16481

Alaskan Pacific Mountain Hemlock Forest and Subalpine Woodland - Northern

BpS Model/Description Version: Nov. 2024

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| --- | --- | --- | --- |
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Reviewer: Beth Schulz, Kristen Zouhar

Vegetation Type

Forest and Woodland

Map Zones

75, 77

Model Splits or Lumps

Alaskan Pacific Mountain Hemlock Forest and Subalpine Woodland was split into northern and southern variants to model differences in fire regimes. For mapping BpS 16481 should apply to the range of this BpS excluding map zone 78.

Geographic Range

This Biophysical Setting (BpS) occurs primarily at the elevational limit of tree growth in the mountain ranges along the subpolar rainforest region of the Gulf Coast of Alaska, including the Kenai, Chugach, St. Elias, Fairweather, and Coast mountains (Alaback 1991; Alaback 1995). It occurs primarily in the maritime region, but also occurs in the sub-boreal transition between coastal and boreal forests, on the inland side of the Kenai and Chugach mountains. It extends along the Gulf Coast of Alaska from Kenai Fjords to Yakutat. The Southeast BpS model variant of this system occurs from around Yakutat Bay south through southeastern Alaska.

Biophysical Site Description

This BpS occurs on lower and upper mountain sideslopes, shoulders, benches, and bedrock outcrops at mid-elevations up to treeline. Soils are typically poorly to well-drained, shallow and are derived from glacial and colluvial deposits, as well as residual bedrock. Within the Kenai, Chugach, and St. Elias mountains, the elevation range is from 0 to 1900 ft. On the Chugach National Forest Mt. Hemlock-Sitka Spruce associations are found at elevations up to 1200 feet and Mt. Hemlock associations are found several hundred feet higher (DeVelice 1999). In southeastern Alaska, the elevation range is 980 to 3280 ft. The lower and upper elevational limits of this system decrease from south to north and from east to west. This BpS is common on north-facing slopes with late lying snow, and also occurs on east and west aspects. This system is uncommon on south-facing slopes.

Vegetation Description

*Tsuga mertensiana* is the dominant conifer with at least 15% cover, and often grows with a stunted growth form (krummholz), but associated canopy trees vary by region. Mature *Tsuga mertensiana* trees are typically 18 to 25 m tall with dbh ranging from 38 to 50 cm (Viereck et al. 1992). *Picea sitchensis* or *Tsuga heterophylla* may be codominant on sites along the central Gulf Coast (Prince William Sound) but are less abundant than *Tsuga mertensiana*. *Picea sitchensis* is commonly found on steep slopes and both *Picea sitchensis* and *Thuja plicata* are occasionally present near the coast. *Tsuga heterophylla* often occurs at lower elevations in this system. *Callitropsis nootkatensis (= Chamaecyparis nootkatensis)* may be present in the overstory in isolated locations in Prince William Sound.In the sub-boreal region, *Picea glauca* or *Picea x lutzii* may be present on the inland (non-maritime) portion of the Kenai and Chugach Mountains, but have less than 15% canopy cover. *Betula papyrifera* *var.* *kenaica* may be common in early seral stages in inland sites. Common shrubs include *Alnus viridis* ssp*. sinuata, Vaccinium ovalifolium, Vaccinium vitis-idaea, Oplopanax horridus*, *Menziesia ferruginea, Harrimanella stelleriana (= Cassiope stelleriana)*, *Rubus spectabilis, Elliotia pyroliflora*, and *Empetrum nigrum*. Common herbaceous species include *Cornus canadensis, Rubus pedatus, Dryopteris expansa*, *Gymnocarpium dryopteris, Phyllodoce aleutica, Luetkea pectinata, Listera cordata, Geum calthifolium, Tiarella trifoliata, Streptopus amplexifolius, Blechnum spicant,* and *Nephrophyllidium crista-galli* (Demeo et al. 1992). Common mosses include *Hylocomium splendens* and *Pleurozium schreberi*. *Sphagnum* spp. may be abundant on sites with restricted drainage. Plant communities in this system are described by DeVelice et al. (1999).

*Picea sitchensis, Elliottia pyroliflorus* and *Nephrophyllidium crista-galli* do not occur in the sub-boreal portion of the region.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| TSME | *Tsuga mertensiana* | Mountain hemlock |
| PISI | *Picea sitchensis* | Sitka spruce |
| PILU | *Picea lutzii* | Picea lutzii |
| VAOV | *Vaccinium ovalifolium* | Oval-leaf blueberry |
| ALVIS | *Alnus viridis ssp. sinuata* | Sitka alder |
| MEFE | *Menziesia ferruginea* | Rusty menziesia |
| ELPY | *Elliottia pyroliflorus* | Copperbush |
| NECR2 | *Nephrophyllidium crista-galli* | Deercabbage |

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

Disturbance Description

In 2017 an extensive search was done by Fire Effects Information System staff to locate information for a synthesis on fire regimes of Alaskan mountain hemlock ecosystems (Zouhar 2017). Selected information from the synthesis is included herein.

