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Rocky Mountain Aspen Forest and Woodland

BpS Model/Description Version: Aug. 2020

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Vegetation Type

Forest and Woodland

Map Zones

21

Geographic Range

This ecological system is widely distributed in MZ21 within a mosaic of other communities in the Northern US Rockies. Communities are usually small spatial extent, generally <25ac (10ha) in size in the northern portions of this zone, in contrast to larger communities in the central and southern Rockies. Subsections M331Dd, M331Dm, 342Dg, M331Db and 342Dd (Cleland et al. 2007) have communities in patches ranging from 25-100ac (10-40ha) in size.

Biophysical Site Description

Most aspen in MZ21 occurs at elevations from 1,525-2,285m (5,000-7,500ft) in the northern portion of the zone and up to 8,500ft or 2,590m in the southern portion of the zone. Aspen typically occurs between sagebrush steppe and the subalpine forest zone, usually in close association with Douglas-fir forest as well as other conifer forests. Aspen is occasionally found at lower and higher elevations, but these stands are often isolated and small. Generally, aspen stands that have low amounts of conifer cover are associated with mollisols. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily is limited by the length of the growing season or low temperatures. In the long term absence of fire, these sites may transition to Douglas-fir or sagebrush, so there is likely some overlapping with those BpS's.

Vegetation Description

These are upland forests and woodlands dominated by *Populus tremuloides* both with and without a significant conifer component (less than five percent to over 40% relative conifer tree cover). Conifer species include Douglas-fir, lodgepole pine, subalpine fir, limber pine and Engelmann spruce. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Juniperus communis*, *Prunus virginiana*, *Rosa woodsii*, *Shepherdia canadensis*, *Potentilla gracilis*, *Symphoricarpos albus*, and *Vaccinium* spp.

Native grasses could include *Calamagrostis canadensis*, *Calamoagrostis ubescens*, *Carex geyeri*, *Carex rossii*, *Elymus glaucus*, *Elymus trachycaulus*, *Festuca idahoensis*, and *Hesperostipa comata*. Associated forbs may include *Taraxacum officinale*, *Achillea millefolium*, *Aster*

conspicuus, *Delphinium* spp., *Geranium viscosissimum*, *Solidago missouriensis*, *Senecio triangularis*, *Lupinus* spp., *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Rudbeckia occidentalis*, *Thalictrum occidentale*, *Valeriana occidentalis*, and many others.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
POTR5	<i>Populus tremuloides</i>	Quaking aspen
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir
PICO	<i>Pinus contorta</i>	Lodgepole pine
ARTR2	<i>Artemisia tridentata</i>	Big sagebrush
PIEN	<i>Picea engelmannii</i>	Engelmann spruce

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

Disturbance Description

Replacement fire and patchy replacement fires were moderately frequent historically and helped maintain this ecological system on the landscape. Replacement fire was modeled, with an overall MFI of 100yrs. Frequency-size class fire distributions are not readily available, but fire sizes may be highly variable given the widely ranging vegetation composition and topography.

The clonal aspen root system can persist through long periods of disturbance-free conditions. This root system is also able to rapidly respond by sprouting or root suckering after disturbances. Fires may have been more frequent (e.g., <25yrs) where aspen was adjacent or closely associated with grassland or shrubland communities. They occurred approximately every 40yrs in the montane aspen-conifer mix. When adjacent to subalpine zone lodgepole pine or closed-canopy Douglas-fir, fires occurred least frequently, at approximately 100-300yrs (Bradley 1992, Barrett 2004), which could maintain most seral aspen stands. The 100-110yr estimate was a consensus of the reviewers and modelers based on their experience in modern landscapes and literature review (Barrett 2004).

For MZ21, modelers considered fire as an either/or event resulting in canopy mortality rather than as mixed or stand-replacing in severity. Modelers also disregarded the argument of whether aspen is seral or climax and recognized that late successional aspen stages could be mixed with conifers in the absence of fire. Moreover, they included native ungulate browsing as a disturbance regime that could influence successional pathways.

After initial review, another reviewer commented that there should be mixed and surface fires in this system, and that conifer encroachment should be considered and modeled separately (Tart, personal correspondence). However, this was not modeled as original modelers did not respond. It is also thought by another reviewer that this system might have had a more frequent return interval, not based on lightning strikes but rather adjacent types and Native American burning. The return interval in this system is in question.

This BpS can display varying fire severities (FRG II, III and IV) depending on tree species composition, but we chose to model for sites heavily dominated by aspen (FRG IV). Fire return intervals in aspen are heavily influenced by adjacent community disturbance dynamics and could vary dramatically on a landscape and through time as conditions change (20-150yrs between disturbances).

Under pre-settlement conditions, disease and insect mortality probably influenced the stand structure (degree of canopy closure, age classes, etc.) of aspen woodlands in this zone. We assumed that outbreaks would thin older trees, >40yrs. Disturbance effects would also have varied from clone to clone. Many aspen clones situated on steep slopes are prone to disturbance caused by avalanches and mud/rock slides. Riparian aspen is prone to flooding and beaver clear-cutting.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	110	100	4	200
Moderate (Mixed)				
Low (Surface)				
All Fires	110	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 size for this type ranges from less than one hectare to 10ha; occasionally, aspen occurs in patches larger than 10ha in the northern portion of the zone. In the southern portion of the zone, patches from 10-40ha are more common in low elevation. Patches may be linear along riparian areas and the forest/grassland ecotone. Nonlinear patches are often localized in swales, depressions and toeslopes.

