16012

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

Model Date: 03/26/08 Report Date: 9/11/15

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

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Vegetation Type

Forest and Woodland

Map Zones

73, 74, 76, 77

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 system occurs throughout the boreal transition region of AK and west to the limit of tree growth. It is not common in the Kenai Mountains, where mountain hemlock dominates treeline forest types, but may be found in western Kenai highlands between Skilak and Tustemena lakes and in higher elevations of Caribou Hills north of Homer.

Biophysical Site Description

This system occurs above the White Spruce zone to 900m (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 gently slopes and benches. This system also occurs at lower elevations at the western limit of white spruce. Soils are cold, but peat-forming mosses are not common in the ground layer (NatureServe 2008).

Vegetation Description

This BpS occurs primarily near the elevational limit and the western limit of tree growth. Forest canopy cover is dominated by white spruce and is generally between 10% and 25% (NatureServe 2008). Picea mariana may be codominant in the overstory. Common shrub species include 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 (NatureServe 2008). On drier or more exposed sites, Cladina spp. replace feathermosses as the dominant ground cover (Viereck 1979). Lichen species may include Cladina arbuscula, C. mitis, C. rangiferina, and C. stellaris, as well as Cetraria cucullata, Cetraria islandica, Cetraria nivalis, Bryoria spp., Alectoria nigricans and Alectoria ochroleuca.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIGL | Picea glauca | White 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 |

Disturbance Description

There is little information about the fire return interval for this type (Abrahamson 2014). White spruce woodlands in the sub-boreal region burn less frequently than those in the interior boreal region (Abrahamson 2014). Experts at the LANDFIRE Anchorage workshop estimated a fire return interval of about 300yrs.

Spruce bark beetle (Dendroctonus rufipennis) infestations are a major natural disturbance affecting this BpS. Beetle outbreaks in spruce forest occurred at an estimated return interval of every 52yrs on the Kenai Peninsula over the past 250yrs (Berg and Scott 2006). Outbreaks that thin stands and produce a growth release in surviving trees occur on average every 50yrs in white and Lutz spruce forests on the Kenai Peninsula (Berg 2004). Spruce bark beetle outbreaks that produce a more substantial thinning occur at longer intervals, with the last two severe infestations occurring in the 1870s-1880s and 1987 –present (Berg 2004). The bark beetle outbreak that began in 1987 on the Kenai Peninsula has killed over 1.3 million acres of spruce (USDA Forest Service 2002). This recent outbreak is associated with warmer than average growing season temperatures that allowed beetles to mature in one year rather than two (Werner and Holsten 1985, Barber et al. 2000 as cited in Werner et al. 2006). Berg (2004) and Berg and Scott (2006) found no association between spruce bark beetle mortality and fire in the past.

When the canopy of these forests is thinned by spruce bark beetle-mortality, bluejoint grass (Calamagrostis canadensis) may proliferate rapidly from its pre-disturbance low level network of rhizomatous roots and may develop into a thick, seedling-excluding sod within a few years (Berg 2004). Boucher (2003) found that rapid spread of Calamagrostis occurs primarily on sites with deep, loamy soils. Boucher and Mead (2006) found that vegetation response varied following the recent outbreak in different geographic locations on the Kenai Peninsula. Some areas exhibited an increase in early seral species (e.g. Calamagrostis canadensis and Chamerion angustifolium); other areas exhibited an increase in late seral mountain hemlock, while in other areas vegetation composition did not shift substantially (Boucher and Mead 2006).

A possible scenario for post-fire succession in this type is the resprouting of low shrubs from underground propagules, followed by invasion of Picea glauca by seed from adjacent stands or surviving trees (NatureServe 2008). Betula papyrifera may invade the site if a seed source is available and site conditions are favorable, but the hardwood phase only occurs on a small fraction of the landscape (may be more common in SW AK). 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 | 397 |  |  | 72 |
| Moderate (Mixed) | 1035 |  |  | 28 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **287** |  |  | **100** |

Scale Description

Large patch

Non-Fire Disturbances

Insects/Disease

Adjacency or Identification Concerns

Adjacent systems may include Alaska Sub-boreal White Spruce-Hardwood Forest or Western North American Boreal Mesic Scrub Birch-Willow Shrubland - Alaska Sub-boreal.

Issues or Problems

Very little information is available on the fire return interval for this type.

Native Uncharacteristic Conditions

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.”

-A reviewer questioned whether the Berg and Scott 2006 estimate for beetle frequency was appropriate for treeline sites? See Disturbance Description.

-A reviewer asks: “Is it odd that the neighboring (and lower elevation) system Alaska Sub-boreal White Spruce-Hardwood Forest (19790) has a much longer modeled MRFI of 625 yrs? Wouldn’t you expect a treeline site to have a longer MFRI due to shorter snow-free season and less fuel?” Is the MFRI of this BpS appropriate relative to the modeled MFRIs of adjacent BpS?

For LANDFIRE National this model was based on input from the experts who attended the LANDFIRE Anchorage modeling meeting (Dec. 07) with additional refinement by Tina Boucher and Kori Blankenship. It is similar to Western North American Boreal Treeline White Spruce Woodland - Boreal but includes insects and disease probability and a less frequent FRI. Beth Schulz reviewed an initial draft of this model. This model did not receive review specifically for z76.

**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 | 0.0025 | 400 | No | 0 |
| AltSuccession | Early1:ALL | Mid1:OPN | 0.0400 | 25 | Yes | 0 |
| ReplacementFire | Late1:OPN | Early1:ALL | 0.0025 | 400 | Yes | 0 |
| Insect/Disease | Late1:OPN | Late1:OPN | 0.0200 | 50 | No | 0 |
| MixedFire | Late1:OPN | Late1:OPN | 0.0010 | 1,000 | No | 0 |
| ReplacementFire | Mid1:OPN | Early1:ALL | 0.0025 | 400 | Yes | 0 |
| MixedFire | Mid1:OPN | Mid1:OPN | 0.0010 | 1,000 | No | 0 |

Succession Classes

Class A 5 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

Post disturbance regeneration: herbaceous to low shrub. 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 present in the in the ground layer.

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. The typical succession sequence for this type does not include a hardwood sere. Betula papyrifera may invade if a seed source is available and site conditions are favorable.

Class B 5 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** |
| PIGL | Picea glauca | White spruce | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| BENA | Betula nana | Dwarf birch | Lower |

Description

Woodland to open hardwood or white spruce-hardwood mix. Tree saplings gain canopy dominance over shrubs. Forest canopy cover is generally 10-25%. Betula papyrifera invades and stands may be either hardwoods or a spruce-hardwood mix.

Class C 90 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 |
| BENA | Betula nana | Dwarf birch | Low-Mid |
| VAUL | Vaccinium uliginosum | Bog blueberry | Low-Mid |
| CLADI3 | Cladina | Reindeer lichen | Lower |

Description

Open white spruce woodland. Site is dominated by mature conifers. 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. Feathermoss are often common in the ground layer. On drier or more exposed sites, Cladina spp. replace feathermosses as the dominant ground cover (Viereck 1979). Lichens may become more common in older stands, with some sites developing into Spruce-Lichen Woodland. Clidina species include C. arbuscula, C. mitis, C. rangiferina, and C. stellaris. Other lichens include Cetraria cucullata, C. islandica, C. nivalis, Bryoria spp., Alectoria nigricans, Alectoria ochroleuca. Insects and disease can thin large overstory trees.

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