

LANDFIRE Biophysical Setting Model

Biophysical Setting 7416030

**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

Modeler 1 Kori Blankenship kblankenship@tnc.org **Reviewer** Tina Boucher antvb@uaa.alaska.edu
Modeler 2 Robert Lambrecht Robert_Lambrecht@fws.gov **Reviewer**
Modeler 3 **Reviewer**

Vegetation Type

Forest and Woodland

Map Zone

74

Model Zone

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity

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

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity

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

Succession to class B. Replacement MFRI = 150yrs.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class B 15%

Early Development 2 All Structures

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☐ 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*, *Empetrum nigrum*. *Arctostaphylos uva-ursi*, *Arctostaphylos rubra* and *Shepherdia canadensis* are typically found on dryer sites (Vioreck 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
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☐ 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.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

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. Feathermosses 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)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity

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

Boggs, K. and Sturdy, M. 2005. Plant associations and post-fire vegetation succession in Yukon-Charley Rivers National Preserve. Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage. Prepared For: National Park Service, Landcover Mapping Program, National Park Service-Alaska Support Office, Anchorage, AK 99501.

Duchesne L.C. and B.C. Hawkes. 2000. Fire in northern ecosystems. In: Brown, J.K. and J.K. Smith (eds.) Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

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. 108 pp.

Heinselman, M.L. 1981. Fire and succession in the conifer forests of northern North America. In: West, D.C., H.H. Shugart, and D.B. Botkin. Forest succession: concepts and application. Springer-Verlag, New York. Chapter 23.

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

Peters, V.S., S.E. Macdonald and M.R.T. Dale. 2005. The interaction between masting and fire is key to white spruce regeneration. Ecology 86(7): 1744-1750.

Rowe, J.S. 1972. Forest Regions of Canada. Canadian Forest Service, Department of Environment. Ottawa. Inform. Can. Catalogue #FO 47-1300.

Viereck et al. 1992. The Alaska vegetation classification. Pacific Northwest Research Station, USDA Forest Service, Portland, OR. Gen. Tech. Rep. PNW-GTR286. 278 pp.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity

Yarie J. 1981. Forest fire cycles and life tables – a case study from interior Alaska. Can. J Forest Res. 11:554-562. Ritter, D. F. 1986. Process geomorphology. Wm. C. Brown Publishers, Dubuque, Iowa. 579 pp.

Yarie J. 1983. Forest community classification of the Porcupine River drainage, interior Alaska, and its application to forest management. USDA Forest Service GTR PNW-154.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity