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Inter-Mountain Basins Curl-Leaf Mountain Mahogany Woodland and Shrubland

BpS Model/Description Version: Aug. 2020

Modelers		Reviewers	
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Vegetation Type

Forest and Woodland

Map Zones

10, 19, 21, 29, 31

Geographic Range

The curl-leaf mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus* or *intercedens*) community type occurs in the Sierra Nevada and Cascade Range, to the Rocky Mountains from Montana to northern Arizona, and in Baja California, and Mexico (Marshall, 1995). In map zone (MZ) 29, curl-leaf mountain mahogany occurs around the Black Hills, east of the Bighorns. On the northern side of the Bighorns, there is CELE. But not much in MZ29. Maybe in foothills of Bighorn Mountains in MZ29. In MZ21, this BpS is a very minor component, primarily in the northwestern corner of the zone. This BpS occurs throughout the western portion of MZ21 as well.

Biophysical Site Description

Curl-leaf mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus*) communities are usually found on upper slopes and ridges between 5,000ft and 10,500ft (USDA-NRCS 2003), although northern stands may occur as low as 2,000ft (Marshall 1995). In western Nevada and southern Idaho, curl-leaf mountain mahogany may occur down to 5,000ft or lower. Most stands occur on rocky shallow soils and outcrops, with mature stand cover between 10% and 55%. In the absence of fire, old stands may occur with >55% cover on somewhat productive sites with moderately deep soils or, at least, fractured belowground bedrock. In southern Idaho, curl-leaf mountain mahogany is most often associated with a limestone bedrock.

Curl-leaf mountain mahogany (*Cercocarpus ledifolius*): Found throughout the foothill country of the Bighorn and other Wyoming mountains on limestone outcrops, this broad-leaf deciduous shrub is as rugged and long living as almost any plant in the world. Specimens found on the southern slopes of the Bighorns are estimated to be at least 2,000yrs old or older (Heald 2006).

Stands of *Cercocarpus ledifolius* occur in the basins and foothills of the Bighorn NF below 7,800ft on landforms such as escarpments and rock outcrops. It can be found on very steep slopes. Soils are rocky and shallow -- mostly in areas with limestone bedrock. Precipitation falls in winter and spring (Welp et al. 2000).

As a symbiotic nitrogen fixer, this shrub is able to grow on nutrient poor sites and gain a competitive advantage over other plants. The very rocky soils are very low in productivity, and very little fuel accumulates, so fire risk is low and fire occurrence rare (Welp et al. 2000).

This type almost always occurs on south facing slopes in MZ21.

Vegetation Description

Mountain big sagebrush is the most common co-dominant with curl-leaf mountain mahogany. Curl-leaf mountain mahogany is both a primary, early successional colonizer rapidly invading bare mineral soils after disturbance and the dominant long-lived species. Where curl-leaf mountain mahogany has re-established quickly after fire, rabbitbrush (*Chrysothamnus nauseosus*) may co-dominate. Litter and shading by woody plants inhibit establishment of curl-leaf mountain mahogany. Invasion of Utah and Rocky Mountain juniper or Douglas-fir can occur and will eventually shade-out the curl-leaf mountain mahogany. Reproduction often appears dependent upon geographic variables (slope, aspect, and elevation) more than biotic factors. Mountain big sagebrush, black sagebrush, and antelope bitterbrush are often associated. Snowberry, Utah serviceberry, and currant are present on cooler sites with more moisture. Utah juniper, western juniper, Douglas-fir, red fir, white fir, Rocky Mountain juniper, Jeffrey pine (more likely PIPO or PSME in MZ29), singleleaf pinyon, and limber pine may be present in small (10% total cover) to large (>30% total cover) amounts. In old, closed-canopy stands, understory may consist largely of prickly phlox (*Leptodactylon pungens*).

Other vegetation present is *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia nova*, *Chrysothamnus nauseosus*, *Rhus trilobata*, *Ribes cereum*, *Ribes setosum*, *Amelanchier alnifolia*, *Prunus virginiana*, *Symphoricarpos oreophilus*, *Physocarpus malvaceus*, occasional trees (*Juniperus scopulorum*, *Pinus ponderosa*, *Pinus flexilis*, and *Pseudotsuga menziesii*), and some grasses (*Elymus spicatus*, *Stipa comata*, *Oryzopsis hymenoides*, and *Koeleria macrantha*) (Welp et al. 2000).

In MZ21 state that Utah juniper, Western juniper, red fir, white fir, jeffrey pine, singleleaf pinyon and prickly phlox are not present.

