USDA Natural Resources Conservation Service

Ecological site R047XB440UT
Mountain Shallow Loam (curl-leaf mountain mahogany)

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 047X–Wasatch and Uinta Mountains

MLRA 47 occurs in Utah (86 percent), Wyoming (8 percent), Colorado (4 percent), and Idaho (2 percent). It encompasses approximately 23,825 square miles (61,740 square kilometers). The northern half of this area is in the Middle Rocky Mountains Province of the Rocky Mountain System. The southern half is in the High Plateaus of the Utah Section of the Colorado Plateaus Province of the Intermontane Plateaus. Parts of the western edge of this MLRA are in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. The MLRA includes the Wasatch Mountains, which trend north and south, and the Uinta Mountains, which trend east and west. The steeply sloping, precipitous Wasatch Mountains have narrow crests and deep valleys. Active faulting and erosion are a dominant force in controlling the geomorphology of the area. The Uinta Mountains have a broad, gently arching, elongated shape. Structurally, they consist of a broadly folded anticline that has an erosion-resistant quartzite core. The Wasatch and Uinta Mountains have an elevation of 4,900 to about 13,500 feet (1,495 to 4,115 meters).

The mountains in this area are primarily fault blocks that have been tilted up. Alluvial fans at the base of the mountains are recharge zones for the basin fill aquifers. An ancient shoreline of historic Bonneville Lake is evident on the footslopes along the western edge of the area. Rocks exposed in the mountains are mostly Mesozoic and Paleozoic sediments, but Precambrian rocks are exposed in the Uinta Mountains. The Uinta Mountains are one of the few ranges in the United States that are oriented west to east. The southern Wasatch Mountains consist of Tertiary volcanic rocks occurring as extrusive lava and intrusive crystalline rocks.

The average precipitation is from 8 to 16 inches (203 to 406 mm) in the valleys and can range up to 73 inches (1854 mm) in the mountains. In the northern and western portions of the MLRA, peak precipitation occurs in the winter months. The southern and eastern portions have a greater incidence of high-intensity summer thunderstorms; hence, a significant amount of precipitation occurs during the summer months. The average annual temperature is 30 to 50 degrees Fahrenheit (-1 to 15 C). The freeze-free period averages 140 days and ranges from 60 to 220 days, generally decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols, Entisols, Inceptisols, and Mollisols. The lower elevations are dominated by a frigid temperature regime, while the higher elevations experience cryic temperature regimes. Mesic temperature regimes come in on the lower elevations and south facing slopes in the southern portion of this MLRA. The soil moisture regime is typically xeric in the northern part of the MLRA, but grades to ustic in the extreme eastern and southern parts. The mineralogy is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy-skeletal.

LRU notes

E47B is the Wasatch Mountains South MLRA. It occurs in the Loa, Panguitch, New Harmony area. Most of Zion, Bryce Canyon National Parks and Cedar Breaks National Monument are in this area. This area is composed of mountain ranges that run north and south.

Ecological site concept

The soils of this site formed mostly in colluvium and residuum from sandstone. Surface soils are very gravelly loam to cobbly loamy sand in texture. Rock fragments may be present on the soil surface and throughout the profile, but make up less than 35 percent of the soil volume. These soils are shallow, well to somewhat excessively drained, and have rapid permeability. pH is neutral to slightly alkaline. Available water-holding capacity ranges from 0.5 to 1.5 inches of water in the upper 20 inches of soil. The soil moisture regime is mostly ustic and the soil temperature regime is frigid. Precipitation ranges from 16 to 22 inches annually.

Associated sites

R047XB438UT	**Mountain Shallow Loam (black sagebrush)** Sites can occur adjacent to each other.

Similar sites

R047XB446UT	**Mountain Shallow Loam (mountain big sagebrush)** Sites can have similar floral characteristics and both have shallow soils.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Cercocarpus ledifolius*
Herbaceous	Not specified

Physiographic features

This ecological site typically occurs on mountains and scarp slopes. Slopes normally range from 25 to 100 percent but may occasionally be steeper. Slope steepness, aspect and elevation will influence the vegetative floristics of this site. Sites are typically located between 7,000 to 10,000 feet in elevation. Runoff is very high.

Table 2. Representative physiographic features

Landforms	(1) Scarp slope (2) Mountain
Runoff class	Very high
Flooding frequency	None
Ponding frequency	None
Elevation	2,377–2,774 m
Slope	25–100%
Aspect	Aspect is not a significant factor

Climatic features

Climate is characterized by cool summers and cold winters. The annual precipitation on this site occurs with about 50 percent arriving during the growing season. The wettest months are August through March. The driest are May and June. The average snow depth in the winter is between 12 and 24 inches. Summer thunderstorms are typical in July and August. Mean annual temperature is 45 degrees.

Table 3. Representative climatic features

Frost-free period (characteristic range)	45-90 days
Freeze-free period (characteristic range)	

Precipitation total (characteristic range)	406-559 mm

Influencing water features

Due to its landscape position, this site is not influenced by streams or wetlands.

