16011

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

Model Date: 04/08/08 Report Date: 9/11/15

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |
| None | None | None | None |

Reviewer: Ilana Abrahamson

Vegetation Type

Forest and Woodland

Map Zones

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

Model Splits or Lumps

This BpS is split into multiple models:

This BpS was split into Boreal and Sub-boreal variants so that regional differences in disturbance regimes could be modeled.

Geographic Range

This type is found in boreal AK from the south slopes of the Brooks Range to the north slopes of the Alaska Range and west to the limit of tree growth (including part of MZ76).

Biophysical Site Description

Boreal White Spruce Woodland occurs primarily near the elevational and latitudinal limit of tree growth. It occurs above Boreal White Spruce to 900 m (Boggs et al. 2001) and below the subalpine shrub and tundra systems and can be seen as the forested transition zone between boreal white spruce forest and non-forested subalpine vegetation. Depending on the topography, this system can occupy a narrow band just below non-forested subalpine or a broad expanse across gentle slopes and benches. Soils are cold, but peat-forming mosses are not common in the ground layer.

Vegetation Description

This type is dominated by Picea glauca although Picea mariana may be codominant (NatureServe 2008). Canopy cover is generally between 10-25%. Hardwoods, if present, can include Betula papyrifera and Populs tremuloides. The shrub layer typically features Betula nana, but other shrubs such as Vaccinium uliginosum, Ledum groenlandicum and Salix pulchra may be common or dominant (NatureServe 2008). In some locations Alnus viridis is the dominant understory shrub (NatureServe 2008). Feathermoss may be common in the in the ground layer (NatureServe 2008). On drier or more exposed sites, Cladina spp.replace feathermosses as the dominant ground cover (Viereck 1979).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIGL | Picea glauca | White spruce |
| PIMA | Picea mariana | Black spruce |
| BENA | Betula nana | Dwarf birch |
| VAUL | Vaccinium uliginosum | Bog blueberry |
| LEDUM | Ledum | Labrador tea |
| ALVI5 | Alnus viridis | Green alder |
| SAPU15 | Salix pulchra | Tealeaf willow |
| BEPA | Betula papyrifera | Paper birch |

Disturbance Description

In 2014 an extensive search was done by Fire Effects Information System Staff to locate information for a synthesis on Fire regimes of Alaskan white spruce communities (Abrahamson 2014). The synthesis reported mean fire-return intervals in boreal white spruce forests from about 40 to >250 years, but it is likely that fire was less frequent in treeline communities (Abrahamson 2014). As of 2014 there was no information on fire type, fire severity, fire intensity, fire pattern, or fire size in this BpS (Abrahamson 2014).

A possible scenario for post-fire succession in this type is the resprouting of low shrubs from underground propagules followed by Picea glauca invading by seed from adjacent stands or surviving trees. Betula papyrifera may invade the site if a seed source is available and site conditions are favorable. The typical succession sequence for this type does not include a hardwood sere. The rate of succession depends on severity of fire and seed source, and some sites may be shrub-dominated for long periods without spruce invasion.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 150 |  |  | 69 |
| Moderate (Mixed) | 333 |  |  | 31 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **103** |  |  | **100** |

Scale Description

Large patch

Non-Fire Disturbances

Adjacency or Identification Concerns

Issues or Problems

Native Uncharacteristic Conditions

The frequency and severity of beetle outbreaks will likely increase under a warmer climate. Abrahamson (2014) includes more information about the effects of climate change on white spruce treeline communities.

Comments

REVIEW NEEDED:

-Is Western North American Boreal Subalpine Balsam Poplar-Aspen Woodland BpS a seral stage of this BpS? In 2021 NatureServe merged Western North American Boreal Subalpine Balsam Poplar-Aspen Woodland (BpS 1607) and Western North American Boreal Treeline White Spruce Woodland (BpS 16011-Boreal and 16012-Sub-boreal) into a single Ecological System called Western North American Boreal Treeline White Spruce-Hardwood Woodland. BpS 16011 and 16012 state: “The typical succession sequence for this type does not include a hardwood sere.”

-Should fire be less frequent than modeled in this BpS? [Abrahamson (2014)](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#ClimateChange) states: “Although few studies describe fire regimes in white spruce treeline communities and fire history varies by site, fire frequencies on treeline sites may be lower than modeled by LANDFIRE. LANDFIRE BpS models of the Western North American Boreal Treeline White Spruce Woodland-Boreal (16011 BpS series e.g., [[75](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#75)]) yield a MFRI of 104 years, which may be more frequent than documented by the scarce literature. In interior Alaska, fire frequencies are generally lower at higher elevations due to lower productivity (i.e., less fuel) and less conducive fire weather [[71](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#71),[120](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#120)]. Some studies found very little evidence of fire in white spruce treeline communities (e.g., [[27](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#27),[49](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#49)]). Paleoecological data indicate that fire-return intervals for white spruce forest-tundra were >200 years in the south-central Brooks Range, when the climate was warmer and dryer than it is today [[59](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#59),[60](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#60)].” Review also indicated that with a MFRI around 100 years white

white spruce may have a hard time regenerating at alpine treeline. Abrahamson (2015) states: “Trees at high elevation or latitude may produce few cones and seeds, and these seeds typically have low viability.”

