

# LANDFIRE Biophysical Setting Model

**Biophysical Setting 7316030**

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

- ☒ This BPS is lumped with: *Western North American Boreal White Spruce Forest*
- ☐ This BPS is split into multiple models: *Boreal White Spruce Forest was lumped with this type because it was felt that although it is a separate existing vegetation type, a separate biophysical environment could not be described for it.*

## General Information

**Contributors** (also see the Comments field)

**Date** 3/12/2008

|                                   |                          |                              |                      |
|-----------------------------------|--------------------------|------------------------------|----------------------|
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| <b>Modeler 2</b> Robert Lambrecht | Robert_Lambrecht@fws.gov | <b>Reviewer</b>              |                      |
| <b>Modeler 3</b>                  |                          | <b>Reviewer</b>              |                      |

### Vegetation Type

Forest and Woodland

### Map Zone

73

### Model Zone

- |                                            |                                            |
|--------------------------------------------|--------------------------------------------|
| <input checked="" type="checkbox"/> Alaska | <input type="checkbox"/> N-Cent.Rockies    |
| <input type="checkbox"/> California        | <input type="checkbox"/> Pacific Northwest |
| <input type="checkbox"/> Great Basin       | <input type="checkbox"/> South Central     |
| <input type="checkbox"/> Great Lakes       | <input type="checkbox"/> Southeast         |
| <input type="checkbox"/> Northeast         | <input type="checkbox"/> S. Appalachians   |
| <input type="checkbox"/> Northern Plains   | <input type="checkbox"/> Southwest         |

### Dominant Species\*

|       |       |
|-------|-------|
| PIGL  | ARUV  |
| PIMA  | VAVI  |
| BEPA  | BENA  |
| POTR5 | CHANA |

### General Model Sources

- ☒ Literature
- ☐ Local Data
- ☒ Expert Estimate

## Geographic Range

Boreal White Spruce-Hardwood Forest occurs from the southern slopes of the Brooks Range to southcentral AK and west to the limit of tree growth.

## 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).

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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).

### **Disturbance Description**

The disturbance regime is characterized by large crown fires with estimates of mean fire return intervals ranging from 50-238yrs (Rowe 1972; Heinselman 1981; Yarie 1981, 1983; Foote 1983; Duchesne and Hawkes 2000). 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 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 to spruce (NatureServe 2008). In upland spruce stands post-burn succession occasionally skips the hardwood/hardwood-spruce stage (class C in this model) and proceeds directly to a spruce dominated stage (Viereck et al. 1992). The former successional scenario is typical of the Fairbanks area while the later 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).

### **Adjacency or Identification Concerns**

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

### **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.

### **Scale Description**

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

### **Issues/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

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its range.

## Comments

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 Lambrecht 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 VDDT model. The model still includes a seral stage with lichens.

Tina Boucher reviewed a draft of this model.

## Vegetation Classes

### Class A 5%

Early Development 1 All Structures

#### Upper Layer Lifeform

- ☒ Herbaceous  
☐ Shrub  
☐ Tree

#### Indicator Species\* and

##### Canopy Position

CHANA2 Upper  
CACA4 Upper  
EQSY Upper  
EQAR Upper

#### Structure Data (for upper layer lifeform)

|                 | Min                  | Max        |
|-----------------|----------------------|------------|
| Cover           | Herbaceous           | Herbaceous |
| Height          | Herbaceous           | Herbaceous |
| Tree Size Class | Seedling/Sapling <5" |            |

☐ Upper layer lifeform differs from dominant lifeform.

#### Description

0-4yrs

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. (Vioreck et al. 1992). Shrubs and trees resprout from root stocks, but woody cover is low.

Succession to class B. Replacement MFRI = 150yrs.

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**Class B 15%**

Early Development 2 All Structures

**Structure Data (for upper layer lifeform)**

|                        | Min                             | Max                              |
|------------------------|---------------------------------|----------------------------------|
| <i>Cover</i>           | Open Shrub (25-74% shrub cover) | Closed Shrub (> 75% shrub cover) |
| <i>Height</i>          | Dwarf Shrub (< 20 cm)           | Tall Shrub (>1.5 m)              |
| <i>Tree Size Class</i> | Seedling/Sapling <5"            |                                  |

**Upper Layer Lifeform**☐ Herbaceous☒ Shrub☐ Tree**Indicator Species\* and Canopy Position**

ARUV Upper

VAVI Upper

BENA Upper

LEPAD Upper

☐ Upper layer lifeform differs from dominant lifeform.**Description**

5-29yrs

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* and *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.