BpS Dominant and Indicator Species

Symbol	Scientific Name	Common Name
CELE3	<i>Cercocarpus ledifolius</i>	Curl-leaf mountain mahogany
ARTRV	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	Mountain big sagebrush
PUTR2	<i>Purshia tridentata</i>	Antelope bitterbrush
SYMPH	<i>Symphoricarpos</i>	Snowberry

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

Disturbance Description

Fire: Curl-leaf mountain mahogany does not resprout and is easily killed by fire (Marshall 1995). Curl-leaf mountain mahogany is a primary, early successional colonizer rapidly invading bare mineral soils after disturbance. Fires are not common in early seral stages, when there is little fuel, except in chaparral. Replacement fire (mean fire return interval [MFRI], 150-500yrs)

becomes more common in mid-seral stands, where herbs and smaller shrubs provide ladder fuel. By late succession, two classes and fire regimes are possible, depending on the history of mixed-severity and surface fires. In the presence of surface fire and past mixed-severity fires in younger classes, the stand will adopt a savanna-like woodland structure with a grassy understory, spiny phlox, and currant. Trees can become very old and will rarely show fire scars. In late closed stands, the absence of herbs and small forbs makes replacement fire uncommon, requiring extreme winds and drought. In such cases, thick duff provides fuel for more intense fires. Mixed-severity fires are present in all classes, except the Late-Closed one, and more frequent in the Mid-Development classes.

Several fire regimes affect this community type. It is clear that being very sensitive to fire and very long-lived suggest a low frequency high severity fire regime group and development in fire-safe sites (Gruell et al. 1985). This is true of Late-Development classes, but younger classes can resemble more the surrounding chaparral or sagebrush communities in their fire behavior and exhibit a moderate frequency, high severity fire regime. Finally, on more productive sites in map zone (MZ) 18 or sites associated with ponderosa pine (FRI, 13-22yrs; Arno and Wilson 1986), a high frequency, low severity fire regime may be appropriate (very open, grassy stands), although this was not modeled. Experts had divergent opinions on this issue; some emphasized infrequent and only stand-replacing fires whereas others suggested more frequent replacement fire, mixed-severity fires, and surface fires. The current model is a compromise, reflecting more frequent fire in Early-Development classes, surface fire in the Late-Open class, and infrequent fire in the Late-Closed class.

Increases in curl-leaf mountain mahogany abundance are often attributed to decreased fire frequency. Curl-leaf mountain mahogany recolonization can be quick if seed in the soil is unharmed, but post-fire establishment can take several decades following severe fires that destroy the seed bank and kill parent plants. Ross (1999) presented state-and-transition successional models for curl-leaf mountain mahogany stands studies in the Petersen and Bald mountain ranges on the California-Nevada border. Disturbances highlighted in the models are those that have been most influential on the area in the past 55yrs. The successional model for the Bald Mountain range incorporates fire, red-breasted sapsucker damage, woodcutting practices, and conifer canopy development, while the model of successional change in the Petersen Mountains is driven by fire as the chief disturbance process.

Curl-leaf mountain mahogany has thick bark and may survive "light" fires. Sprouts following fire are rare and short-lived. Most often curl-leaf mountain mahogany is killed by fire, and regeneration is by seedling establishment. Seed may come from curl-leaf mountain mahogany trees avoiding fire in low fuel areas or by seed surviving in soil.

The very rocky soils are very low productivity, and very little fuel accumulates, so fire risk is low and fire occurrence rare (Welp et al. 2000).

Ungulate herbivory: Heavy browsing by native medium and large mammals reduces mountain mahogany productivity and reproduction (USDA-NRCS 2003). This is an important disturbance in early (especially) and mid-seral stages, when mountain mahogany seedlings are becoming

established. Browsing by small mammals has been documented (Marshall 1995), but is relatively unimportant and was incorporated as a minor component of native herbivory mortality.

Windthrow and snow creep on steep slopes are also sources of mortality.

Fire Frequency

Severity	Avg FI	Percent of All Fires	Min FI	Max FI
Replacement	289	24	100	500
Moderate (Mixed)	153	46	50	150
Low (Surface)	234	30		
All Fires	70	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

Because these communities are restricted to rock outcrops and thin soils, stands usually occur on a small scale and are spatially separated from each other by other communities that occur on different aspects or soil types. A few curl-leaf mountain mahogany stands may be much larger than 100ac, especially in southern Idaho.

Adjacency or Identification Concerns

Some existing curl-leaf mountain mahogany stands may be in big sagebrush (BpS 1125, Inter-Mountain Basins Big Sagebrush Steppe; and BpS 1126, Inter-Mountain Basins Montane Sagebrush Steppe), which is now uncharacteristic because of fire exclusion.

In Montana, very hedged by deer browsing. Very short today in MZ29.

Curl-leaf mountain mahogany functions as a late-seral or a mid-seral species in most communities. Site conditions likely dictate curl-leaf mountain mahogany's place in succession. Curl-leaf mountain mahogany's shade tolerance is low, so if sites can support coniferous species, curl-leaf mountain mahogany may be replaced as conifers dominate the canopy. However, succession proceeds at an "extremely slow" rate in many curl-leaf mountain mahogany communities, and long-term studies of successional change in curl-leaf mountain mahogany communities are lacking (Gucker 2006; Chumley et al 1998; Holmgren 1987).

