

10550

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

BpS Model/Description Version: Aug. 2020

Update: 3/18

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Vegetation Type

Forest and Woodland

Map Zones

27

Geographic Range

Colorado, northern New Mexico and parts of Arizona and Utah. It is questionable if this Biophysical Setting (BpS) occurs in map zone (MZ) 25. It is thought that this BpS might occur on the very tip of the Sandias in MZ27, but probably <100ac. It might also occur in higher elevations on the mapzone border in Colorado.

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 New Mexico and the Intermountain region.

Biophysical Site Description

Engelmann Spruce and Subalpine Fir Forests are the matrix forests of the subalpine zone, with elevations ranging from 1,275m in the north to 3,500m in the south (4,100-11,500ft). 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 individually. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby co-dominated spruce-fir forests are on granitic or volcanic rocks. Xeric species may include *Juniperus communis*, *Linnaea borealis*, *Mahonia repens* or *Vaccinium scoparium*.

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 (not in Southwest). 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 subalpine fir, or possibly Engelmann spruce in the north of the mapzone. Other tree species may include, aspen, limber pine and Douglas-fir. Cork bark fir also may occur in the southern part of the zone.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
PIEN	<i>Picea engelmannii</i>	Engelmann spruce
ABLA	<i>Abies lasiocarpa</i>	Subalpine fir
POTR5	<i>Populus tremuloides</i>	Quaking aspen

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

Disturbance Description

Disturbance includes occasional blow-down, insect outbreaks and stand-replacing fire. Fire regime characterized by primarily long-interval (e.g., 150-300yr) stand replacement fires, with minor amount of terrain influenced by moderately long-interval mixed severity fires.

Disturbances also include insect/disease and windthrow events.

A disturbance regime dominated by infrequent, stand-scale disturbance by crown fire, wind, pests, and pathogens is well documented for the central and northern Rockies, but has not yet been documented for the Southwest. For example, there is little evidence for a crown fire regime in the Southwest, but there is clear evidence for a mixed-severity fire regime in at least the southern Colorado Plateau. For example, Fule et al. (2003) report mean fire return intervals of 8.8 years for 10% scarring and 31 yrs for 25% scarring. The presence of a mixed severity fire regime may reflect the relatively low elevation of many spruce-fir stands in the Southwest and the proximity of these stands to mixed conifer forest; however, it also could represent a shift from climate related factors determining the fire regime of spruce-fir forest at central and northern latitudes (Schoennagel et al. 2004) to a mix of climate- and fuel-related related factors at southern latitudes (Vankat 2005).

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	206	69	150	300
Moderate (Mixed)	452	31		
Low (Surface)				
All Fires	141	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 (much smaller in the Southwest), with occasional very large patches (disturbances) in the thousands of acres. There may be frequent small disturbances in the 10s of acres or less.

Adjacency or Identification Concerns

Most similar to 1056, Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland.

This system 1055 would be adjacent to BpS 1051, 1052, 1055, 1057, 1146, and tundra.

This BpS might also be confused with BpS 1052 and to a lesser degree 1051. BpS 1055 and 1056 can also be confused because low-elevation spruce-fir intermingles with mid-and-high-elevation mixed conifer with spruce-fir in drainages and north-facing slopes and mixed conifer

on other topographic positions. Fire exclusion likely resulted in high elevation mixed conifer having greater resemblance to spruce-fir.

Exotics are not yet common in Southwestern spruce-fir forest. Many stands have recently undergone dramatic insect-related mortality. It is questionable whether this thinning represents a natural cycle or has been promoted by global climate warming.

Prior to the insect-related mortality mentioned above, stands were likely denser because of fire exclusion, assuming that stands in the Southwest had been characterized by a mixed severity fire regime.

Spruce-fir may be a case when different units should be recognized for the Southwest (including MZ25) (see Disturbance Description for differences). Most people assume that research findings for spruce-fir in Colorado also apply to the Southwest, but there is little or no evidence of this. Either we haven't done enough research in the Southwest or spruce-fir functions differently in the Southwest. Research suggests the latter.

Issues or Problems

This system might not occur in MZs 27 or 33; however, the MZs 27 and 33 version received good review and comments for the Southwest in general. Model changes were suggested, but because this system would occur so infrequently in MZs 27 or 33, they were not implemented.

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	13	Early Development 1 - All Structures
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEN	<i>Picea engelmannii</i>	Engelmann spruce	All
ABLA	<i>Abies lasiocarpa</i>	Subalpine fir	All

Description

Early succession after moderately long- to long-interval replacement fires. This class succeeds to a mid-closed stage. Alternatively, it might succeed to a mid-open stage, under the right conditions.

Maximum Tree Size Class

Pole 5-9" DBH

Class B	19	Mid Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEN	<i>Picea engelmannii</i>	Engelmann spruce	Upper
ABLA	<i>Abies lasiocarpa</i>	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
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEN	<i>Picea engelmannii</i>	Engelmann spruce	Upper
ABLA	<i>Abies lasiocarpa</i>	Subalpine fir	Upper

Description

Primarily moderately tolerant saplings to poles (1-6.9in DBH).

Maximum Tree Size Class

Medium 9-21"DBH

Class D	17	Late Development 1 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEN	Picea engelmannii	Engelmann spruce	Upper
ABLA	Abies lasiocarpa	Subalpine fir	Upper
POTR	Poa tracyi	Tracy's bluegrass	Middle

Description

Poles (5in+ DBH) 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	33	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PIEN	Picea engelmannii	Engelmann spruce	Upper
ABLA	Abies lasiocarpa	Subalpine fir	Upper
POTR	Poa tracyi	Tracy's bluegrass	Middle

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	429

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
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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. 1984. 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.

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.

Fulé, P.Z., J.E. Crouse, T.A. Heinlein, M.M. Moore, W.W. Covington and G. Verkamp. 2003. Mixed-severity fire regime in a high-elevation forest of Grand Canyon, Arizona, USA. *Landscape Ecology* 18: 465-486.

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.

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.

NatureServe. 2006. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA, U.S.A. Data current as of 18 July 2006.

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

Schoennagel, T., T.T. Veblen and W.H. Romme. 2004. The interaction of fire, fuels, and climate across Rocky Mountain forests. *BioScience* 54: 661-676.

Vankat, J. L. 2005. Montane and subalpine terrestrial ecosystems of the southern Colorado Plateau – literature review and conceptual models. Pages 1-100 (of Supplement II) in L. Thomas, M. Hendrie (ed.), C. Lauver, S. Monroe, N. Tancroto, S. Garman and M. Miller. *Vital signs*

monitoring plan for the Southern Colorado Plateau Network: phase III report, National Park Service, Southern Colorado Plateau Network, Flagstaff, Arizona
(http://www1.nature.nps.gov/im/units/scpn/Documents/Supplements/SupplementII_Montane_Model.pdf). [note: a version of this has been submitted for publication and is in review]