Succession to class C. The alternate succession pathway to D (probability = 0.01) represents self-replacing white spruce stands in areas where there is no adjacent hardwood seed source (e.g., Noatak, northeast boreal and higher elevation). Replacement MFRI = 150yrs.

**Class C 30%**

Mid Development 1 Open

**Structure Data (for upper layer lifeform)**

|                        | Min                         | Max                         |
|------------------------|-----------------------------|-----------------------------|
| <i>Cover</i>           | Open (25-59% tree cover)    | Closed (60-100% tree cover) |
| <i>Height</i>          | Dwarf Tree (< 3 m)          | Tree (> 3 m)                |
| <i>Tree Size Class</i> | Pole 5-9" (swd)/5-11" (hwd) |                             |

**Upper Layer Lifeform**☐ Herbaceous☐ Shrub☒ Tree**Indicator Species\* and Canopy Position**

BEPA Upper

POTR5 Upper

PIGL Upper

ROAC Upper

☐ Upper layer lifeform differs from dominant lifeform.

Presence of hardwoods distinguishes class C from D.

**Description**

30-129yrs

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*.

Succession to class E. Replacement MFRI = 150yrs. Mixed fire (MFRI = 300yrs) maintains this class.

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**Class D 10 %**

Mid Development 2 Open

**Upper Layer Lifeform**

- ☐ Herbaceous  
☐ Shrub  
☒ Tree

**Indicator Species\* and****Canopy Position**

- PIGL Upper  
 BENA Lower  
 ARRU Lower  
 VAVI Lower

**Structure Data (for upper layer lifeform)**

|                 | Min                          | Max                         |
|-----------------|------------------------------|-----------------------------|
| Cover           | Woodland (10-24% tree cover) | Closed (60-100% tree cover) |
| Height          | Tree (> 3 m)                 | Tree (> 3 m)                |
| Tree Size Class | Pole 5–9" (swd)/5–11" (hwd)  |                             |

- ☐ Upper layer lifeform differs from dominant lifeform.

Absence of hardwoods distinguishes class D from C. There are not mapping criteria to distinguish class D from E but trees are likely shorter and the stand likely more dense in D than in E.

**Description**

30-129yrs

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.

Succession to class E. Replacement MFRI = 150yrs. Mixed fire (MFRI = 300yrs) maintains this class.

**Class E 40 %**

Late Development 1 Open

**Upper Layer Lifeform**

- ☐ Herbaceous  
☐ Shrub  
☒ Tree

**Indicator Species\* and****Canopy Position**

- PIGL Upper  
 ROAC Lower  
 VIED Lower  
 BENA Lower

**Structure Data (for upper layer lifeform)**

|                 | Min                           | Max                         |
|-----------------|-------------------------------|-----------------------------|
| Cover           | Woodland (10-24% tree cover)  | Closed (60-100% tree cover) |
| Height          | Tree (> 3 m)                  | Tree (> 3 m)                |
| Tree Size Class | Med. 9–20" (swd)/11–20" (hwd) |                             |

- ☐ Upper layer lifeform differs from dominant lifeform.

Absence of hardwoods distinguishes class E from C. There are not mapping criteria to distinguish class D from E but trees are likely shorter and the stand likely more dense in D than in E.

**Description**

130yrs+

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.

This class persists in the absence of disturbance. Replacement MFRI = 150yrs. Mixed fire (MFRI = 300yrs)

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maintains this class.

## Disturbances

**Fire Regime Group\*\*:** IV

**Historical Fire Size (acres)**

Avg 0

Min 0

Max 0

**Sources of Fire Regime Data**

- ☒ Literature  
☐ Local Data  
☒ Expert Estimate

**Additional Disturbances Modeled**

- ☐ Insects/Disease    ☐ Native Grazing    ☐ Other (optional 1)  
☐ Wind/Weather/Stress    ☐ Competition    ☐ Other (optional 2)

**Fire Intervals**

|             | Avg FI | Min FI | Max FI | Probability | Percent of All Fires |
|-------------|--------|--------|--------|-------------|----------------------|
| Replacement | 149.7  |        |        | 0.00668     | 71                   |
| Mixed       | 364.2  |        |        | 0.00275     | 29                   |
| Surface     |        |        |        |             |                      |
| All Fires   | 106    |        |        | 0.00943     |                      |

**Fire Intervals (FI):**

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

## References

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