For LANDFIRE National this model was based on input from the experts who attended the LANDFIRE Fairbanks modeling meeting (Nov. 07) and refined by Tricia Wurtz. This BpS was created for the AK Boreal region and did not receive review for other regions in the state.

**Model Parameters**

*Using Track Changes in Word you may suggest changes to any of the parameters indicated in the following tables. If you wish to see how those changes impact model results, go to the “Simulation Model Review Instructions” section on* <http://www.landfirereview.org/models.html>*. If you do not wish to edit and run the actual model, the TNC LANDFIRE will do so and if requested provide the reviewer with the results.*

**Deterministic Transitions**

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Late1:OPN | 24 |
| Late1:OPN | 25 | Late1:OPN | 999 |
| Mid1:OPN | 25 | Late1:OPN | 69 |

**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** |
| ReplacementFire | Early1:ALL | Early1:ALL | 0.0067 | 149 | No | 0 |
| AltSuccession | Early1:ALL | Mid1:OPN | 0.0400 | 25 | Yes | 0 |
| ReplacementFire | Late1:OPN | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| MixedFire | Late1:OPN | Late1:OPN | 0.0033 | 303 | No | 0 |
| ReplacementFire | Mid1:OPN | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| MixedFire | Mid1:OPN | Mid1:OPN | 0.0033 | 303 | No | 0 |

Succession Classes

Class A 10 Early Development 1 - All Structures

Structural Information

Tree Size Class: Seedling/Sapling <5"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | Betula nana | Dwarf birch | Upper |
| VAUL | Vaccinium uliginosum | Bog blueberry | Upper |
| LEGR | Ledum groenlandicum | Bog labrador tea | Upper |
| SAPU15 | Salix pulchra | Tealeaf willow | Upper |

Description

This class is characterized by herbaceous and shrub vegetation. Shrubs resprout from underground propagules and then Picea glauca invades by seed from adjacent stands or surviving trees. The shrub layer typically features Betula nana, but other shrubs such as Vaccinium uliginosum, Ledum groenlandicum and Salix pulchra may be common or dominant. In some locations Alnus viridis is the dominant understory shrub. Feathermoss may be common in the in the ground layer. On drier or more exposed sites, Cladina spp. replace feathermosses as the dominant ground cover (Viereck 1979). The rate of succession depends on severity of fire and seed source, and some sites may be shrub-dominated for long periods without spruce invasion. Hardwoods may invade the site if a seed source is available and site conditions are favorable.

Class B 15 Mid Development 1 - Open

Structural Information

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

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |
| PIGL | Picea glauca | White spruce | Upper |
| PIMA | Picea mariana | Black spruce | Upper |

Description

This class is characterized by hardwood or white spruce-hardwood mixed forest. Betula papyrifera and/or Populs tremuloides invade with or without spruce and gain canopy dominance over the shrubs. Forest canopy cover is generally 10-25%. Eventually hardwoods senesce and white spruce gains canopy dominance (class C).

Class C 75 Late Development 1 - Open

Structural Information

Tree Size Class: Med. 9–20" (swd)/11–20" (hwd)

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIGL | Picea glauca | White spruce | Upper |
| PIMA | Picea mariana | Black spruce | Upper |
| BENA | Betula nana | Dwarf birch | Low-Mid |
| CLADI3 | Cladina | Reindeer lichen | Lower |

Description

This class is characterized by open white spruce woodland. Forest canopy cover is generally 10-25%. Hardwoods, if previously present in the stand, lose dominance in overstory during this phase. The understory may include various combinations of low shrubs, herbs and mosses. Lichens grow as the stand ages. The dominant lichen genus is typically Cladina; species include C. arbuscula, C. mitis, C. rangiferina, and C. stellaris. Other lichens may include Cetraria cucullata, C. islandica, C. nivalis, Bryoria spp., Alectoria nigricans and Alectoria ochroleuca. Beetles affect this class but the rate of outbreaks is uncertain and generally not severe enough to cause a state transition.

References

Abrahamson, Ilana L. 2014. Fire regimes of Alaskan white spruce communities. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/fire\_regimes/AK\_white\_spruce/all.html [2016, May 20].

Abrahamson, Ilana. 2015. Picea glauca, white spruce. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/plants/tree/picgla/all.html [2016, May 20].

Boggs, K., A. Garibaldi, J. Stevens, J. Grunblatt, and T. Helt. 2001. Denali National Park and Preserve Landcover mapping project. Volume 2: Landcover classes and plant associations. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK. 164pp.

Foote, J. M. 1983. Classification, description, and dynamics of plant communities after fire in the taiga of interior Alaska. Res. Pap. PNW-307. Portland, OR. USDA Forest Service. Pacific Northwest Research Station. 108pp.

NatureServe. 2008. International Ecological Classification Standard: Terrestrial Ecological Classifications. Draft Ecological Systems Description for Alaska Boreal and Sub-boreal Regions.

Viereck, L.A. 1979. Characteristics of treeline plant communities in Alaska. Holarctic Ecology. 2:228-238.