

LANDFIRE Biophysical Setting Model

Biophysical Setting 7516790

Alaska Sub-boreal White Spruce-Hardwood Forest

☒ This BPS is lumped with: see below

☐ This BPS is split into multiple models: Alaska Sub-boreal White-Lutz Spruce Forest & Woodland and Western North American Boreal Mesic Birch-Aspen Forest (when it occurs in the AK sub-boreal region) are lumped with Alaska Sub-boreal White Spruce-Hardwood Forest because it is not clear that these types occur on different biophysical settings. Although these types are mappable as separate existing vegetation types they should be mapped as one BpS.

General Information

Contributors (also see the Comments field) **Date** 2/10/2008

Modeler 1 Karen Murphy karen_a_murphy@fws.gov **Reviewer** Rob DeVelice rdevelice@fs.fed.us

Modeler 2 Evie Witten ewitten@tnc.org **Reviewer**

Modeler 3 Kori Blankenship kblankenship@tnc.org **Reviewer**

Vegetation Type

Forest and Woodland

Map Zone

75

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 MEFE
BEPA ALVIS
POBA2 CACA4
POTR5 OPHO

General Model Sources

- ☒ Literature
☐ Local Data
☒ Expert Estimate

Geographic Range

These systems occur throughout the sub-boreal region of AK. The White Spruce-Hardwood Forest type occurs primarily on the west side of the Kenai Peninsula on the Kenai Lowland and also at lower elevations in the northwestern Kenai Mountains.

Biophysical Site Description

These systems typically occur on well-drained upland terrain, including side slopes, toe slopes, and inactive terraces. Soils are generally developed on surficial deposits including glacial till, colluvium and loess. Within the Kenai Mountains, the Sub-boreal White Spruce-Hardwood system occurs at a lower elevation zone than Mountain Hemlock-White Spruce and Mountain Hemlock systems.

Vegetation Description

The dominant canopy species are *Picea glauca* or *Picea X lutzii* (the hybrid produced where the ranges of *P. sitchensis* and *P. glauca* overlap) and *Betula papyrifera*. Other common canopy trees include *Populus balsamifera* and *P. tremuloides*. *Picea mariana* may also be present. *Salix scouleriana* is locally common.

Common understory shrubs include *Alnus viridis* ssp. *sinuata*, *Viburnum edule*, *Rosa acicularis*, *Ribes triste*, *Vaccinium vitis-idaea* and *Linnaea borealis*. *Menziesia ferruginea*, *Vaccinium ovalifolium* and

*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

Oplopanax horridus may also be common, especially in the spruce-dominated type.

Common herbaceous species include *Calamagrostis canadensis*, *Chamerion angustifolium*, *Gymnocarpium dryopteris*, *Cornus canadensis* and, especially in the spruce-dominated type, *Equisetum arvense* and *Dryopteris expansa*. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi* (DeVelice et al. 1999).

Disturbance Description

The major disturbance processes are fire, human disturbance, blowdown, insect infestations and, in the Kenai Mountains, snow avalanches. Although lightning and natural fires have historically been infrequent, wildfire plays an important role in the disturbance regime of this system (NatureServe 2008). Under the natural fire regime, fires were infrequent, but large (USDA Forest Service 2002). Estimates of the mean fire return interval range from 600-800yrs (Berg and Anderson 2006, Berg et al. 2004, Potkin 1997, personal communication FRCC experts' workshop March 2004).

Spruce bark beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of sub-boreal spruce and spruce-hardwood forests. Spruce beetles typically attack larger, slow-growing spruce, but infestations periodically escalate to epidemic levels when forest and climatic conditions are favorable for beetle expansion (NatureServe 2008). During epidemic-level infestations, beetles are less selective and may attack and kill a wider range of spruce trees. Beetle outbreaks that thin stands and produce a growth release in surviving trees occur on average every 50yrs in white and Lutz spruce forests on the Kenai Peninsula (Berg et al 2006). Spruce bark beetle outbreaks that produce a more substantial thinning occur at longer intervals, with the last two severe infestations occurring in the 1870s-1880s and 1987-present (Berg et al 2006). The bark beetle outbreak that began in 1987 on the Kenai Peninsula has killed over 1.3 million acres of spruce (USDA Forest Service 2002). Berg (2004) found no association between spruce bark beetle mortality and fire in the past.

When the canopy of these forests is thinned by heavy spruce bark beetle-mortality, bluejoint grass (*Calamagrostis canadensis*) and fireweed (*Epilobium angustifolium*) tend to increase rapidly and dominate the site for at least 10yrs (Holsten et al. 1995). *Calamagrostis* may proliferate rapidly from its pre-disturbance low level network of rhizomatous roots and may develop into a thick, seedling-excluding sod within a few years (Berg et al 2006). Boucher (2003) found that rapid spread of *Calamagrostis* occurs primarily on sites with deep, loamy soils. Thinning of the spruce canopy by beetle attacks also helps to maintain hardwoods in the canopy over time.

Other natural disturbances include wind, avalanche and landslides. Windthrow gap disturbances are important in both spruce and hemlock recruitment in these forests (Potkin 1997).

