LANDFIRE Biophysical Setting Model

Biophysical Setting 7216030 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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Modeler 3			**Reviewer**		

Vegetation Type

Forest and Woodland

Map Zone

72

Model Zone

☑ Alaska
☐ California
☐ Great Basin
☐ Great Lakes
☐ Northeast
☐ Northern Plains
☐ N-Cent.Rockies
☐ Pacific Northwest
☐ South Central
☐ Southeast
☐ S. Appalachians
☐ Southwest

Dominant Species*

PIGL ARUV
PIMA VAVI
BEPA BENA
POTR5 CHANA

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

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.

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; Heinsleman 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 created for the AK boreal region and did not receive review for the arctic region.

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 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

- [x] 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. (Viereck 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

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Indicator Species* and Canopy Position

ARUV	Upper
VAVI	Upper
BENA	Upper
LEPAD	Upper

Structure Data (for upper layer lifeform)

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

☐ 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, 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

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Indicator Species* and Canopy Position

BEPA	Upper
POTR5	Upper
PIGL	Upper
ROAC	Upper

Structure Data (for upper layer lifeform)

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

☐ 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

- [x] Literature
- [ ] Local Data
- [x] Expert Estimate

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 fir combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inver 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.

Additional Disturbances Modeled

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

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