16030

**Western North American Boreal Mesic White Spruce-Hardwood Forest**

Model Date: 03/12/08 Report Date: 9/11/15

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

Reviewer: Ilana Abrahamson

Vegetation Type

Forest and Woodland

Map Zones

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

Model Splits or Lumps

BpS Western North American Boreal Spruce-Lichen Woodland (1602) is lumped into this BpS.

Geographic Range

Boreal White Spruce occurs from the southern slopes of the Brooks Range to southcentral AK and west to the limit of tree growth (including part of MZ76).

Biophysical Site Description

These systems occur on rolling hills, inactive terraces, and mountain side slopes up to 750m. Soils are typically derived from glacial or other depositional processes and include moraines, drumlins, eskers, kettle-kame, colluvium, and loess deposits (NatureServe 2008). These systems commonly occur on well-drained upland terrain on west, east and south aspects, but are possible on all aspects (NatureServe 2008). Permafrost is commonly absent.

Boreal Spruce-Lichen Woodland occurs most commonly on cool, well-drained sites with thin soils (NatureServe 2008).

Vegetation Description

Canopy cover in mature stands is dominated by Picea glauca and typically ranges from 25-70%, except in the case of Boreal Spruce-Lichen Woodland, which has a more open canopy (10-25% cover). Other trees such as Picea mariana, Betula papyrifera, and Populus tremuloides may be subdominant in the overstory, but Picea glauca contributes at least 75 % of the total forest canopy in the forested type (NatureServe 2008). Mature stands are often open-canopied with a well-developed shrub layer (NatureServe 2008). The woodland type may be dominated by Picea mariana (NatureServe 2008).

Common understory shrubs include Arctostaphylos uva-ursi, Vaccinium vitis-idaea, V. uliginosum, Betula nana, Empetrum nigrum, Ledum palustre ssp. decumbens, L. groenlandicum, Rosa acicularis and Viburnum edule. Arctostaphylos rubra and Shepherdia canadensis are typically found on dryer sites (Viereck et al. 1992). Common herbaceous species include Chamerion angustifolium ssp. angustifolium and Calamagrostis canadensis. Other herbaceous species can include Equisetum sylvaticum, E. arvense, Geocaulon lividum, Mertensia paniculata, Pyrola ssp., Linnaea borealis and Goodyera repens (Viereck et al. 1992). Feather mosses such as Hylocomium splendens and Pleurozium schreberi are common in the ground layer of the forested type (Boggs and Sturdy 2005). In the mature woodland type, feather mosses are less important, while lichens, primarily Cladina spp, form a very important component of the understory (NatureServe 2008).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIGL | Picea glauca | White spruce |
| PIMA | Picea mariana | Black spruce |
| BEPA | Betula papyrifera | Paper birch |
| POTR5 | Populus tremuloides | Quaking aspen |
| ARUV | Arctostaphylos uva-ursi | Kinnikinnick |
| VAVI | Vaccinium vitis-idaea | Lingonberry |
| BENA | Betula nana | Dwarf birch |
| CHANA2 | Chamerion angustifolium ssp. angustifolium | Fireweed |

Disturbance Description

The disturbance regime of boreal white spruce forests are characterized by large crown fires with estimates of mean fire return intervals on upland sites ranging from 82-105 years (Abrahamson 2014). Boreal white spruce fire regimes are influenced by the surrounding vegetation matrix and therefore be difficult to distinguish (Abrahamson 2014). White spruce have thin bark and are typically killed by fire. Except in the case of severe fires, post-fire succession tends to return to the pre-disturbance forest type (Foote 1983). Pre-burn species colonize the site via rhizomes, root sprouts and trunk sprouts (NatureServe 2008). A variety of herbaceous communities dominate: primarily Chamerion angustifolium ssp. angustifolium and Calamagrostis canadensis (NatureServe 2008). Betula papyrifera, Populus tremuloides or Picea glauca may individually invade and dominate sites, but eventually Picea glauca gains dominance over hardwoods (NatureServe 2008). In severe portions of fires, the organic layer is consumed killing the underground propagules, and revegetation of the site is by seed.