Mountain hemlock forests are stable over long periods and rarely experience large-scale disturbances (Viereck et al. 1992). Before European settlement, most of the landscape in the mountain hemlock zone in Alaska was occupied by old-growth forests, showing no signs of large-scale disturbance for many centuries (Boucher 2003). Studies of similar mountain hemlock communities in coastal southwestern British Columbia reveal ancient stands and estimates of 1,000 (Parish and Antos 2006) to more than 1,500 (Lertzman and Krebs 1991; Parish and Antos 2004) years without stand-level disturbances.

Small-patch successional dynamics and old-growth stand structure are typical of mountain hemlock forest communities (e.g., Lertzman 1992; Lertzman and Krebs 1991; Parish and Antos 2004). The major disturbance processes affecting this system include soil creep, wind, snow avalanche, and fungal pathogens such as red ring rot (*Phellinus pini*) (NatureServe 2013), which typically cause mortality of individual or small groups of trees (Boggs et al. 2008). Climate and weather, especially extreme events, may have an important role in small-scale mortality of canopy and subcanopy trees (Parish and Antos 2004). Windthrow gap disturbances are important in both spruce and hemlock recruitment in these forests (Potkin 1997). A moderate level of disturbance probably maintains *Picea sitchensis* in the system.

Evidence of past fires in Alaskan mountain hemlock communities is sparse and fire-frequency estimates are inferred from other data because fire history studies are not available. Evidence suggests long fire-free intervals in these communities, and fires that did occur were likely high-severity and variable in size. In general, long fire-return intervals (FRIs) are the rule on the western coast of North America, where exceptional droughts or successive years of drought are needed to create conditions conducive to fire (Alaback et al. 2003). Lightning is much less common in coastal regions than in interior Alaska (Gabriel and Tande 1983; Noste 1969), and the cold, wet climate and low incidence of lightning rarely provide opportunities for fire in Alaskan mountain hemlock forests. There is almost no lightning and little human activity in the Prince William Sound area suggesting that fire is not an important factor in this system (personal communication, Sue Kesti) for the entire area to which it applies. However, wildfires may play an important role in the disturbance regime in areas where lightning strikes do occur, such as the inland side of the Kenai, the Chugach mountains, and the upper Lynn Canal.

Charcoal was present in most soil pits within the forest zone in the Kenai Mountains; this anecdotal evidence suggests the occurrence of widespread, infrequent fires in this BpS (USDA Forest Service 2002), but at unknown intervals. [A reviewer notes that “It is not clear whether these were mountain hemlock, spruce, or mixed forests (or some of each type), so it is difficult to extrapolate this anecdotal evidence to apply specifically to this BpS.”] Several sites dominated by mountain hemlock in the Kenai Mountains showed evidence of past fires: most commonly charred stumps, but also sedimentary charcoal in soil profiles. Charcoal samples taken from soils at 4 mountain hemlock-dominated sites in this area had average radiocarbon dates of 3,010, 2,470, 1,290, and 570 years BP, suggesting past fires during those periods, but at unknown intervals. An additional site dominated by Lutz spruce with a minor mountain hemlock component had soil charcoal dated to about 1,540 years BP (Potkin 1997).

An estimated FRI for this system is 1000 yrs (personal communication, FRCC expert’s workshop, March 2004). Soil charcoal dates from mountain hemlock and Lutz spruce forests in the Kenai Mountains have been used to suggest an average FRI of 600 years (Potkin 1997), but this is not a standard method for calculating FRIs. Other FRI estimates for this system are based on an estimate of how much time had elapsed since the last fire occurred in mountain hemlock forests in coastal British Columbia (e.g., Lertzman and Krebs 1991; Parish and Antos 2004; Parish and Antos 2006). However, these do not represent mean FRIs, but fire-free periods that resulted in current forest structure and composition. For example, based on estimated ages of large trees growing on large, unscarred stumps, and on preliminary analysis of pollen and charcoal in the soil profile, Lertzman and Krebs (1991) estimate that mountain hemlock stands in the Coast Mountains of British Columbia had not experienced a major fire for over 1,500 years. Similar evidence suggests that fire has been absent from Mt Cain on northern Vancouver Island for 1,500 years or more (Parish and Antos 2004).

Because mountain hemlock has little adaptation to survive fire (Means 1990), the infrequent fires would likely be stand-replacing (Agee 1993). Fires are thought to have been large in mountain hemlock forests (Agee 1993; NatureServe 2013). However, fire size in these systems depends largely on forest distribution and structure, which, at subalpine elevations, is often patchy and grades into shrub, tundra, rock and ice (Agee 1993). The fragmented nature of these forests in the Kenai Mountains, for example, likely limited fire spread (Boucher 2003).

