

LANDFIRE Biophysical Setting Model

Biophysical Setting 6816041

Western North American Boreal Mesic Black Spruce Forest - Boreal

- ☒ This BPS is lumped with: WNA Boreal Spruce-Lichen Woodland (in part)
- ☒ This BPS is split into multiple models: Western North American Boreal Mesic Black Spruce Forest was split into a Boreal and Sub-boreal variant for BpS modeling so that regional differences could be represented.

Boreal Spruce Lichen Woodland may occur as a seral stage or variant of Boreal Treeline White Spruce Woodland, Boreal Mesic Black Spruce Forest, or, less commonly, in these same systems in the sub-Boreal region.

General Information

Contributors (also see the Comments field)

Date 3/12/2008

Modeler 1 Jill Johnstone

jill.johnstone@usask.ca

Reviewer Will Putnam

wputman@tananachief.org

Modeler 2

Reviewer

Modeler 3

Reviewer

Vegetation Type

Forest and Woodland

Map Zone

68

Model Zone

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

Dominant Species*

PIMA BENA
BEPA LEDUM
POTR5 SALIX
PIGL CACA4

General Model Sources

- ☒ Literature
☐ Local Data
☒ Expert Estimate

Geographic Range

This type occurs throughout the boreal region of AK. It may also be found in arctic AK.

Biophysical Site Description

This type is typically found on upland slopes and inactive alluvial deposits (NatureServe 2008). Soils are well-drained, and permafrost is generally absent (NatureServe 2008). There is little to no peat development; but there may be an organic layer derived from non-sphagnum mosses (NatureServe 2008).

Vegetation Description

Picea mariana is the dominant overstory species, but *Picea glauca* may be codominant on some sites (NatureServe 2008). Early successional stands may be dominated by *Betula papyrifera* or *Populus tremuloides* (NatureServe 2008). *Populus tremuloides* replaces *Betula papyrifera* on drier sites (Foote 1983, Chapin et al. 2006). Common understory shrubs include *Rosa acicularis*, *Betula nana*, *Ledum* spp., *V. uliginosum*, *Vaccinium vitis-idaea* and *Empetrum nigrum* (NatureServe 2008). Herbaceous species include *Calamagrostis canadensis*, *Chamerion angustifolium* (*Epilobium angustifolium*), and *Equisetum* spp. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi* (NatureServe 2008). Lichens, such as *Cladina* spp., may be abundant, especially in later seral stages (NatureServe 2008). Total tree cover in mature stands typically ranges from 40-70% (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

Disturbance Description

Crown fires or ground fires of enough intensity to kill overstory trees are the dominant disturbance influencing Boreal Mesic Black Spruce. Mean fire return interval estimates for Boreal Black Spruce in interior Alaska range from 25 to 130yrs (Yarie 1983, Heinzelman 1981, Viereck 1983, Viereck 1986).

The post-fire successional trajectory may be self-replacement, with black spruce following the early seral herb and shrub stages; alternatively, black spruce-hardwood may follow the early seral stages before returning to black spruce (Chapin et al. 2006). The pre-burn stand composition will influence the likely successional trajectory with pre-burn spruce stands more likely to succeed to spruce and pre-burn hardwood stands more likely to succeed to hardwood after the fire. If white spruce is present in the conifer initiation, then white and black spruce can be codominant in the conifer canopy throughout the successional stages.

Wind and insect damage affect this type but very little research exists to help describe or model that effect. These disturbances are also much smaller in their impacts than the dominant, stand-replacement disturbances caused by fire.

Adjacency or Identification Concerns

Native Uncharacteristic Conditions

Scale Description

Matrix.

Issues/Problems

The probability of fire in the mixed spruce-hardwood stage (class C) relative to the spruce dominated stages (class D and E) is unclear. It was assumed that the herb and shrub dominated stages (class A and B) are less fire prone, and therefore have a lower fire probability, than the later seral stages. The probability and effects of insects, disease and wind/weather events in this system are unclear and are included in the old-growth stage (class E) of the model as a place holder.

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 (Nov. 07) and Anchorage (Dec. 07) modeling meetings and refined by Jill Johnstone.

Will Putnam expressed concern that the distinction between this BpS and Western North American Boreal White Spruce-Hardwood Forest is ambiguous. They can occur on similar sites, and in many cases the relative dominance of *P. mariana* vs. *P. glauca* is mostly a function of succession and/or disturbance history.

Vegetation Classes

*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 A 5%

Early Development 1 All Structures

Upper Layer Lifeform

- ☒ Herbaceous
☐ Shrub
☐ Tree

Indicator Species* and**Canopy Position**

CACA4 Upper
 CHAN9 Upper
 EQUIS Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Herbaceous	Herbaceous
Height	Herbaceous	Herbaceous
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

0-4yrs

Post-disturbance, herbaceous vegetation. Common herbaceous species include Calamagrostis canadensis, Chamerion angustifolium (Epilobium angustifolium) and Equisetum spp (NatureServe 2008).

Succession to class B. Replacement MFRI = 250yrs.