A typical successional sequence progresses from herbaceous to shrub to hardwood/hardwood-spruce and finally to spruce after 100 to 150 years (Foote 1983). In upland spruce stands post-burn succession occasionally skips the hardwood/hardwood-spruce stage and proceeds directly to a spruce dominated stage (Viereck et al. 1992). The former successional scenario is typical of the Fairbanks area while the latter is more common around Yukon Charley, Noatak, NE boreal and at higher elevations (NatureServe 2008). Boreal Spruce-Lichen Woodland may occur as a very late successional stage of this system.

Post-fire regeneration of white spruce appears to be more successful when fires occur in mast years (Peters et al. 2005). This interaction between fire, masting and subsequent tree regeneration could have implications for historical stand structure and successional dynamics over time (Peters et al. 2005).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 149 |  |  | 71 |
| Moderate (Mixed) | 364 |  |  | 29 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **106** |  |  | **100** |

Scale Description

This BpS occurs in a matrix with other vegetation types. Crown fires were typically large patch occurrences.

Non-Fire Disturbances

Adjacency or Identification Concerns

This system may be found alongside any boreal black spruce or hardwood systems.

Issues or Problems

It should be noted that there is a considerable variation across the range of this community type. This description and the associated model attempt to capture the most common attributes of the system across its range.

Only a few studies report fire regime information for white spruce forests and they are limited primarily to map zone 70, which may not be representative of fire regimes elsewhere in Alaska (Abrahamson 2014).

Native Uncharacteristic Conditions

Recent warmer and drier conditions, along with human activities including fire suppression and some logging practices have likely increased the current frequency and severity of spruce bark beetle outbreaks compared with presettlement conditions.

Comments

More information on fire in Alaskan white spruce communities can be found in the Fire Effects Information System Synthesis: [Fire regimes of Alaskan white spruce communities](https://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html) (Abrahamson 2014).

This system was created during LANDFIRE National for the AK Boreal region and reviewed by Tina Boucher for that region. It did not receive review for other regions in the state.

This model was based on input from the experts who attended the LANDFIRE Fairbanks modeling meeting (Nov. 07) and refined by Robert Lambrecht. Experts from this workshop indicated the potential need for a self-replacement spruce model and another for the short-term mix of spruce and hardwood. This model represents both concepts using a deterministic pathway to represent the more common spruce-hardwood pathway and an alternate succession pathway to represent the less common spruce-spruce pathway.

This model may need to be split into two regional variants: this model to cover most of the boreal region and a variant with a lower fire return interval and no birch, to apply to the Copper River Basin and the Wrangell Mountains.

Though Robert Lambrect originally lumped Western North American Boreal Spruce-Lichen Woodland into this model as a late seral stage, a reviewer suggested that the Spruce Lichen Woodland would be a better fit as a seral stage of the Boreal and Sub-boreal Treeline White Spruce Woodland and the Mesic Black Spruce Forest models. Colleen Ryan removed the reference to the lump in this model but did not alter the description or state-and-transition simulationmodel. The model still includes a seral stage with lichens.

**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 | Early2:ALL | 4 |
| Early2:ALL | 5 | Mid1:OPN | 29 |
| Late1:OPN | 130 | Late1:OPN | 999 |
| Mid1:OPN | 30 | Late1:OPN | 129 |
| Mid2:OPN | 30 | Late1:OPN | 129 |

**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 |
| ReplacementFire | Early2:ALL | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| AltSuccession | Early2:ALL | Mid2:OPN | 0.0100 | 100 | 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 |
| ReplacementFire | Mid2:OPN | Early1:ALL | 0.0067 | 149 | Yes | 0 |
| MixedFire | Mid2:OPN | Mid2:OPN | 0.0033 | 303 | No | 0 |

Succession Classes

Class A 5 Early Development 1 - All Structures

Structural Information

Upper Layer Lifeform: Herb

Upper Layer Canopy Cover: Herbaceous - Herbaceous%

Upper Layer Canopy Height: Herbaceous - Herbaceous

Tree Size Class: Seedling/Sapling <5"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CHANA2 | Chamerion angustifolium ssp. angustifolium | Fireweed | Upper |
| CACA4 | Calamagrostis canadensis | Bluejoint | Upper |
| EQSY | Equisetum sylvaticum | Woodland horsetail | Upper |
| EQAR | Equisetum arvense | Field horsetail | Upper |

Description

Post disturbance regeneration. A variety of herbaceous communities dominate; primarily Chamerion angustifolium ssp. angustifolium and Calamagrostis canadensis. Other herbaceous species can include Equisetum sylvaticum, E. arvense, Geocaulon lividum, Mertensia paniculata and Pyrola ssp. (Viereck et al. 1992). Shrubs and trees resprout from root stocks, but woody cover is low.

