16013

Western North American Boreal Treeline White Spruce-Hardwood Woodland - Hardwood

BpS Model/Description Version: Nov. 2024

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

Forest and Woodland

Map Zones

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

Model Splits or Lumps

This Biophysical Setting (BpS) is split into multiple models:

This BpS was split into Boreal and Boreal Transition variants so that regional differences in disturbance regimes could be modeled. The Hardwood split represent areas where hardwoods dominate.

Geographic Range

The geographic range of this Biophysical Setting (BpS) extends from the Brooks Range in the north, to the Alaska Range in the south and west along the Seward Peninsula, Nulato Hills, Kuskokwim Mountains, and Aleutian Range. *Populus balsamifera* is the northernmost tree species in North America (Saarela et al. 2012) and as such forms small stands at the elevational, latitudinal, and western limits of tree growth in Alaska. This BpS occurs beyond the coniferous treeline in western and northern Alaska. This BpS is not common in the Kenai Mountains where mountain hemlock dominates treeline forest types, but it may be found in western Kenai highlands between Skilak and Tustemena lakes and in higher elevations of Caribou Hills north of Homer. In MZ76 this BpS is found in Nowacki ecoregions 8, 9 and 10. This BpS description and model focuses on the boreal region.

Biophysical Site Description

This BpS occurs on upland terrain at treeline. The system extends to the alpine on southerly aspects and into the Arctic along river valleys. Specifically in the Arctic, this alliance occurs in isolated stands associated with north-flowing rivers, primarily braided streams, and aufeis deposits (Bockheim et al. 2003). It also occurs infrequently on south-facing slopes in the foothills of the Brooks Range (Breen 2014). The mean balsam poplar absolute canopy cover is approximately 50%, mean height is 9.76m, and mean tree diameter is 14.26 cm.

Soils are generally well-drained, unmodified cryofluevents lacking permafrost in the boreal forest and with deep active layers in the Arctic (Viereck et al. 1992; Ping et al. 1998). These soils develop on colluvial deposits, glacial till, or bedrock. At the limits of their occurrence, *P. balsamifera* survival has been connected to sheltered sites and the presence of year-round groundwater (e.g. perennial springs).

Vegetation Description

*Populus balsamifera* ssp*. balsamifera* and/or *P. tremuloides* are the dominant overstory species. Trees are often stunted on exposed sties (Jorgenson et al. 2003). Plots from Denali National Park showed an average tree height of 2.4 meters for Dwarf Poplar Aspen Forest (Clark and Duffy 2006). Moist sites are conducive to *Populus balsamifera* establishment where more well drained sites are dominated by *P. tremuloides*. Common understory shrubs include *Viburnum edule, Rosa acicularis, Arctostaphylos* spp., and *Salix* spp. A wide variety of herbaceous species may occur including *Calamagrostis canadensis, Pyrola* spp., and *Aconitum delphinifolium* (Viereck 1979; Jorgenson et al. 2003).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| POBA2 | *Populus balsamifera* | Balsam poplar |
| POTR5 | *Populus tremuloides* | Quaking aspen |
| VIED | *Viburnum edule* | Squashberry |
| ROAC | *Rosa acicularis* | Prickly rose |
| ARCTO3 | *Arctostaphylos* | Manzanita |
| SAAL | *Salix alaxensis* | Feltleaf willow |
| CACA4 | *Calamagrostis canadensis* | Bluejoint |

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

Disturbance Description

The disturbance dynamics of these high elevation forests are unclear but wind/exposure and fire could be driving disturbance process as well as steep talus slopes that are not conducive to soil retention and development. Steep slopes with poor rooting substrate are prone to landslide and avalanche.

Balsam poplar and quaking aspen are fire adapted. Balsam poplar may be top killed by moderate intensity fires but can root sprout within several weeks following fire (Harris 1990). Aspen is also easily top killed by fire, but fire stimulates vigorous root sprouting (Howard 1996). Topographic roughness leads to lower probability of an area burning (Hammond et al. 2019) so it is likely that those hardwood stands at treeline in more mountainous terrain will have a longer fire return interval (FRI).

