16780

Alaska Sub-boreal Mountain Hemlock-White Spruce Forest

BpS Model/Description Version: Nov. 2024

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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| None | None | None | None |

Reviewer: Beth Schulz

Vegetation Type

Forest and Woodland

Map Zones

75, 77

Geographic Range

This Biophysical Setting (BpS) occurs primarily in the Kenai and Chugach Mountains.

Biophysical Site Description

This BpS occurs on sideslopes and rolling terrain in the Kenai and Chugach Mountains and represents a transition from maritime forests to southcentral boreal forests. Soils are mesic and derived from colluvium, glacial deposits, or residual bedrock.

Vegetation Description

*Picea glauca* (more common on the northern part of the Kenai Peninsula) or *Picea X lutzii* (the hybrid produced where the ranges of *P. sitchensis* and *P. glauca* overlap; more common on the central and western portions of the Kenai Peninsula) and *Tsuga mertensiana* are the dominant conifers. *T. mertensiana* has at least 15% cover. Other tree species that may be present include *Betula papyrifera var. kenaica* and *Populus balsamifera*.

Common shrubs include *Menziesia ferruginea*, *Alnus viridis* ssp. *Sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vaccinium vitis-idaea, Rubus pedatus* and *Linnaea borealis*. Common herbaceous species include *Equisetum arvense, Dryopteris expansa* and *Gymnocarpium dryopteris*. Common mosses include *Hylocomium splendens* and *Pleurozium schreberi*. Plant communities in this BpS are described by DeVelice et al. (1999).

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PILU | *Picea lutzii* | Picea lutzii |
| TSME | *Tsuga mertensiana* | Mountain hemlock |
| BEPAK | *Betula papyrifera var. kenaica* | Kenai birch |
| POBA2 | *Populus balsamifera* | Balsam poplar |
| MEFE | *Menziesia ferruginea* | Rusty menziesia |
| VACCI | *Vaccinium spp.* | Blueberry |
| RUPE | *Rubus pedatus* | Strawberryleaf raspberry |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

The major disturbance processes in this system are fire, human disturbance, blowdown, avalanches, and insect infestations. Although lightning and natural fires have historically been infrequent, wildfire plays an important role in the disturbance regime of this system. Under the natural fire regime, fires were infrequent, but large. Estimates of the mean fire return interval range (MFRI) are from 600-800yrs (Berg and Anderson 2006, Potkin 1997 unpubl.). This model includes an overall fire return interval of 800yrs.

Spruce beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forest in southcentral AK. While the spruce component in this BpS is impacted by spruce beetles, the hemlock is not. The major affect of spruce beetle is that they create openings in dense forest cover. Forests of the Kenai Peninsula have experienced periodic beetle infestations which occasionally rise to epidemic proportions. A major infestation, which began in 1987, impacted 429,000ha on the Kenai Peninsula (USDA Forest Service 2004; Rude, Kenai Peninsula Spruce Bark Beetle Mitigation Program, unpublished data) out of 772,000ha of total forested area (van Hees and Larson 1991).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 1008 | 80 |  |  |
| Moderate (Mixed) | 3912 | 20 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 802 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Matrix

Adjacency or Identification Concerns

This system is similar to Alaska Sub-boreal White Spruce Forest but has at least 15% cover *Tsuga Mertensiana*. Within the Kenai Mountains, this BpS occurs above the Kenai White Spruce Forest and below the Mountain Hemlock Forest.

Issues or Problems

Native Uncharacteristic Conditions

The following information was taken from the Coastal Boreal Transition Forest FRCC Guidebook model description (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.

Comments

Tina Boucher and Kori Blankenship based this model on the FRCC Guidebook PNVG model for Coastal Boreal Transition Forest (CBTF; Murphy and Witten 2006). The MFRI was increased from the CBFT model based on input from the experts who attended the LANDFIRE Anchorage modeling meeting (Dec. 07). 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 Class A to comply with LANDFIRE modeling rules. Beth Schulz reviewed an initial draft of this model. Tina Boucher reviewed a later draft and suggested that this system would be mostly in the closed canopy classes under reference conditions. Alternate succession pathways were added to classes C and D to allow for recovery and closure of the canopy following insect attacks.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 5-10 | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 10-25 | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 25-50 | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | >50 | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | C brdlf | B brdlf | B brdlf | B brdlf | B brdlf |
| Tree | 0-5 | C mix | C mix | C mix | C mix | C mix | C mix | B mix | B mix | B mix | B mix |
| Tree | 5-10 | C mix | C mix | C mix | C mix | C mix | C mix | B mix | B mix | B mix | B mix |
| Tree | 10-25 | C mix | C mix | C mix | C mix | C mix | C mix | B mix | B mix | B mix | B mix |
| Tree | 25-50 | C mix | C mix | C mix | C mix | C mix | C mix | B mix | B mix | B mix | B mix |
| Tree | >50 | C mix | C mix | C mix | C mix | C mix | C mix | B mix | B mix | B mix | B mix |
| Tree | 0-5 | D con | D con | D con | D con | D con | D con | E con | E con | E con | E con |
| Tree | 5-10 | D con | D con | D con | D con | D con | D con | E con | E con | E con | E con |
| Tree | 10-25 | D con | D con | D con | D con | D con | D con | E con | E con | E con | E con |
| Tree | 25-50 | D con | D con | D con | D con | D con | D con | E con | E con | E con | E con |
| Tree | >50 | D con | D con | D con | D con | D con | D con | E con | E con | E con | E con |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 2 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| BEPA | *Betula papyrifera var. kenaica* | Kenai birch | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Upper |
| ALVIS | *Alnus viridis* ssp*. sinuata* | Sitka alder | Upper |
| CHAN2 | *Chlorogalum angustifolium* | Narrowleaf soap plant | Upper |

