## Curl-leaf Mountain Mahogany (CMM)

### General Information

### Cover Type Overview

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* Crosswalks
  + EVeg: Regional Dominance Type 1
    - Curl-leaf Mountain Mahogany
  + LandFire BpS Model
    - 0610620: Inter-Mountain Basin Curl-leaf Mountan Mahogany Woodland and Shrubland
  + Presettlement Fire Regime Type:
    - Curl-leaf Mountain Mahogany

### Vegetation Description

The CMM landcover type is characterized by the dominance or codominance of *Cercocarpus ledifolius*. Other shrubs such as *Artemisia, Arctostaphylos, Ceanothus,* and *Ephedra* may be present. *C. ledifolius* is both a primary early successional colonizer rapidly invading bare mineral soils after disturbance and the dominant long-lived species. Depending on the effects of a given fire on the seed bank, in some cases it could take 10 years to recolonize. Where *C. ledifolius* has reestablished quickly after fire, *Chrysothamnus nauseosus* may codominate. Litter and shading by woody plants inhibits the establishment of *C. ledifolius*, particularly in late seral conditions where canopy cover is high. Reproduction often apears more dependent upon geographic variables (slope, aspect, and elevation) than biotic factors. *Artemisia arbuscula* and *Artemisia nova* are infrequently associated. *Symphoricarpos, Amelanchier,* and *Ribes* are present on cooler, moister sites. *Pinus monophylla, Juniperus, Pseudotsuga menziesii, Abies magnifica, Abies concolor,* and *Pinus jeffreyi* may have sporadic presence at very low densities. In older stands the understory may consist largely of *Leptodactylon pungens* (LandFire 2007, Gucker 2006).

### Distribution

*C. ledifolius* communities are usually found on upper slopes and ridges between 2130 and 3200 m (7000-10,500 ft), although northern stands may occur as low as 600 m (200 ft). It is more common on northwestern and northeastern aspects. Most stands occur on rocky, shallow soils and outcrops, with mature stand cover rom 10-55%. In the absence of fire, old stands may occur on somewhat deeper soils, with more than 55% cover (LandFire 2007).

**Disturbances**

### Wildfire

Wildfires tend to be high mortality, stand-replacing fires that initiate a process of post-fire forest succession. High mortality fires kill large as well as small trees, and may kill many of the shrubs and herbs as well, although below-ground organs of at least some individual shrubs and herbs survive and re-sprout.

*C. ledifolius* is easily killed by fire and does not resprout. However, it 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-dominated stands. Stand-replacing fires are more common in mid-seral stands, where herbs and smaller shrubs provide ladder fuels. When surface fire is relatively common, stands will adopt a savanna-like woodland structure with an understory characterized by *Ribes, L. pungens*, and various grasses. Trees can become very old and will rarely show fire scars. In late, closed stands, the absence of herbs and small forbs makes fire uncommon, requiring extreme winds and drought conditions. However, stands that do burn often experirence high mortality fire (LandFire 2007).

Although it is not included in this iteration of the model, scientists have noted that *Bromus tectorum* has invaded most of these communities, altering successional pathways and disturbance regimes. It burns readily and is an early-season post-fire colonizer (Verner 1988).

Data on fire return intervals (FRIs) are available from a few review papers. Van de Water and Safford’s 2011 paper aggregates hundreds of articles, conference proceedings, and LandFire data on fire return intervals, with an emphasis on Californian sources. In it, Curl-leaf mountain mahogany is analyzed and found to have a mean FRI of 52 years, median of 62 years, mean min of 30 years and mean max of 130 years. The LandFire model for this type (2007) predicted a mean replacement FRI of 285 years with a range of 100-500 years, a mean mixed severity FRI of 149 years with a range of 50-150 years, a mean surface FRI of 238 years, and an overall mean FRI of 69 years. We recalculated these numbers using condition-specific information and using only high and low mortality fire categories, which resulted in an interval of 223 years for high mortality fire, 56 years for low mortality fire, and 45 years for any fire.

Table 1. Fire return intervals (years) and percentage of high versus low mortality fires. Values were derived from BpS model 0610790 (LandFire 2007) and Van de Water and Safford (2011).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variant** | **Modifier** | **Fire Mortality** | **Mean** | **Min** | **Max** | **% of Fires** |
| CMM | None | High | 223 | – | – | 20 |
| Low | 56 | – | – | 80 |
| All Fires | 45 | 30 | 130 | 100 |

### Other Disturbance

Other disturbances are not currently modeled, but may, depending on the condition affected and mortality levels, reset patches to early development, maintain existing condition classes, or shift/accelerate succession to a more open condition.