In general, species dominance in the boreal forest post fire will shift along different trajectories according to variation in underlying landscape attributes (Johnstone and Chapin 2006; Kane et al. 2007; Johnstone et al. 2010; Roland et al. 2013). In this BpS, steep slopes and southern aspect are key landscape attributes that affect fire behavior and resulting plant community succession. For example, south-facing slopes are more productive due to their deeper active layer, leading to mostly white spruce stands with mixed hardwoods at the treeline. North-facing slopes commonly have continuous permafrost and don’t receive the warmth needed to support treeline hardwood stands. These communities where tree species occur are woodlands dominated by *Picea mariana* with a *Ledum* ssp. *decumbens/Betula nana* understory.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 1183 | 18 |  |  |
| Moderate (Mixed) | 258 | 82 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 212 | 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 small patch

Adjacency or Identification Concerns

Issues or Problems

This model was defined at the Fairbanks workshop as having an additional early seral stage dominated by alpine tundra shrubs, herbaceous vegetation, or bare ground. This class was described as a persistent state occurring on sites frequently disturbed by avalanches or other weather events (snow, ice, wind, etc). It was later determined that this stage could not be adequately modeled with the two tree dominated stages (Class A and B in the current model) and that it was probably best to represent the non-forested sites as a different BpS.

It seems that the extent of this BpS is narrowly limited to boreal forest southern slopes at treeline (and some north of the Brooks Range north facing riverbeds, which could be described with GIS by looking at average coniferous treeline, masking out the slopes greater than 35 degrees (?) and defining this narrow band through spectral signature of the broadleaf species.

Native Uncharacteristic Conditions

Comments

9/13/2022:

- Kori Blankenship adjusted the modeled mean fire return interval (MFRI) from 159 to 208 years based on the relative fire frequency rankings developed for boreal forest BpS during the Boreal Forest BpS Review Work Session in February 2022. The change in fire frequency changed the succession class proportions less than +/- 5%.

- A reviewer questioned if *P. tremuloides* belonged in this BpS: “if this is a true treeline community, I question the inclusion of *P. tremuloides*. From Viereck et al. 1979: Quaking aspen *Populus tremuloides* Michx., which is found on the warm and dry sites in interior Alaska (Fig. 2G), is more limited in its regional distribution and never forms part of the arctic or alpine tree”

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.

This system was created during LANDFIRE National for the AK Boreal 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 Fairbanks (Nov. 07) and Anchorage modeling meetings (Dec. 08) and was refined by Mitch Michaud and Michelle Schuman. The probability of fire in the state-and-transition simulation model is a best guess based on the assumption that this type would have a FRI similar to that of tundra types.

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 | A | A | A | A | A | A | A | A |
| Tree | 5-10 | B | B | B | B | B | B | B | B | B | B |
| Tree | 10-25 | B | B | B | B | B | B | B | B | B | B |
| Tree | 25-50 | B | B | B | B | B | B | B | B | B | B |
| Tree | >50 | B | B | B | B | B | B | B | B | B | B |

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 21 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POBA2 | *Populus balsamifera* | Balsam poplar | Upper |
| VIED | *Viburnum edule* | Squashberry | Lower |
| ROAC | *Rosa acicularis* | Prickly rose | Lower |

Description

This class is characterized by young stands of balsam poplar. Trees come in immediately post-disturbance along with the shrubs and herbaceous species. Wind desiccation can delay the development of trees.

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

Class B 79 Late Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POBA2 | *Populus balsamifera* | Balsam poplar | Upper |
| VIED | *Viburnum edule* | Squashberry | Lower |
| ROAC | *Rosa acicularis* | Prickly rose | Lower |

Description

This class is characterized by mature balsam poplar trees with a well-developed understory. Mature stands can be more open than early seral stands (Class A) but not always. Hardwoods begin to senesce after about 150yrs and a mixed age stand develops.

*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 | Late1:ALL | 49 |
| Late1:ALL | 50 | Late1: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** |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.0067 | 149 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.004 | 250 | Yes | 0 |
| Mixed Fire | Late1:ALL | Early1:ALL | 0.005 | 200 | Yes | 0 |

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