10550

Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland

BpS Model/Description Version: Aug. 2020

|  |  |  |  |
| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
| Dick Edwards | rsedwards@fs.fed.us | Chuck Kostecka | kostecka@webaccess.net |
| Paul Langowski | plangowski@fs.fed.us | Vic Ecklund | vecklund@csu.org |
| Mike Babler | mbabler@tnc.org | None | None |

Reviewed by: Casey Teske

Vegetation Type

Forest and Woodland

Map Zones

15, 28

Model Splits or Lumps

This BpS is lumped with: Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland (BpS 10560). The descriptions and models are identical.

Geographic Range

Colorado, northern New Mexico, and parts of Arizona and Utah. Elevations typically range from 2,875-3,355m (9,500-11,000ft). Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, south into NM and the Intermountain region. They are the matrix forests of the subalpine zone, with elevations ranging from 1,275m in its northern distribution to 3,355m in the south (4,100-11,000ft). They often represent the highest elevation forests in an area. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. In some areas, such as Wyoming*, Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Xeric species may include *Juniperus communis*, *Linnaea borealis*, *Mahonia repens*, or *Vaccinium scoparium*.

Biophysical Site Description

Biophysical Setting (BpS) occurs in the subalpine zone on gentle to moderately steep terrain (e.g., 10-60% slope). Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches.

Vegetation Description

The overstory is typically dominated by Engelmann spruce and/or subalpine fir. Other tree species may include lodgepole pine, aspen, limber pine, bristlecone pine and Douglas-fir. Cork bark fir occurs in the southern part of the zone. *Pinus contorta* may be common in some areas. *Populous tremuloides* may also occur.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| PIEN | *Picea engelmannii* | Engelmann spruce |
| ABLA | *Abies lasiocarpa* | Subalpine fir |
| PICO | *Pinus contorta* | Lodgepole pine |
| POTR5 | *Populus tremuloides* | Quaking aspen |

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

Disturbance Description

Disturbance includes occasional blowdown, insect outbreaks and stand-replacing fire. Fire Regimes V and IV: Primarily long-interval (e.g., 150-300yrs) stand replacement fires, with minor amount of terrain influenced by moderately long-interval (e.g., 50-100yrs) mixed severity fires. Disturbances also include insect/disease and windthrow events.

In BpS review of 2017, it was suggested that surface fires be added to this type as well. Patch size would vary but could be in the 10s of acres or less and somewhat frequent (e.g., 10-500yrs and 2% of all fires). While evidence of these fires was found in literature, specificity as to return interval, succession classes, and impacts were not found in literature (see Sherriff 2001); therefore surface fires were not included. LANDFIRE suggests local modelers include surface fires where more definitive information exists.

The relationship between spruce beetle and fire disturbances is complex, with some authors noting no increase in fire with an increase in spruce beetle (Andrus 2016). This can be due to a thinning effect by the beetles. Page et al. (2014) report changes in spruce flammability that can change ignition probability. Also see Jolly et al. (2012) and Page et al. (2012).

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 194 | 69 | 150 | 300 |
| Moderate (Mixed) | 424 | 31 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 133 | 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

Patch sizes vary but are mostly in the 100s of acres, with occasional very large patches (disturbances) in the 1,000s of acres. There may be frequent small disturbances in the 10s of acres or less.

Adjacency or Identification Concerns

BpS 1056 (Mesic-Wet Spruce-Fir) and 1055 (Dry-Mesic Spruce-Fir) are similar.

Issues or Problems

Native Uncharacteristic Conditions

Comments

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 | A | A | A | A | A | A | A | A | A | A |
| Tree | 5-10 | C | C | C | C | C | B | B | B | B | B |
| Tree | 10-25 | D | D | D | D | D | E | E | E | E | E |
| Tree | 25-50 | D | D | D | D | D | E | E | E | E | E |
| Tree | >50 | D | D | D | D | D | E | E | E | E | E |

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 14 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIEN | Picea engelmannii | Engelmann spruce | All |
| ABLA | Abies lasiocarpa | Subalpine fir | All |

Description

Early succession after moderately-long to long interval replacement fires.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class B 19 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIEN | Picea engelmannii | Engelmann spruce | Upper |
| ABLA | Abies lasiocarpa | Subalpine fir | Upper |

Description

Shade tolerant and mixed conifer saplings to poles.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class C 18 Mid Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIEN | Picea engelmannii | Engelmann spruce | Upper |
| ABLA | Abies lasiocarpa | Subalpine fir | Upper |

Description

Primarily moderately tolerant saplings to poles.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class D 17 Late Development 1 - Open

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIEN | Picea engelmannii | Engelmann spruce | Upper |
| ABLA | Abies lasiocarpa | Subalpine fir | Upper |

Description

Poles and larger diameter moderately shade tolerant conifer species in small to moderate size patches, generally on south aspects.