Ignitions in Alaskan mountain hemlock forests may come from adjacent white and Lutz spruce-dominated forests, which burn more frequently. However, observations in the Kenai Mountains suggest that fires may travel from valley bottom Lutz spruce stands, but often stop at the lower boundary of mountain hemlock-dominated forests (Potkin 1997).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 1284 | 80 |  |  |
| Moderate (Mixed) | 5198 | 20 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 1029 | 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, small patch

Adjacency or Identification Concerns

This BpS typically occurs from sea level to treeline in coastal environments. Adjacent BpS types include Alaska Sub-boreal Mountain Hemlock-White Spruce Forest, Alaskan Pacific Maritime Sitka Spruce Forest, and Alaskan Pacific Maritime Western Hemlock Forest. In the sub-boreal region, the Alaska Sub-boreal Mountain Hemlock-White Spruce Forest typically occurs in the elevation zone below this system.

Issues or Problems

This BpS is stable over long periods and rarely disturbed; therefore, secondary succession patterns are poorly understood (Viereck et al 1992). Fire is included in the model but may not occur (or is extremely rare) in some areas to which this model applies

Native Uncharacteristic Conditions

As a result of climate warming, white spruce are now recruiting above mountain hemlock in the sub-boreal region of the Kenai Peninsula.

Comments

4/2022: A reviewer commented that “given the descriptions of this type in Alaska (the patchy nature of the veg and high fuel moisture year-round) it seems more likely that fire severity would be mixed than stand replacing.” The reviewer noted that this was a guess. Feedback is needed on the relative proportions of surface, mixed, and replacement fire in this BpS.

10/2021: This description was updated by NatureServe staff and Kori Blankenship based on the updated Ecological Systems classification for Alaska. Edits focused on adjusting the Geographic Range, Biophysical Site Descriptions, and Vegetation Description sections.

For LANDFIRE National, this model was based on the FRCC Guidebook PNVG model for Kenai Mountain Hemlock (KMHM; Murphy and Witten 2006) but the mid- and late-seral stages had to be collapsed so that LANDFIRE could distinguish them for mapping. Ed Berg and John Morton helped to refine the model for the Kenai Peninsula and Tina Boucher modified the description to include the rest of the range. Much of the Disturbance Description was taken from the Kenai Mountain Hemlock (KMHM; Murphy and Witten 2006) description with some modifications.

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 | C | C | C | C | C | B | B | B | B |
| Tree | 5-10 | C | C | C | C | C | C | B | B | B | B |
| Tree | 10-25 | C | C | C | C | C | C | B | B | B | B |
| Tree | 25-50 | C | C | C | C | C | C | B | B | B | B |
| Tree | >50 | C | C | C | C | C | C | B | B | B | B |

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 3 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| VAOV | *Vaccinium ovalifolium* | Oval-leaf blueberry | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Upper |
| RUSP | *Rubus spectabilis* | Salmonberry | Upper |

Description

This post-disturbance class is characterized by mesic herbaceous vegetation and tall shrubs. Herbaceous species may start from seed immediately post-disturbance. Shrubs and tree seedlings become established; after approximately 50 years tree saplings attain the height of tall shrubs. Common shrubs include *Menziesia ferruginea, Alnus viridis* ssp*. sinuata, Vaccinium ovalifolium* and *Oplopanax horridus*.

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

Class B 61 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |
| ALVIS | *Alnus viridis* ssp*. sinuata* | Sitka alder | Lower |

Description

This class is characterized by closed spruce-mountain hemlock or mountain hemlock forest. Conifers share dominance with tall shrubs in the early stages of this class. Between 170-200 years conifers gain canopy dominance.

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

Class C 36 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| TSME | *Tsuga mertensiana* | Mountain hemlock | Upper |
| PILU | *Picea lutzii* | Picea lutzii | Upper |
| MEFE | *Menziesia ferruginea* | Rusty menziesia | Lower |
| ALVIS | *Alnus viridis* ssp*. sinuata* | Sitka alder | Lower |

Description

This class is characterized by open spruce-mountain hemlock or mountain hemlock forest. Conifers share dominance with tall shrubs in the early stages of this class. Between 170-200yrs conifers gain canopy dominance.

*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 | 49 |
| Mid1:OPN | 50 | Mid1:OPN | 999 |
| Mid1:CLS | 50 | Mid1: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 |
| Wind or Weather or Stress | Mid1:OPN | Mid1:OPN | 0.0002 | 5000 | No | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.0002 | 5000 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.0008 | 1250 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:OPN | 0.0002 | 5000 | Yes | 0 |
| Wind or Weather or Stress | Mid1:CLS | Mid1:CLS | 0.0002 | 5000 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.0008 | 1250 | Yes | 0 |

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