16042

Western North American Boreal Mesic-Wet Black Spruce Forest and Woodland - Sub-boreal

Model Date: 04/07/08 Report Date: 9/11/15

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
| Michelle Schuman | michelle.schuman@ak.usda.gov | None | None |
| None | None | None | None |
| None | None | None | None |

Reviewer: Janet Fryer

Vegetation Type

Forest and Woodland

Map Zones

73, 74, 75, 76, 77

Model Splits or Lumps

Western North American Boreal Mesic-Wet Black Spruce Forest and Woodland was split into a Boreal and Sub-boreal variant for BpS modeling so that regional differences could be represented.

Western North American Boreal Spruce-Lichen Woodland (BpS 1602) 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.

Geographic Range

This system occurs in the boreal transition region of AK, south of the Alaska Range, including the Susitna and Matanuska Valleys and the Kenai Peninsula (NatureServe 2008).

Biophysical Site Description

Sub-boreal Mesic Black Spruce Forest occurs on well-drained to moderately well-drained sites including old alluvial fans, abandoned floodplains and inactive terraces. Soils are gravelly and feature shallow to moderately deep organic horizons. Permafrost is absent.

Vegetation Description

Picea mariana and P. glauca are the dominant overstory species in an open forest canopy. Common understory shrubs include Betula nana, Ledum spp., V. uliginosum, Vaccinium vitis-idaea and Empetrum nigrum. Common mosses include Hylocomium splendens and Pleurozium schreberi. Total tree cover typically ranges from 40-70%.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIMA | Picea mariana | Black spruce |
| PIGL | Picea glauca | White spruce |
| BENA | Betula nana | Dwarf birch |
| LEDUM | Ledum | Labrador tea |
| VAUL | Vaccinium uliginosum | Bog blueberry |
| VAVI | Vaccinium vitis-idaea | Lingonberry |
| EMNI | Empetrum nigrum | Black crowberry |
| HYSP70 | Hylocomium splendens | Splendid feather moss |

Disturbance Description

The disturbance regime is characterized by crown fires and ground fires of enough severity to kill overstory trees. A literature review for black spruce fire regimes (Fryer 2014a) found only one fire history study for this type by De Volder. De Volder (1999) estimated a fire frequency range of 25-185 years (mean=89 yrs) on the Kenai Peninsula. Paleostudies reported means of 150 years (in 2,000 yrs BP) on the Copper Plateau (Lynch et al. 2004), 113 yrs (from 131-1194 AD) for Grizzly Lake near the Copper River (Tinner et al. 2008), and a mean of 98 yrs (from 5,500-2,400 BP) on the Kenai National Wildlife Refuge (Lynch et al. 2002). A “best guess” for this system without human disturbance has been estimated at 170yrs (FRCC expert’s consultation, 2004).

Succession after fire can return to black spruce or can pass through a hardwood sere before returning to black spruce. Seasonality affects burn severity. An early season burn can kill the overstory without affecting the ground layer, but a late-season burn can reduce the duff layer and kill the understory plants. Calamagrostis is not a major factor in Sub-boreal black spruce succession.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 216 |  |  | 87 |
| Moderate (Mixed) | 1430 |  |  | 13 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **188** |  |  | **100** |

Scale Description

This BpS is typically found in large patches (NatureServe 2008).

Across AK fires in black spruce communities tend to be small, but a few large fires (e.g. 50,000 ha or larger) account for most of the area burn and have the most ecological impact (see Fryer 2014a and references therein). During most fire years a small number of large fires account for most of the total area burned (Gabriel and Tande 1983). Ecologically significant fires usually occur during the exceptional fire years and cover 200,000+ ha (Viereck 1983).

Non-Fire Disturbances

Insects/Disease

Wind/Weather/Stress

Adjacency or Identification Concerns

In some locations, this BpS can be confused with the White Spruce BpS because black and white spruces often mix, especially on sites with transitional moisture and thermal conditions (Murphy and Witten 2006).