### Vegetation Condition Classes

We recognize four separate condition classes for CMM: Early Development (ED), Mid Development – Open (MDO), Mid Development – Closed (MDC), and Late Development (LD). We use condition classes not in the sense of fire regime condition classes, but as an alternative to “successional” classes that imply a linear progression of states and tend not to incorporate disturbance. The condition classes identified here are derived from a combination of successional processes and anthropogenic and natural disturbance, and are intended to represent a composition and structural condition that can be arrived at from multiple other conditions described for that landcover type. Thus our condition classes incorporate age, size, canopy cover, and vegetation composition as well as relative seral stages. In general, the delineation of stages has originated from the LandFire biophysical setting model descriptive of a given landcover type; however, condition classes are not necessarily identical to the classes identified in those models.

### Early Development (ED)

### Description *C. ledifolius* seedlings rapidly invade bare mineral soils after fire. Litter and shading by woody plants inhibits establishment. Bunchgrasses and disturbance-tolerant forbs and resprouting shrubs, such as *Symphoricarpos*, may be present. *Ericameria* and *Artemisia* seedlings are likely present. Vegetation composition will affect fire behavior, especially if chaparral species like *Arctostaphylos* or *Ceanothus* are present (LandFire 2007).

**Succession Transition** In the absence of disturbance, this class will transition to MDO after 20 years.

**Wildfire Transition** High mortality wildfire (100% of fires in this condition) recycles the patch through the ED condition. Low mortality wildfire is not modeled for this condition class.

**Mid Development – Open (MDO)**

**Description** *C. ledifolius* may codominate with mature *Artemisia, Purshia, Symphoricarpos,* or *Ericameria.* Few *C. ledifolius* seedlings are present. Canopy cover is less than 30% (LandFire 2007).

**Succession Transition** After 40 years without any disturbance, stands in this condition will transition to MDC. After 120 years since entering an MD condition, stands transition to LDO.

**Wildfire Transition** High mortality wildfire (35% of fires in this condition) recycles the patch through the ED condition. Low mortality wildfire (65%) maintains the MDO condition.

**Mid Development – Closed (MDC)**

**Description** Young *C. ledifolius* are common, although shrub diversity is very high. Common shrubs include *Artemisia, Purshia,* and *Symphoricarpos*. Canopy cover is over 30% (LandFire 2007).

**Succession Transition** After 120 years since entering an MD condition, stands in this condition will transition to LD.

**Wildfire Transition** High mortality wildfire (27.6% of fires in this condition) recycles the patch through the ED condition. Low mortality wildfire (72.4%) opens the stand up to MDO 28.6% of the time; otherwise, the patch remains in MDC.

**Late Development (LD)**

**Description** Moderate to high cover of large shrub- or tree-like *C. ledifolius*. When low mortality fire is relatively frequent, late-successional *C. ledifolius* may exhibit evidence of infrequent fire scars on older trees. Patches may consist of open savanna-like woodlands with an herbaceous-dominated understory. Other shrub species may be abundant, but decadent. When low mortality fire is absent, very few other shrubs are present, and herbaceous cover is low. Duff may be very deep, and scattered trees may occur. *C. ledifolius* trees reach very old age in the absence of stand-replacing fire, potentially living over 1000 years (LandFire 2007).

**Succession Transition** In the absence of disturbance, this class will maintain.

**Wildfire Transition** High mortality wildfire (11.1% of fires in this condition) recycles the patch through the ED condition. Low mortality wildfire (88.9%) maintains the LDO condition.

**Condition Classification**

Polygons will be randomly assigned to the other condition classes based on a 20:10:70 distribution for early/mid/late development (based on an analysis of past fire in the project area). Open versus closed is based on a break point of 30% cover (LandFire 2007). Random numbers between 0 and 1 were generated using numpy for Python and used to assign each CMM polygon to a condition.

**Draft Model**

(See PDF) Disturbance-Succession model for CMM.

**References**

Gucker, Corey L. “Cercocarpus ledifolius” *Fire Effects Information System*, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, 2006. < http://www.fs.fed.us/database/feis/> [Accessed 29 July 2013.].

LandFire. “Biophysical Setting Models.” Biophysical Setting 0610790: Great Basin Xeric Mixed Sagebrush Shrubland. 2007. LANDFIRE Project, U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior. <http://www.landfire.gov/national\_veg\_models\_op2.php>. Accessed 9 November 2012.

Van de Water, Kip M. and Hugh D. Safford. “A Summary of Fire Frequency Estimates for California Vegetation Before Euro-American Settlement.” *Fire Ecology* 7.3 (2011): 26-57. doi: 10.4996/fireecology.0703026.