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

Native Uncharacteristic Conditions

Adapted from Murphy and Witten (2006): The present landscape of the western Kenai Peninsula reflects human-caused fires that occurred over the last 100yrs, creating areas of early successional plant communities, which include large stands of broadleaved forests (Potkin 1997). Over 99% of the fires occurring on the Kenai Peninsula portion of the Chugach National Forest between 1914 and 1997 were

*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

ignited by human actions (Potkin 1997). These human-caused fires have generally increased the richness and patchiness of the vegetation at the landscape scale (USDA Forest Service 2002). The large number of acres burned on the Kenai Peninsula during settlement caused conversion of some mature spruce stands to grass, brush and broadleaf tree vegetation types. Prior to the settlement period of the late 1800s, the majority of the age structures of the coniferous forest surveyed by Potkin (1997) were likely in the late successional stages (Langille 1904 in Potkin 1997) and conifers were likely dominant.

Following spruce bark beetle outbreaks on the Kenai Peninsula grass and other fine vegetation increased (Holsten et al 1995). Fire spreads rapidly through this type of vegetation; indeed the majority of fires (most of which were human caused) on the Kenai Peninsula portion of the Chugach National Forest between 1914 and 1997 occurred in grassy vegetation (Potkin 1997). Standing and downed beetle killed trees increase the amount of both fine, flashy fuels and heavy fuels. Spruce bark beetle outbreaks may be increasing in frequency and severity in southcentral Alaska due to the warming climate. Berg et al. (2006) found that recent outbreaks on the Kenai peninsula were positively associated with average summer temperature in the preceding years. If this is true, current patterns of beetle attack and current fire regimes are likely atypical of reference conditions for this type.

Scale Description

Matrix or large patch

Issues/Problems

Comments

This model was based on the FRCC Guidebook Potential Natural Vegetation Group model for Coastal Boreal Transition Forest (CBTF) (Murphy and Witten 2006). Disturbances with a probability of 0.0001 (i.e. 10,000yr return interval) were removed from the model because their effect is insignificant in a 1000yr simulation. Class ages were adjusted slightly to make them line up along the main successional pathway, and the relative age function was not used in any class except A to comply with LANDFIRE modeling rules. These changes did not change the fire return intervals or the percent of the landscape in each class. Because only minor changes were made to the CBTF VDDT model, its original authors are included as contributors to this model, and Kori Blankenship's name was added. Much of the text in the General Information section of this description was taken from the draft Boreal Ecological Systems legend (NatureServe 2008).

Vegetation Classes

Class A 5%

Structure Data (for upper layer lifeform)

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
☒ Shrub
☐ Tree

Indicator Species* and Canopy Position

CACA4 Upper
 EQAR Upper
 CHAN9 Upper
 MEFE Upper

	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

0 -29yrs

Post disturbance regeneration: herbaceous to tall shrub-sapling. Following a moderate severity burn,

*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.

vegetative reproduction of shrubs and birch and aspen from shoots and suckers. Light-seeded herbs establish where mineral soil is exposed. White and Lutz spruce seedlings are rare, but may be present if mineral soil was exposed, seed trees remained after fire and they produced a good seed crop (Foote 1983). Following severe fire on loamy soil, Calamagrostis may spread rapidly from rhizomes and capture a large percentage of the site (Boucher 2003). Mosses and lichens exist but are not an important component. If Calamagrostis captures the site, it may persist throughout this class but may become less dominant within 20yrs (Schulz 2000).

Common shrubs include Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vaccinium vitis-idaea and Linnaea borealis. Common herbaceous species include Calamagrostis canadensis, Equisetum arvense, Dryopteris expansa and Gymnocarpium dryopteris.

Succession to class B. More open sites are represented by an alternate succession pathway to C (probability = 0.005)

Class B 10 %

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and Canopy Position

PIGL Upper
BEPA Upper
POBA2 Upper
POTR5 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Closed (60-100% 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.

For mapping, presence of hardwoods distinguishes class B from class E.

Description

30-129yrs

Closed conifer, hardwood, or mixed. Tree saplings gain canopy dominance over shrubs. Tree species may include spruce, hardwoods or both. Rosa acicularis, Equisetum spp. and Linnaea borealis are commonly in the understory. Mosses and lichens become established.

Succession to class E. Replacement MFRI = 1000yrs.

Class C 15 %

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and Canopy Position

PIGL Upper
BEPA Upper
POBA2 Upper
POTR5 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Open (25-59% tree cover)	Open (25-59% 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.

For mapping, presence of hardwoods distinguishes class C from D.

Description

30-129yrs

Open conifer, hardwood or mixed. Young trees become dominant in the overstory. Calamagrostis, if

*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

dominant in class A, diminishes in importance. *Rosa acicularis*, *Equisetum* spp. and *Linnea borealis* are commonly in the understory. Lichens and mosses become established.

Succession to class D. Replacement MFRI = 1000yrs.