Issues or Problems

Native Uncharacteristic Conditions

The following information was taken from the Black Spruce Southcentral PNVG model description (Murphy and Witten 2006):

In recent decades black spruce began encroaching into drying sphagnum bogs, creating “islands” of spruce where spruce were not previously present (Ed Berg, personal communication, March 4, 2004). This drying and resultant encroachment is attributed to the warming climate.

Comments

Reviewer Janet Fryer raised several issues that require further review:

Fryer (2014a) found no evidence of mixed-severity fire for this BpS in the sub-boreal region. Does the use of mixed fire in the model represent the mix of crown and lethal surface fire or something else? Should mixed fire be removed or modified?

Fryer suggested that a mean of 216 years for replacement fire might be too long, but acknowledged that data for refining the fire frequencies in this model are limited. What is the fire frequency for replacement fire?

According to Berg et al. 2003 spruce bark beetles has a greater impact than fire on black spruce forests on the Kenai Peninsula, but as currently modeled fire is the dominant disturbance in this BpS. What is the frequency and impact of insects?

During LANDIFRE National his model did not receive review specifically for z76. This model was based on the FRCC Guidebook PNVG model for Black Spruce Southcentral (BSSC; Murphy and Witten 2006) and input from the experts who attended the LANDFIRE Fairbanks(Nov. 07) and Anchorage (Dec. 07) modeling meetings. It was refined by Michelle Schuman. The class definitions and age ranges were taken from experts at the Anchorage and Fairbanks meetings with input from Michelle Schuman and the disturbance probabilities are similar to those in the BSSC model.

**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 | Mid1:ALL | 14 |
| Late1:CLS | 75 | Late1:CLS | 999 |
| Late1:OPN | 75 | Late1:OPN | 999 |
| Mid1:ALL | 15 | Late1:OPN | 74 |
| Mid2:ALL | 15 | Late1:OPN | 74 |

**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 | 0.0060 | 167 | No | 0 |
| AltSuccession | Early1:ALL | Mid2:ALL | 0.0110 | 91 | Yes | 0 |
| ReplacementFire | Late1:CLS | Early1:ALL | 0.0050 | 200 | Yes | 0 |
| Insect/Disease | Late1:CLS | Late1:OPN | 0.0010 | 1,000 | Yes | 0 |
| MixedFire | Late1:CLS | Late1:OPN | 0.0007 | 1,429 | Yes | 0 |
| Wind/Weather/Stress | Late1:CLS | Late1:OPN | 0.0010 | 1,000 | Yes | 0 |
| ReplacementFire | Late1:OPN | Early1:ALL | 0.0050 | 200 | Yes | 0 |
| MixedFire | Late1:OPN | Late1:OPN | 0.0007 | 1,429 | No | 0 |
| ReplacementFire | Mid1:ALL | Early1:ALL | 0.0022 | 455 | Yes | 0 |
| AltSuccession | Mid1:ALL | Late1:CLS | 0.0150 | 67 | Yes | 0 |
| MixedFire | Mid1:ALL | Mid1:ALL | 0.0012 | 833 | No | 0 |
| ReplacementFire | Mid2:ALL | Early1:ALL | 0.0040 | 250 | Yes | 0 |

Succession Classes

Class A 10 Early Development 1 - All Structures

Structural Information

Tree Size Class: Seedling/Sapling <5"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BENA | Betula nana | Dwarf birch | Upper |
| LEDUM | Ledum | Labrador tea | Middle |
| VAUL | Vaccinium uliginosum | Bog blueberry | Low-Mid |
| VAVI | Vaccinium vitis-idaea | Lingonberry | Lower |

Description

Moss, herbs, seedlings of trees and shrubs establish 3 months to three years post fire (Foote 1983). Shrubs and saplings 1.4 to 7 m tall typically begin capturing sites 4-5yrs post fire. The tall shrub and sapling layer is characterized by 60-100% canopy closure. Tree saplings may include spruce, hardwoods or both. Common understory shrubs include Betula nana, Ledum spp., Vaccinium uliginosum, V. vitis-idaea and Empetrum nigrum. Common mosses include Hylocomium splendens and Pleurozium schreberi.

