# LANDFIRE Biophysical Setting Model

## *Biophysical Setting* 7716790 Alaska Sub-boreal White Spruce-Hardwood Forest

☑ *This BPS is lumped with: see below*

☐ *This BPS is split into multiple models: AK 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



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**Vegetation Type**

Forest and Woodland

**Map Zone**

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**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 | 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

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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 sucessional 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 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 created for the AK sub-boreal region and did not receive review for other parts of the state.

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 .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*

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### *Class A* 5 %

Early Development 1 All Structures

**Upper Layer Lifeform**

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

**Indicator Species* and Canopy Position**

| | |
|---|---|
| CACA4 | Upper |
| EQAR | Upper |
| CHAN9 | Upper |
| MEFE | 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**

0-29yrs

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

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### *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.

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**Class C** **15 %**

Mid Development 1 Open

**Upper Layer Lifeform**

- [ ] Herbaceous
- [ ] Shrub
- [x] 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 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.

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**Class D** **65 %**

Late Development 1 Open

**Upper Layer Lifeform**

- [ ] Herbaceous
- [ ] Shrub
- [x] 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)

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***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

**Fire Regime Group**:** V

**Historical Fire Size (acres)**

Avg 0
Min 0
Max 0

**Sources of Fire Regime Data**

- ☑ Literature
- ☐ Local Data
- ☑ Expert Estimate

**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 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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