Class D 65 %

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and Canopy Position

PIGL Upper
 BEPA Upper
 POBA2 Upper
 POTR5 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Woodland (10-24% tree cover)	Open (25-59% tree cover)
Height	Tree (> 3 m)	Tree (> 3 m)
Tree Size Class	Large 20" – 40"	

- ☐ Upper layer lifeform differs from dominant lifeform.

For mapping, absence of hardwoods distinguishes class D from C.

Description

130-400yrs

Open conifer. Open spruce, hardwood or mixed stands with tree density <60%. Hardwoods, if present and mixed with spruce, lose dominance in overstory during this phase. Occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.

This class persists in the absence of disturbance. Replacement MFRI = 625yrs. Mixed fire (MFRI = 3333yrs) causes a transition to C. Insects and disease can maintain this class (probability = 0.028) or cause a transition to C (probability = 0.0015)

Class E 5 %

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
☐ Shrub
☒ Tree

Indicator Species* and Canopy Position

PIGL Upper
 BEPA Upper
 POBA2 Upper
 POTR5 Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	Closed (60-100% tree cover)	Closed (60-100% tree cover)
Height	Tree (> 3 m)	Tree (> 3 m)
Tree Size Class	Large 20" – 40"	

- ☐ Upper layer lifeform differs from dominant lifeform.

For mapping, absence of hardwoods distinguishes class E from B.

Description

130-400yrs

Closed conifer, hardwood, or mixed. Site is dominated by mature conifers with >60% canopy closure. Hardwoods, if present and mixed with spruce, lose dominance in overstory during this phase. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.

This class persists in the absence of disturbance. Replacement MFRI = 606yrs. Mixed fire (MFRI = 2500yrs) causes a transition to D. Insects and disease can maintain this class (probability = 0.012), cause a transition to D (probability = 0.013) or cause a transition to C (probability = 0.0018).

Disturbances

*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

Fire Regime Group:** V

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	715			0.0014	87
Mixed	5000			0.0002	12
Surface					
All Fires	625			0.00161	

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

Berg, E. 2004. White spruce fire history on the Kenai Peninsula, Alaska, based on radiocarbon-dated soil charcoal. Unpublished manuscript. Kenai National Wildlife Refuge, AK.

Berg, E.E., J.D. Henry, C.L. Fastie, A.D. De Volder and S.M. Matsuoka. 2006. Spruce beetle outbreaks on the Kenai Peninsula, Alaska, and Kluane National Park and Reserve, Yukon Territory: Relationship to summer temperatures and regional differences in disturbance regimes. *For. Ecol. Man.* 227(3): 219-232.

Berg, E. and R.S. Anderson. 2006. Fire history of white and Lutz spruce forests on the Kenai Peninsula, Alaska, over the last two millennia as determined from soil charcoal. *For. Ecol. Man* 227: 275-283.

Boucher, T.V. 2003. Vegetation response to prescribed fire in the Kenai Mountains, Alaska. Res. Pap. PNW-RP-554. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 59 pp.

DeVelice, R.L., Hubbard, C.J., Boggs, K. et al. 1999. Plant community types of the Chugach National Forest. Tech. Publ. R10-TP-76. Juneau, AK: USDA Forest Service, Alaska Region. 375 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.

Holsten, E.H., R.A. Werner and R.L. DeVelice. 1995. Effects of spruce beetle (Coleoptera: Scolytidae) outbreak and fire on Lutz spruce in Alaska. *Environmental Entomology* 24(6): 1539-1547.

Murphy, K.A. and E. Witten. 2006. Coastal Boreal Transition Forest. 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.

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.

*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

Potkin, M. 1997. Fire history disturbance study of the Kenai Peninsula mountainous portion of the Chugach National Forest. Draft. USDA Forest Service, Chugach National Forest. December 5, 1997. Anchorage, AK.

Ritter, D.F. 1986. Process geomorphology. Wm. C. Brown Publishers, Dubuque, Iowa. 579 pp.

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

Rude, M. Kenai Peninsula Spruce Bark Beetle Mitigation Program, unpublished data.

Schulz, B. 2000. Resurrection Creek Permanent Plots Revisited. USDA Forest Service, Forest Health Protection, Alaska Region, Anchorage, AK. Technical report R10-TP-89. 14 pp.

USDA Forest Service. 2004. Forest insect and disease conditions in Alaska in 2003. USDA Forest Service, Forest Pest Management Tech. Rep. R10-TP-123, Anchorage, AK.

USDA Forest Service. 2002. Final Environmental Impact Statement, Chugach National Forest Land Management Plan Revision. Available at: http://www.fs.fed.us/r10/chugach/forest_plan/feis_docs.html.

Van Hees, W.W.S. and F.R. Larson. 1991. Timberland resources of the Kenai Peninsula, Alaska, 1987. USDA Forest Service Resource Bulletin PNW-RB-180. Portland, OR. 56 pp.

Werner, R.A., E.H. Holsten, S.M. Matsuoka and R.E. Burnside. 2006. Spruce beetles and forest ecosystems in south-central Alaska: A review of 30 years of research. *Forest Ecology and Management* . 227(3): 195-206.

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.

*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.