea.*

*Maximum Tree Size Class*  
Seedling/Sapling <5"

Class C 65 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMA | *Picea mariana* | Black spruce | Upper |
| BENA | *Betula nana* | Dwarf birch | Lower |
| LEPAD | *Ledum palustre* ssp*. decumbens* | Marsh Labrador tea | Lower |
| VAUL | *Vaccinium uliginosum* | Bog blueberry | Lower |

Description

This class is characterized by mature black spruce tussock forest (spruce cover generally 10-25%; tussock cover >25%). Overstory is dominated by *Picea mariana*. It is during this class when organic material begins to accumulate and a distinctive “active layer” appears, affecting fire behavior depending upon how dry it gets.

*Maximum Tree Size Class*  
Pole 5–9" (swd)/5–11" (hwd)

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:ALL | 9 |
| Mid1:ALL | 10 | Late1:OPN | 49 |
| Late1:OPN | 50 | Late1:OPN | 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 | 0.0087 | 115 | Yes | 0 |
| Replacement Fire | Mid1:ALL | Early1:ALL | 0.0087 | 115 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.002 | 500 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0087 | 115 | Yes | 0 |

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