16790

Alaska Sub-boreal White-Lutz Spruce-Hardwood Forest and Woodland

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Vegetation Type

Forest and Woodland

Map Zones

73, 74, 75, 76, 77

Geographic Range

These systems occur throughout the sub-boreal region of AK.

Biophysical Site Description

This BpS typically occurs 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.

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 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).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIGL | Picea glauca | White spruce |
| BEPA | Betula papyrifera | Paper birch |
| POBA2 | Populus balsamifera | Balsam poplar |
| POTR5 | Populus tremuloides | Quaking aspen |
| MEFE | Menziesia ferruginea | Rusty menziesia |
| ALVIS | Alnus viridis ssp. sinuata | Sitka alder |
| CACA4 | Calamagrostis canadensis | Bluejoint |
| OPHO | Oplopanax horridus | Devilsclub |

Disturbance Description

The major disturbance processes are fire, insect infestations, blowdown, landslides, and (in the Kenai Mountains) snow avalanches. Windthrow gap disturbances are important in both spruce and hemlock recruitment in these forests (Potkin 1997).

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 could be very 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). White spruce is typically killed by fire (Abrahamson 2015). 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).

In 2014, an extensive literature search was done by Fire Effects Information System staff to locate information for a synthesis on Fire regimes of Alaskan white spruce communities (Abrahamson 2014). According to this synthesis: “Most historical and paleological evidence suggests that subboreal white spruce communities on the Kenai Peninsula burned infrequently [Berg and Anderson 2006, Boucher 2003, Potkin 1997]. Soil charcoal data from the western Kenai Peninsula suggest that upland white spruce and Lutz spruce forests have not burned for an average of 600 years. Across 22 sites, time-since-fire ranged from 90 to ~1,500 years. Over the last ~2,500 years, the mean fire-return interval was 515 ± 355, with intervals ranging from 105 to 1,642 years [[Berg](http://www.fs.fed.us/database/feis/fire_regimes/AK_white_spruce/all.html#16) and Anderson 2006].”

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. In south-central and southwest Alaska, Sheriff and others (2011) reported a 10 to 165 year interval between outbreaks and an average of 48 years based on a 250-year record.

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.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 715 |  |  | 87 |
| Moderate (Mixed) | 5000 |  |  | 13 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **625** |  |  | **100** |

Scale Description

Matrix or large patch

Non-Fire Disturbances

Insects/Disease

Adjacency or Identification Concerns

Issues or Problems

There is little scientific literature about fire regimes in Alaskan white spruce communities (Abrahamson 2014).

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 100 years, 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.

Comments

For LANDFIRE National this model did not receive review specifically for z76. 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. 10,000 year return interval) were removed from the model because their effect is insignificant in a 1000 year 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).

**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:CLS | 29 |
| Late1:CLS | 130 | Late1:CLS | 400 |
| Late1:OPN | 130 | Late1:OPN | 399 |
| Mid1:CLS | 30 | Late1:CLS | 129 |
| Mid1:OPN | 30 | Late1:OPN | 129 |

**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** |
| AltSuccession | Early1:ALL | Mid1:OPN | 0.0050 | 200 | Yes | 0 |
| ReplacementFire | Late1:CLS | Early1:ALL | 0.0017 | 588 | Yes | 0 |
| Insect/Disease | Late1:CLS | Late1:CLS | 0.0120 | 83 | No | 0 |
| Insect/Disease | Late1:CLS | Late1:OPN | 0.0130 | 77 | Yes | 0 |
| MixedFire | Late1:CLS | Late1:OPN | 0.0004 | 2,500 | Yes | 0 |
| Insect/Disease | Late1:CLS | Mid1:OPN | 0.0018 | 556 | Yes | 0 |
| ReplacementFire | Late1:OPN | Early1:ALL | 0.0016 | 625 | Yes | 0 |
| Insect/Disease | Late1:OPN | Late1:OPN | 0.0280 | 36 | No | 0 |
| Insect/Disease | Late1:OPN | Mid1:OPN | 0.0015 | 667 | Yes | 0 |
| MixedFire | Late1:OPN | Mid1:OPN | 0.0003 | 3,333 | Yes | 0 |
| ReplacementFire | Mid1:CLS | Early1:ALL | 0.0010 | 1,000 | Yes | 0 |
| ReplacementFire | Mid1:OPN | Early1:ALL | 0.0010 | 1,000 | Yes | 0 |

Succession Classes

Class A 5 Early Development 1 - All Structures

Structural Information

Tree Size Class: Seedling/Sapling <5"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CACA4 | Calamagrostis canadensis | Bluejoint | Upper |
| EQAR | Equisetum arvense | Field horsetail | Upper |
| CHAN9 | Chamerion angustifolium | Fireweed | Upper |
| MEFE | Menziesia ferruginea | Rusty menziesia | Upper |

Description

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.

More open sites are represented by an alternate succession pathway.

Class B 10 Mid Development 1 - Closed

Structural Information

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

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIGL | Picea glauca | White spruce | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POBA2 | Populus balsamifera | Balsam poplar | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

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.

Class C 15 Mid Development 1 - Open

Structural Information

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

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIGL | Picea glauca | White spruce | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POBA2 | Populus balsamifera | Balsam poplar | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

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.

Class D 65 Late Development 1 - Open

Structural Information

Tree Size Class: Large 20" – 40"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIGL | Picea glauca | White spruce | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POBA2 | Populus balsamifera | Balsam poplar | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

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.

Class E 5 Late Development 1 - Closed

Structural Information

Tree Size Class: Large 20" – 40"

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIGL | Picea glauca | White spruce | Upper |
| BEPA | Betula papyrifera | Paper birch | Upper |
| POBA2 | Populus balsamifera | Balsam poplar | Upper |
| POTR5 | Populus tremuloides | Quaking aspen | Upper |

Description

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.

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