Communities are usually small in spatial extent, generally <10ha in size in the northern portions of this zone, in contrast to larger communities in the central and southern Rockies. Subsections M331Dd, M331Dm, 342Dg, M331Db and 342Dd have communities in patches ranging from 25-100ac (10-40ha) in size.

Adjacency or Identification Concerns

In this zone, aspen stands tend to be dynamic in size and distribution and interact with adjacent communities. Because patch sizes tend to be small, and because one state in the disturbance model can include aspen in the understory of a predominantly coniferous stand, they may be difficult to map and identify.

Aspen decline varies across the region. Factors affecting aspen currently include drought, fire suppression and ungulate browsing. These factors have reduced aspen patch sizes and composition, and/or created senescent stands lacking suckers for regeneration of tree-sized aspen.

Depending on ungulate influence, herbaceous layers may be lush and diverse or depauperate and dominated by exotic grasses. Common exotic graminoids may include *Bromus inermis*, *Poa pratensis*, and *Phleum pratense*.

Herbivory also affects the growth rates of aspen sprouts or suckers and at high levels, has the potential to overwhelm the sprouting or suckering response and prevent overstory recruitment from occurring.

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Description

Class A	7	Early Development 1 - All Structures
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
POTR5	Populus tremuloides	Quaking aspen	Upper

Description

Aspen suckers less than two meters tall. Understory species include a wide variety of shrubs, forbs and grasses.

This structure is an established, persistent, shrub-type aspen clone that is maintained in this state either because of continual browsing or suboptimal site conditions. As such, it was the starting point in which to model asexual regeneration in the face of disturbance. A reviewer suggested that this class would be eliminated and returned to grass in three years under intense browsing; however, that scenario is not an accurate depiction of this class. This condition does not represent site establishment via sexual reproduction that would revert to grass three years after seedling establishment. Also, although aspen suppression by herbivores is important in the Greater Yellowstone Ecosystem (which would more likely be a current condition, not the reference condition scenario being described), there seems to be insufficient evidence that this process can extirpate a patch in three years. Aspen appears relatively persisting and although it certainly can be extirpated, it is believed that this occurs far less frequently.

Maximum Tree Size Class

Seedling <4.5ft

Class B	24	Mid Development 1 - All Structures
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
POTR5	Populus tremuloides	Quaking aspen	Upper

Description

Aspen 2-10m tall dominate. Canopy cover usually closed, but might be more open at times, representing dense sapling stand. Fire frequency is highly variable because of site conditions and adjacent vegetation.

Pole 5-9" DBH

Class C	27	Late Development 1 - Closed
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
POTR5	<i>Populus tremuloides</i>	Quaking aspen	Upper

Description

Closed-canopy, relatively pure aspen stand with large overstory trees. Fire frequency highly variable depending upon site location and adjacent vegetation.

Aspen always suckers. Suckering and recruitment might be impeded because of overstory auxin transport, but is infrequently eliminated, unless there are other root problems with the clone. Existing data suggest that aspen can persist in the understory of conifers as a shrub for relatively long periods of time (Dan Kashian, personal communication).

Any reduction of canopy auxin transport because of mixed or replacement fire will stimulate the suckering response.

Maximum Tree Size Class

Medium 9-21"DBH

Class D	27	Late Development 2 - Open
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Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
POTR5	Populus tremuloides	Quaking aspen	Upper
ARTR2	Artemisia tridentata	Big sagebrush	Lower
GRASS	<NOT FOUND IN NRCS>	<NOT FOUND IN NRCS>	Lower
PSME	Pseudotsuga menziesii	Douglas-fir	Low-Mid

Description

Aspen widely spaced, open canopy existing until the over-story succumbs to mortality. This is a transitional state caused by insects, disease, herbivory or interactions among these factors.

Mean FRIs for fire are highly variable.

Outside reviewer commented that 25% in class D historically seemed too high, and that it should rather be approx 10-15%.

Maximum Tree Size Class

Medium 9-21"DBH

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
PSME	<i>Pseudotsuga menziesii</i>	Douglas-fir	Upper
PICO	<i>Pinus contorta</i>	Lodgepole pine	Upper
PIEN	<i>Picea engelmannii</i>	Engelmann spruce	Upper
ARTR2	<i>Artemisia tridentata</i>	Big sagebrush	Low-Mid

Description

A catch-all category that represents aspen replaced by other vegetation types or a mixed aspen-conifer overstory that is changing to a conifer dominated forest. If aspen persists in the understory, parent root material remaining on site allows aspen regeneration after fire.

Maximum Tree Size Class

Very Large >33"DBH

Model Parameters**Deterministic Transitions**

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:ALL	9
Mid1:ALL	10	Late1:CLS	39
Late1:CLS	40	Late1:CLS	999
Late2:OPN	40	Late3:CLS	149
Late3:CLS	150	Late3: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
Native Grazing	Early1:ALL	Early1:ALL	0.01	100	Yes	0
Replacement Fire	Mid1:ALL	Early1:ALL	0.01	100	Yes	0
Alternative Succession	Late1:CLS	Late3:CLS	1	1	Yes	200
Insects or Disease	Late1:CLS	Late2:OPN	0.005	200	Yes	0
Native Grazing	Late1:CLS	Late2:OPN	0.01	100	Yes	0
Replacement Fire	Late1:CLS	Early1:ALL	0.01	100	Yes	0
Insects or Disease	Late2:OPN	Late2:OPN	0.005	200	No	0
Native Grazing	Late2:OPN	Late2:OPN	0.01	100	No	0
Replacement	Late2:OPN	Early1:ALL	0.01	100	Yes	0

Fire Replacement Fire	Late3:CLS	Early1:ALL	0.01	100	Yes	0
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