16481

Alaskan Pacific Mountain Hemlock Forest and Subalpine Woodland - Northern

Model Date: 11/05/08 Report Date: 9/11/15

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Reviewer: Kristen Zouhar

Vegetation Type

Forest and Woodland

Map Zones

73, 75, 77, 78

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.

Geographic Range

This system occurs in the Kenai, Chugach, and St. Elias mountains in the subpolar rainforest region (Alaback 1991, 1995). It occurs primarily in the maritime region, but also occurs in the sub-boreal transition between coastal and boreal forests. It extends along the Gulf Coast of AK from Kenai Fjords to Yakutat. The Southeast variant of this system occurs from around Yakutat Bay south through southeastern Alaska.

Biophysical Site Description

Within the Kenai, Chugach, and St. Elias Mountains this system occurs on mountain side slopes, shoulders, and bedrock outcrops from 0 to 1900 ft (NatureServe 2008a). 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). Soils are typically shallow, well-drained and are derived from glacial and colluvial deposits as well as residual bedrock. This BpS is common on north-facing slopes, and also occurs on east and west aspects. This system is uncommon on south-facing slopes (NatureServe 2008a).

Vegetation Description

Tsuga mertensiana may dominate or share dominance with Picea sitchensis or Tsuga heterophylla on sites along the central Gulf Coast (Prince William Sound). Chamaecyparis nootkatensis may be present in the overstory in isolated locations in Prince William Sound. 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 may be common in early seral stages in inland sites.

Common shrubs include Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium, V. vitis-idaea, Oplopanax horridus, Cassiope stellariana, Rubus spectabilis, Elliotia pyroliflora and Empetrum nigrum (NatureServe 2008a, NatureServe 2008b). Common herbaceous species include Cornus canadensis, Rubus pedatus, Dryopteris expansa, Gymnocarpium dryopteris, Listera cordata, Tiarella trifoliata and Streptopus amplexifolius (NatureServe 2008a, NatureServe 2008b). Common mosses include Hylocomium splendens and Pleurozium schreberi (NatureServe 2008). Sphagnum spp. may be abundant on some sites. 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 |

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 are the rule on the western coast of North America, where exceptional droughts or successive years of drought are needed to create conditions conducive fire (Alaback et al. 2003). Lightning is much less common in coastal 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 and Chugach mountains and 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 fire-return interval 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 fire-return interval of 600 years (Potkin 1997); but this is not a standard method for calculating fire-return intervals. Other fire-return interval 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 fire-return intervals, 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** | **Min FI** | **Max FI** | **Percent of All Fires** |
| Replacement | 1430 |  |  | 78 |
| Moderate (Mixed) | 5000 |  |  | 22 |
| Low (Surface) |  |  |  |  |
| **All Fires** | **1111** |  |  | **100** |

Scale Description

Matrix

Non-Fire Disturbances

Wind/Weather/Stress

Adjacency or Identification Concerns

This BpS typically occurs from sea level to treeline in coastal environments; adjacent 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

Review Question:

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

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.

**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 | 49 |
| Mid1:CLS | 50 | Mid1:CLS | 999 |
| Mid1:OPN | 50 | Mid1:OPN | 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** |
| AltSuccession | Early1:ALL | Mid1:OPN | 0.0050 | 200 | Yes | 0 |
| ReplacementFire | Mid1:CLS | Early1:ALL | 0.0008 | 1,250 | Yes | 0 |
| Wind/Weather/Stress | Mid1:CLS | Mid1:CLS | 0.0002 | 5,000 | No | 0 |
| MixedFire | Mid1:CLS | Mid1:OPN | 0.0002 | 5,000 | Yes | 0 |
| ReplacementFire | Mid1:OPN | Early1:ALL | 0.0008 | 1,250 | Yes | 0 |
| MixedFire | Mid1:OPN | Mid1:OPN | 0.0002 | 5,000 | No | 0 |
| Wind/Weather/Stress | Mid1:OPN | Mid1:OPN | 0.0002 | 5,000 | No | 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** |
| 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 50yrs tree saplings attain the height of tall shrubs. Common shrubs include Menziesia ferruginea, Alnus viridis ssp. sinuata, Vaccinium ovalifolium and Oplopanax horridus (NatureServe 2008a, NatureServe 2008b).

Class B 60 Mid Development 1 - Closed

Structural Information

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

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 170-200yrs conifers gain canopy dominance. Tsuga mertensiana is the dominant tree with at least 15% cover.

Class C 35 Mid Development 1 - Open

Structural Information

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

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. Tsuga mertensiana is the dominant tree with at least 15% cover.

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