*Maximum Tree Size Class*  
Large 21-33"DBH

Class E 32 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| PIEN | Picea engelmannii | Engelmann spruce | Upper |
| ABLA | Abies lasiocarpa | Subalpine fir | Upper |

Description

Pole and larger diameter moderately to shade tolerant conifer species, in moderate to large size patches, all aspects.

*Maximum Tree Size Class*  
Large 21-33"DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 39 |
| Mid1:OPN | 40 | Late1:OPN | 79 |
| Mid1:CLS | 40 | Late1:CLS | 129 |
| Late1:OPN | 80 | Late1:CLS | 129 |
| 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** |
| Competition or Maintenance | Early1:ALL | Early1:ALL | 0.002 | 500 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Alternative Succession | Early1:ALL | Mid1:OPN | 0.02 | 50 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Mid1:OPN | 0.002 | 500 | No | 0 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Mid1:CLS | 0.0125 | 80 | Yes | 0 |
| Competition or Maintenance | Mid1:CLS | Mid1:CLS | 0.001 | 1000 | No | 0 |
| Insects or Disease | Mid1:CLS | Mid1:OPN | 0.002 | 500 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:OPN | 0.01 | 100 | Yes | 0 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.002 | 500 | No | 0 |
| Insects or Disease | Late1:OPN | Late1:OPN | 0.003 | 333 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Insects or Disease | Late1:CLS | Late1:OPN | 0.002 | 500 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:OPN | 0.005 | 200 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.005 | 200 | Yes | 0 |

References

Alexander, B.G., Jr., F. Ronco, Jr., E.L. Fitzhugh and J.A. Ludwig. 1984a. A classification of forest habitat types of the Lincoln National Forest, New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-104. Fort Collins, CO. 29 pp.

Alexander, R.R. and F. Ronco, Jr. 1987. Classification of the forest vegetation on the national forests of Arizona and New Mexico. USDA Forest Service Research Note RM-469. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Andrus, R.A., Veblen, T.T., Harvey, B.J. and Hart, S.J., 2016. Fire severity unaffected by spruce beetle outbreak in spruce‐fir forests in southwestern Colorado. Ecological applications, 26(3), pp.700-711.

DeVelice, R.L. et al. 1986. A Classification of Forest Habitat Types of Northern New Mexico and Southern Colorado. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station. GTR RM-131.

Hart, S.J., Veblen, T.T. and Kulakowski, D., 2014. Do tree and stand-level attributes determine susceptibility of spruce-fir forests to spruce beetle outbreaks in the early 21st century? Forest Ecology and Management, 318, pp.44-53.

Hess, K. and C.H. Wasser. 1982. Grassland, shrubland, and forest habitat types of the White River-Arapaho National Forest. Unpublished final report 53-82 FT-1-19. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 335 pp.

Hess, K. and R.R. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt national forests in northcentral Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-266. Fort Collins, CO. 48 pp.

Higuera, P.E., Briles, C.E. and Whitlock, C., 2014. Fire‐regime complacency and sensitivity to centennial‐through millennial‐scale climate change in Rocky Mountain subalpine forests, Colorado, USA. Journal of Ecology, 102(6), pp.1429-1441.

Jolly, W.M., R.A. Parsons, A.M. Hadlow, G.M. Cohn, S.S. Mcallister, J.B. Popp, R.M. Hubbard, And J.F. Negron. 2012. Relationships between moisture, chemistry, and ignition of Pinus contorta needles during the early stages of mountain pine beetle attack. For. Ecol. Management. 269(1):52–59.

Komarkova, V. et al. 1988. Forest Vegetation of the Gunnison and Parts of the Uncompahgre National Forests: A Preliminary Habitat Type Classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. GTR RM-163.

Mehl, M.S. 1992. Old-growth descriptions for the major forest cover types in the Rocky Mountain Region. Pages 106-120 in: M.R. Kaufmann, W.H. Moir and R.L. Bassett. Old-growth forests in the southwest and Rocky Mountain regions. Proceedings of the old-growth forests in the Rocky Mountains and Southwest conference, Portal, AZ. March 9-13, 1992. USDA Forest Service, General Technical Report RM-213, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Muldavin, E.H., R.L. DeVelice and F. Ronco, Jr. 1996. A classification of forest habitat types southern Arizona and portions of the Colorado Plateau. USDA Forest Service General Technical Report RM-GTR-287. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 130 pp.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Page, W.G., M.J. Jenkins, And J.B. Runyon. 2012. Mountain pine beetle attack alters the chemistry and flammability of lodgepole pine foliage. Can. J. For. Res. 42(8):1631–1647.

Page, W.G., Jenkins, M.J. and Runyon, J.B., 2014. Spruce beetle-induced changes to Engelmann spruce foliage flammability. Forest Science, 60(4), pp.691-702.

Romme, W. H. 1982. Fire and landscape diversity in subalpine forests of Yellowstone National Park. Ecological Monographs. 52(2): 199-221.

Sherriff, R.L., Veblen, T.T. & Sibold, J.S. (2001) Fire history in high elevation subalpine forests in the Colorado Front Range. Ecoscience, 8, 369–380.