Alternate succession represents the probability that some stands will go through a hardwood (with spruce understory) or spruce-hardwood stage (class C) rather than following the main successional pathway to a black spruce dominated stage (class B).

Class B 10 Mid Development 1 - All Structures

Structural Information

Tree Size Class: Pole 5–9" (swd)/5–11" (hwd)

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMA | Picea mariana | Black spruce | Upper |
| PIGL | Picea glauca | White spruce | Upper |
| BENA | Betula nana | Dwarf birch | Lower |
| LEDUM | Ledum | Labrador tea | Lower |

Description

Black or white spruce overtops shrubs and gains dominance. Tree density may be < or > 60% depending on site conditions.

Alternate succession causes a transition to class E and represents the probability that some stands go directly to a closed spruce stage rather than following the main successional pathway to an open spruce stage (class D).

B should be distinguished from D and E based on tree size class but if that is not mapped, B can be considered a dwarf tree class for mapping.

Class C 5 Mid Development 2 - All Structures

Structural Information

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 |
| PIMA | Picea mariana | Black spruce | Mid-Upper |
| PIGL | Picea glauca | White spruce | Mid-Upper |

Description

Hardwoods (with spruce in the understory) or 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.

Class D 50 Late Development 1 - Open

Structural Information

Tree Size Class: Med. 9–20" (swd)/11–20" (hwd)

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMA | Picea mariana | Black spruce | Upper |
| PIGL | Picea glauca | White spruce | Upper |
| BENA | Betula nana | Dwarf birch | Lower |
| LEDUM | Ledum | Labrador tea | Lower |

Description

This class is characterized by open spruce lichen forest or woodland. Spruce gains dominance over hardwoods (if previously present). Tree canopy cover is < 60% and maybe < 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. For spruce lichen woodland, the dominant lichen genus is Cladina; species include C. arbuscula, C. mitis, C. rangiferina, and C. stellaris. Other lichens include Cetraria cucullata, C. islandica, C. nivalis, Bryoria spp., Alectoria nigricans and Alectoria ochroleuca.

If fire is absent for long periods paludification may occur (Moss 1953, Harper et al. 2006).

Class E 25 Late Development 1 - Closed

Structural Information

Tree Size Class: Med. 9–20" (swd)/11–20" (hwd)

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIMA | Picea mariana | Black spruce | Upper |
| PIGL | Picea glauca | White spruce | Upper |
| BENA | Betula nana | Dwarf birch | Lower |
| LEDUM | Ledum | Labrador tea | Lower |

Description

This class is characterized by closed spruce forest. Site is dominated by mature black or white spruce with > 60% canopy closure although cover generally does not exceed 70%. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.

References

Barney, R. J.; Stocks, B. J. 1983. Fire frequencies during the suppression period. In: Wein, Ross W.; MacLean, David A., eds. The role of fire in northern circumpolar ecosystems. New York: John Wiley & Sons: 45-61.

Berg, Edward E.; Anderson, R. S.; De Volder, A. D. 2003. Fire and spruce bark beetle disturbance regimes on the Kenai Peninsula, Alaska, [Online]. In: Proceedings, 2nd international wildland fire ecology and fire management congress held concurrently with the 5th symposium on fire and forest meteorology; 2003 November 16-20; Orlando, FL. Boston, MA: American Meteorology Society (Producer): Available: http://ams.confex.com/ams/FIRE2003/techprogram/paper\_65661.htm [2014, April 17].

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

Cronan, James; McKenzie, Donald; Olson, Diana. [n.d.]. Fire regimes of the Alaska boreal forest. Draft manuscript. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 124 p. In cooperation with: Seattle, WA: University of Washington, School of Forest Resources; New Haven, CT: Yale School of Forestry and Environmental Studies; Moscow, ID: University of Idaho; Fairbanks, AK: U.S. Department of the Interior, Bureau of Land Management, Alaska Fire Service. Available online: http://www.frames.gov/documents/alaska/fire\_history/fire\_regimes\_alaskan\_boreal\_forest\_draft\_gtr.zip [2012, September 4]

De Volder, A. 1999. Fire and climate history of lowland black spruce forests, Kenai National Wildlife Refuge, Alaska. Flagstaff, AZ. Northern Arizona University. 128 p. MS Thesis.