Class B 15 Early Development 2 - All Structures

Structural Information

Upper Layer Lifeform: Shrub

Upper Layer Canopy Cover: Open Shrub (25-74% shrub cover) - Closed Shrub (> 75% shrub cover)%

Upper Layer Canopy Height: Dwarf Shrub (< 20 cm) - Tall Shrub (>1.5 m)

Tree Size Class: Seedling/Sapling <5"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| ARUV | Arctostaphylos uva-ursi | Kinnikinnick | Upper |
| VAVI | Vaccinium vitis-idaea | Lingonberry | Upper |
| BENA | Betula nana | Dwarf birch | Upper |
| LEPAD | Ledum palustre ssp. decumbens | Marsh labrador tea | Upper |

Description

This stage is dominated by shrubs and saplings. Common shrub species include Rosa acicularis, Viburnum edule, Betula nana, Ledum palustre ssp. Decumbens, L. groenlandicum, Vaccinium vitis-idaea, V. uliginosum, Empetrum nigrum. Arctostaphylos uva-ursi, Arctostaphylos rubra and Shepherdia canadensis are typically found on dryer sites (Viereck et al. 1992). Betula papyrifera and Populus tremuloides saplings are common on some sites.

The alternate succession pathway represents self-replacing white spruce stands in areas where there is no adjacent hardwood seed source (e.g., Noatak, NE boreal and higher elevation).

Class C 30 Mid Development 1 - Open

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: Open (25-59% tree cover) - Closed (60-100% tree cover)%

Upper Layer Canopy Height: Dwarf Tree (< 3 m) - Tree (> 3 m)

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 |
| ROAC | Rosa acicularis | Prickly rose | Upper |

Description

This is predominantly a hardwood forest although conifers may be present and mixed with the hardwoods. Trees begin to shade out the shrub understory. The overstory dominants include Betula papyrifera and Populus tremuloides. Picea glauca and P. mariana may be present. Common understory species include Rosa acicularis, Viburnum edule, Arctostaphylos spp., Linnaea borealis, Chamerion angustifolium and Geocaulon lividum.

Class D 10 Mid Development 2 - Open

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: Woodland (10-24% tree cover) - Closed (60-100% tree cover)%

Upper Layer Canopy Height: Tree (> 3 m) - Tree (> 3m)

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 |
| BENA | Betula nana | Dwarf birch | Lower |
| ARRU | Arctostaphylos rubra | Red fruit bearberry | Lower |
| VAVI | Vaccinium vitis-idaea | Lingonberry | Lower |

Description

This class represents mid-seral, self-replacing white spruce stands in areas where there is no adjacent hardwood seed source or geographic areas that tend to lack the hardwood component such as the Noatak, NE boreal region and higher elevations. Picea glauca dominates the overstory but P. mariana may be present.

Class E 40 Late Development 1 - Open

Structural Information

Upper Layer Lifeform: Tree

Upper Layer Canopy Cover: Woodland (10-24% tree cover) - Closed (60-100% tree cover)%

Upper Layer Canopy Height: Tree (> 3 m) - Tree (> 3m)

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 |
| ROAC | Rosa acicularis | Prickly rose | Lower |
| VIED | Viburnum edule | Squashberry | Lower |
| BENA | Betula nana | Dwarf birch | Lower |

Description

Mature spruce forest. Hardwoods senesce. Accumulation of evergreen litter begins to change soil characteristics.

Picea glauca dominates the overstory but P. mariana may be present. Common understory species include Rosa acicularis, Viburnum edule, Shepherdia canadensis, Vaccinium vitis-idaea, Arctostaphylos spp., Linnaea borealis, Chamerion angustifolium, and Geocaulon lividum.

This stage incorporates the concept of Boreal Spruce-Lichen Woodland where lichens, primarily Cladina spp., are a very important component of the understory. Feather mosses are not as important as in other white spruce systems.

References

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