Description

Herbaceous vegetation, shrubs, and saplings dominate this class. Following a moderate severity burn, shrubs (e.g., *Menziesia ferruginea, Alnus viridis* ssp. *sinuata, Vaccinium ovalifolium* and *Oplopanax horridus*) reproduce vegetatively from shoots and suckers. Light-seeded herbs establish where mineral soil is exposed (e.g., *Chamerion angustifolium* and *Equisetum arvense*). Birch seeds in on mineral soil if there is a seed source. 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). Later in this class, dense tall shrubs (*Alnus* spp. and *Salix* spp.) and/or saplings are in the overstory, with herbs, tree seedlings, and litter below. Mosses and lichens exist but are not an important component.

*Maximum Tree Size Class*  
Seedling/Sapling <5"

Class B 20 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| BEPA | *Betula papyrifera var. kenaica* | Kenai birch | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |

Description

Hardwood, spruce-hemlock or spruce-hemlock-hardwood forest dominates. Tree saplings gain canopy dominance over shrubs. *Menziesia ferruginea, Alnus viridis* ssp. *sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vacciniun vitis-idaea* and *Linnaea borealis* are commonly in the understory. Mosses and lichens become established.

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

Class C 6 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| BEPA | *Betula papyrifera var. kenaica* | Kenai birch | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |

Description

Hardwood, spruce-hemlock, or spruce-hemlock-hardwood forest dominates. Young trees become dominant in the overstory. *Menziesia ferruginea, Alnus viridis* ssp. *sinuata, Vaccinium ovalifolium, Oplopanax horridus, Vaccinium vitis-idaea* and *Linnaea borealis* are commonly in the understory. Lichens and mosses become established.

If this class originates from an insect attack that has thinned the spruce to open up the canopy, the canopy will often close up as the remaining overstory trees expand their canopies and understory trees grow into the canopy. This pathway is represented by alternate succession to Class B.

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

Class D 27 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |
| VAOV | *Vaccinium ovalifolium* | Oval-leaf blueberry | Lower |

Description

Open spruce-hemlock forest with < 60% canopy closure. Hardwoods, if present and mixed with spruce, lose dominance in the overstory during this phase. Occasional hardwoods may remain. The understory may include various combinations of tall shrubs, low shrubs, herbs, mosses and lichens.

If this class originates from an insect attack that has thinned the spruce to open up the canopy, the canopy will often close up as the remaining overstory trees expand their canopies and understory hemlocks grow into the canopy. This pathway is represented by alternate succession to Class E.

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

Class E 45 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |
| VAOV | *Vaccinium ovalifolium* | Oval-leaf blueberry | Lower |

Description

Closed spruce-hemlock forest 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.

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

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 29 |
| Mid1:OPN | 30 | Late1:OPN | 129 |
| Mid1:CLS | 30 | Late1:CLS | 129 |
| Late1:OPN | 130 | Late1:OPN | 999 |
| Late1:CLS | 130 | Late1:CLS | 999 |

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** |
| Alternative Succession | Early1:ALL | Mid1:OPN | 0.005 | 200 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Mid1:CLS | 0.02 | 50 | Yes | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0008 | 1250 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Mid1:OPN | 0.0001 | 10000 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.0008 | 1250 | Yes | 0 |
| Mixed Fire | Late1:OPN | Mid1:OPN | 0.0003 | 3333 | Yes | 0 |
| Insects or Disease | Late1:OPN | Mid1:OPN | 0.0015 | 667 | Yes | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.028 | 36 | No | 0 |
| Alternative Succession | Late1:OPN | Late1:CLS | 0.02 | 50 | Yes | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0011 | 909 | Yes | 0 |
| Insects or Disease | Late1:CLS | Mid1:OPN | 0.0018 | 556 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Late1:OPN | 0.0001 | 10000 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.0004 | 2500 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.013 | 77 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:CLS | 0.012 | 83 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0011 | 909 | Yes | 0 |

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