Class B 15%

Early Development 2 Open

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Indicator Species* and**Canopy Position**

SALIX Upper
 BENA Upper
 LEDUM Upper
 ROAC

Structure Data (for upper layer lifeform)

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

☐ Upper layer lifeform differs from dominant lifeform.

Description

5-29yrs

This class is shrub dominated. Common species include willow, Betula nana, Ledum spp, Rosa acicularis, Vaccinium uliginosum, V. vitis-idaea and Empetrum nigrum. Both hardwoods and spruce regeneration may be present.

The successional trajectory of the shrub stage will depend on the pre-burn stand composition. If hardwoods dominated the site before the burn, they are likely to vigorously resprout and gain dominance after the fire. If spruce dominated the site before a burn, they are likely to regain dominance in the post-fire stand.

Succession to class C or D. One possible successional trajectory (represented by deterministic succession in the model) would include a hardwood phase (class C). But this class can also take an alternative successional pathway (probability = 0.02) directly to a spruce dominated phase (class D). Replacement MFRI = 250yrs.

*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 C 30 %

Mid Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and**Canopy Position**

BEPA Upper
 POTR5 Upper
 PIMA Upper
 PIGL Upper

Structure Data (for upper layer lifeform)

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

☐ Upper layer lifeform differs from dominant lifeform.

Presence of hardwoods distinguishes C from D and E.

Description

30-119yrs

Mixed hardwood-spruce forest. Hardwoods and spruce overtop shrubs and gain dominance. Early in this age class trees are at least 2.5 cm DBH and 4-8 m tall (Foote 1983). *Populus tremuloides* replaces *Betula papyrifera* on drier sites (Foote 1983, Chapin et al. 2006). Spruce may occur as an understory, subdominant and/or co-dominant component. Tree density may be < or >60% depending on site conditions. Beneath trees, shrubs, herbs and mosses exist. As the stage advances, spruce and moss become more important.

Succession to class E. Replacement MFRI = 150yrs. Mixed fire (MFRI = 250yrs) maintains this class.

Class D 30 %

Mid Development 2 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and**Canopy Position**

PIMA Upper
 PIGL Upper
 BENA Lower
 LEDUM Lower

Structure Data (for upper layer lifeform)

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

☐ Upper layer lifeform differs from dominant lifeform.

For mapping purposes, if tree size class can't distinguish class D and E, class D can be considered closed and E woodland and open.

Description

30-119yrs

Mid-seral black spruce/feathermoss. *Picea mariana* dominates but *Picea glauca* may be codominant on some sites. Spruce overtops the shrubs. Spruce canopy cover is commonly 50-70%.

Succession to class E. Replacement MFRI = 80yrs. Mixed fire (MFRI = 133yrs) 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 E 20 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and**Canopy Position**

PIMA Upper
 PIGL Upper
 BENA Lower
 LEDUM Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Woodland (10-24% tree cover)	Open (25-59% tree cover)
Height	Tree (> 3m)	Tree (> 3m)
Tree Size Class	Med. 9–20" (swd)/11–20" (hwd)	

- ☐ Upper layer lifeform differs from dominant lifeform.

For mapping purposes, if tree size class can't distinguish class D and E, class D can be considered closed and E woodland and open.

Description

120yrs+

Open, old-growth black spruce. *Picea mariana* dominates but *Picea glauca* may be codominant on some sites. Spruce gains dominance over hardwoods (if previously present). Tree canopy cover is generally <60% and may be <25% (woodland) depending on site conditions. Occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens. If fire is absent for long periods paludification may occur, resulting in an opening of the tree canopy to woodland conditions.

Black Spruce-Lichen Woodland may occur in this class.

This class persists in the absence of disturbance. Replacement MFRI = 80yrs. Mixed fire (MFRI = 133yrs) maintains this class. Insects/disease (probability = 0.001) and wind/weather/stress (probability = 0.01) can cause a transition to class D.

Disturbances**Fire Regime Group**:** III**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	111.9			0.00893	65
Mixed	206.3			0.00485	35
Surface					
All Fires	73			0.01379	

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

Chapin, F.S., Oswood, M. W., Van Cleve, K., Viereck, L.A. and Verblya, D. L. (eds.) 2006. Alaska's Changing Boreal Forest. Oxford University Press, NY. 354 p.

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

*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

York. Chapter 23.

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 p.

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

Viereck, L.A. 1983. The effects of fire in black spruce ecosystems of Alaska and northern Canada. In: Wein, Ross W.; MacLean, David A., eds. The role of fire in northern circumpolar ecosystems. New York: John Wiley & Sons Ltd.: 201-220. Chapter 11.

Viereck, L.A. Van Cleve, K. Dyrness, C.T. 1986 Forest Ecosystems in the Alaska Taiga. In: Van Cleve, K., Chapin F.S. III, Flanagan, P.W. (and others), eds. Forest Ecosystems in the Alaskan taiga: a synthesis of structure and function. New York: Springer-Verlag; 1986: 22-43.

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.