DeWilde, La'ona. 2003. Human impacts to fire regime in interior Alaska. Fairbanks, AK: University of Alaska Fairbanks. 88 p. Thesis.

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.

Fryer, Janet L. 2014a. Fire regimes of Alaskan black spruce communities. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/fire\_regimes/AK\_black\_spruce/all.html

Fryer, Janet L. 2014b. Picea mariana. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/plants/tree/picmar/all.html

Gabriel, H.W. and G.F. Tande. 1983. A regional approach to fire history in Alaska. BLM Alaska TR-83-9.

Harper, Karen A.; Bergeron, Yves; Drapeau, Pierre; Gauthier, Sylvie; De Grandpre, Louis. 2006. Changes in spatial pattern of trees and snags during structural development in Picea mariana boreal forests. Journal of Vegetation Science. 17(5): 625-636.

Heinselman, M.L. 1978. Fire in wilderness ecosystems. In J.C.Hendee, G.H. Stankey & R.C. Lucas, eds. Wilderness Management. USDA Forest Service, Misc. Pub. 1365.

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.

Jorgenson, M.T. et al. 2003. An ecological land survey for Fort Richardson, Alaska. Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, ERDC/CRREL TR-03019.

Kasischke, Eric S.; Turetsky, Merritt R.; Ottmar, Roger D.; French, Nancy H. F.; Hoy, Elizabeth E.; Kane, Evan S. 2008. Evaluation of the composite burn index for assessing fire severity in Alaskan black spruce forests. International Journal of Wildland Fire. 17(4): 515-526.

Lynch, Jason A.; Clark, James S.; Bigelow, Nancy H.; Edwards, Mary E.; Finney, Bruce P. 2002. Geographic and temporal variations in fire history in boreal ecosystems in Alaska. Journal of Geophysical Research. 107(D1): 8152. doi:10.1029/2001JD000332

Lynch, Jason A.; Hollis, Jeremy L.; Hu, Feng Sheng. 2004. Climatic and landscape controls of the boreal forest fire regime: Holocene records from Alaska. Journal of Ecology. 92(3): 477-489.

Moss, E. H. 1953. Marsh and bog vegetation in northwestern Alberta. Canadian Journal of Botany. 31(4): 448-470.

Murphy, K.A. and E. Witten. 2006. Black Spruce Southcentral. In Fire Regime Condition Class (FRCC) Interagency Guidebook Reference Conditions. Available at www.frcc.gov.

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

Racine, Charles H.; Dennis, John G.; Patterson, William A., III. 1985. Tundra fire regimes in the Noatak River watershed, Alaska: 1956-83. Arctic. 38(3): 194-200.

Rowe, J.S., J.L Bergsteinsson, G.A. Padbury, and R. Hermesh. 1974. Fire Studies in the

Mackenzie Valley. ALUR Report 73-74-61. Arctic Land Use Research Program, Department of Indian Affairs and Human Development, Ottawa, Canada. 123 pp.

Tinner, Willy; Bigler, Christian; Gedye, Sharon; Gregory-Eaves, Irene; Jones, Richard T.; Kaltenrieder, Petra; Krahenbuhl, Urs; Hu, Feng Sheng. 2008. A 700-year paleoecological record of boreal ecosystem responses to climatic variation from Alaska. Ecology. 89(3): 729-743.

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, Leslie A.; Schandelmeier, Linda A. 1980. Effects of fire in Alaska and adjacent Canada--a literature review. BLM-Alaska Tech. Rep. 6; BLM/AK/TR-80/06. Anchorage, AK: U.S. Department of the Interior, Bureau of Land Management, Alaska State Office. 124 p.

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.

Yarie J. 1981. Forest fire cycles and life tables – a case study from interior Alaska. Can. J Forest Res. 11:554-562.