Issues or Problems

Data about the setback in succession caused by native grazing are lacking but consistently observed by experts. In the model, only Class A exhibited a reversal of succession (mountain mahogany establishment) with native grazing, whereas no successional reversal was specified for Classes B and C, which do not support many seedlings.

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Native Uncharacteristic Conditions

Comments

During the 2015 BpS Review, it was noted that MZs 10, 19, 29, and 31 have the same VDDT model and s-class mapping rules for this BpS. Descriptive additions were made to the model in MZs 29 and 31 and these were included in the final description here.

During LANDFIRE National this BpS for MZ29 was adopted from the same BpS 1062 from MZ19 created by Sarah Heide and reviewed by Jon Bates. Descriptive additions and elaborations were made for MZ29. MZ 29 and 31 reviewers were Steve Cooper and Kathy Roche. For MZ21 Klara Varga and Tristan Fluharty reviewed the model.

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	C	C	C	B	B	B	B	B	B	B
Shrub	>3.0	C	C	C	B	B	B	B	B	B	B
Tree	0-5	C	C	C	B	B	B	B	B	B	B
Tree	5-10	D	D	D	E	E	E	E	E	E	E
Tree	10-25	D	D	D	E	E	E	E	E	E	E
Tree	25-50	D	D	D	E	E	E	E	E	E	E
Tree	>50	D	D	D	E	E	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 8 Early Development 1 - All Structures
Upper Layer Lifeform: Shrub

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CELE3	<i>Cercocarpus ledifolius</i>	Curl-leaf mountain mahogany	Upper
ARTR2	<i>Artemisia tridentata</i>	Big sagebrush	Upper

Class D 21 Late Development 1 - Open

Upper Layer Lifeform: Tree

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CELE3	Cercocarpus ledifolius	Curl-leaf mountain mahogany	Upper
ARTR2	Artemisia tridentata	Big sagebrush	Low-Mid
PUTR2	Purshia tridentata	Antelope bitterbrush	Low-Mid

Description

Moderate cover of mountain mahogany. Various shrub species typically dominate. However, under mixed-severity fire disturbance, various grass species may dominate. This class describes one of two late-successional endpoints for curl-leaf mountain mahogany. Evidence of infrequent fire scars on older trees and presence of open savanna-like woodlands with herbaceous-dominated understory are evidence of this condition. Other shrub species may be abundant, but decadent.

Class E 45 Late Development 1 - Closed

Upper Layer Lifeform: Tree

Indicator Species

Symbol	Scientific Name	Common Name	Canopy Position
CELE3	Cercocarpus ledifolius	Curl-leaf mountain mahogany	Upper

Description

High cover of large shrub or tree-like mountain mahogany. Very few other shrubs are present and herb cover is low. Duff may be very deep. Scattered trees may occur in this class. This class describes one of two late-successional endpoints for curl-leaf mountain mahogany. Class will become old-growth.

Model Parameters

Deterministic Transitions

From Class	Begins at (yr)	Succeeds to	After (years)
Early1:ALL	0	Mid1:OPN	19
Mid1:OPN	20	Mid1:CLS	59
Mid1:CLS	60	Late1:CLS	149
Late1:OPN	60	Late1:OPN	999
Late1:CLS	150	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
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Replacement Fire	Early1:ALL	Early1:ALL	0.002	500	Yes	0
Mixed Fire	Early1:ALL	Early1:ALL	0.01	100	No	0
Native Grazing	Early1:ALL	Early1:ALL	0.02	50	Yes	0
Replacement Fire	Mid1:OPN	Early1:ALL	0.007	143	Yes	0
Native Grazing	Mid1:OPN	Mid1:OPN	0.01	100	No	0
Mixed Fire	Mid1:OPN	Mid1:OPN	0.02	50	No	0
Native Grazing	Mid1:CLS	Mid1:CLS	0.001	1000	No	0
Mixed Fire	Mid1:CLS	Late1:OPN	0.005	200	Yes	0
Replacement Fire	Mid1:CLS	Early1:ALL	0.007	143	Yes	0
Mixed Fire	Mid1:CLS	Mid1:CLS	0.013	77	No	0
Alternative Succession	Late1:OPN	Late1:CLS	1	1	Yes	150
Replacement Fire	Late1:OPN	Early1:ALL	0.003	333	Yes	0
Mixed Fire	Late1:OPN	Late1:OPN	0.005	200	No	0
Surface Fire	Late1:OPN	Late1:OPN	0.02	50	No	0
Replacement Fire	Late1:CLS	Early1:ALL	0.002	500	Yes	0

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