Wetland description

N/A

Soil features

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Table 4. Representative soil features

Parent material	(1) Colluvium–sandstone (2) Residuum–sandstone
Surface texture	(1) Cobbly loamy sand (2) Very gravelly loam
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to rapid
Depth to restrictive layer	25–51 cm
Soil depth	25–51 cm
Surface fragment cover <=3"	5–27%
Surface fragment cover >3"	8–15%
Available water capacity (25.4-50.8cm)	1.27–3.81 cm
Calcium carbonate equivalent (25.4-50.8cm)	0–1%
Electrical conductivity (25.4-50.8cm)	0–2 mmhos/cm
Sodium adsorption ratio (25.4-50.8cm)	0
Soil reaction (1:1 water) (25.4-50.8cm)	6.8–7.8
Subsurface fragment volume <=3" (25.4-50.8cm)	5–39%
Subsurface fragment volume >3" (25.4-50.8cm)	0–20%

Ecological dynamics

It is impossible to determine in any quantitative detail the Historic Climax Plant Community (HCPC) for this ecological site because of the lack of direct historical documentation preceding all human influence. In some areas, the earliest reports of dominant plants include the cadastral survey conducted by the General Land Office, which began in the late 19th century for this area. However, up to the 1870s the Shoshone Indians, prevalent in northern

Utah and neighboring states, grazed horses and set fires to alter the vegetation for their needs. In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long. Itinerant and local sheep flocks followed, largely replacing cattle as the browse component increased.

Below is a State and Transition Model diagram that illustrates the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates of fire, herbicide treatment, tillage, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram. The transition between Reference State 1 and State 2 is considered irreversible because of the naturalization of exotic species of both flora and fauna, possible extinction of native species, and climate change. There may have also been accelerated soil erosion.

When available, monitoring data (of various types) were employed to validate more subjective inferences made in this diagram. See the complete files in the office of the State Range Conservationist for more details.

The plant communities shown in this State and Transition Model may not represent every possibility, but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, or new ones may be added. None of these plant communities should necessarily be thought of as “Desired Plant Communities.” According to the USDA NRCS National Range and Pasture Handbook (USDA-NRCS 2003), Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including descriptions of a plant community is to capture the current knowledge at the time of this revision.

State 1 Reference State
The Reference State is a description of this ecological site just prior to Euro-American settlement but long after the arrival of Native Americans. The description of the Reference State was determined by NRCS Soil Survey Type Site Location information and familiarity with rangeland relict areas where they exist. The least modified plant community would have been dominated by a low statured curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and a mixture of herbaceous species. Other common shrubs may have included antelope bitterbrush (*Purshia tridentata*) and mountain big sagebrush (*Artemisia tridentata* ssp. vaseyana). These sites would have had wildfire return intervals of approximately 20 to 50 years.

Plant Community 1.1: scattered low-statured curl-leaf mountain mahogany and associated shrubs/ rich native perennial herbaceous understory
This plant community would have been characterized by a scattering of low-statured curl-leaf mountain mahogany. Antelope bitterbrush and mountain big sagebrush may have also been present with an understory composed of a variety of forbs and grasses.

Transition T1a: from State 1 to State 2 (Reference State to Curl-leaf Mountain Mahogany Non-native State)
The simultaneous introduction of exotic species, both plants and animals, possible extinctions of native flora and fauna, and climate change has caused State 1 to transition to State 2. Reversal of such historic changes (i.e. a return pathway) back to State 1 is not practical.

State 2 Curl-leaf Mountain Mahogany/ Introduced Non-natives State
Plant Community 2.1 Curl-leaf Mountain Mahogany/ Introduced Non-natives State
State 2 is a description of the ecological site just following Euro-American settlement, which has been influenced by the introduction of several non-native plants and animals, possible extinctions of native species, and a different climate. The plant community will be very similar to State 1 with the exception that some introduced species are likely to be present. This plant community is considered the current potential, and is dominated by curl-leaf mountain mahogany with a scattering of antelope bitterbrush and mountain big sagebrush. The native perennial herbaceous understory is still intact, but a small component of non-native species will also be present. The resiliency of this state is maintained by the root-sprouting nature of the dominant shrubs. Reductions in livestock use during the

growth season will maintain the stability of the state. Alternatively, continued season-long heavy livestock grazing will reduced the stability of this state.

Community Phase 2.1: scattered low-statured curl-leaf mountain mahogany and associated shrubs/ rich native perennial herbaceous understory
This plant community is characterized by a scattering of low-statured curl-leaf mountain mahogany, antelope bitterbrush, and mountain big sagebrush. The native perennial understory is composed of a variety of forbs and grasses.

Transition T2a: from State 2 to State 3 (Curl-leaf Mountain Mahogany/ Introduced Non-natives State to Tall Dense Curl-leaf Mountain Mahogany State)
Heavy continuous livestock grazing took place on these sites between the 1850s and 1950s. The effects of this heavy livestock grazing were further worsened with fire exclusion policies. A rapid increase of deer numbers in the 1950s and 1960s caused high-lining of the trees. Curl-leaf mountain mahogany began to grow taller and larger in dbh (diameter at breast height), while the herbaceous understory species were reduced greatly. Key indicators of the approach to this transition are a loss of perennial grass understory, an increase in the shrub component relative to grasses, and an increase in height and dbh of mahogany, as well as high-lining and hedging of trees. This transition is triggered by sustained heavy grazing (over time), first by livestock, and later by excessive numbers of deer.

State 3 Tall Dense Curl-leaf Mountain Mahogany State
Plant Community 3.1 Tall Dense Curl-leaf Mountain Mahogany State
In the absence of fire, and continued heavy impacts from livestock, deer, and elk grazing, the native grasses will markedly decrease while the shrubs, mainly curl-leaf mountain mahogany, will grow taller and more dense as reproduction becomes rarer. The resiliency of this state is maintained root-sprouting nature of the dominant shrubs. Reductions in livestock use during the growth season will maintain the stability of the state. Alternatively, continued season-long use by both domestic and wild ungulates will reduced the stability of this state.

Plant Community Phase 3.1: abundant curl-leaf mountain mahogany/ depauperate understory
This plant community is characterized by a dramatic increase in curl-leaf mountain mahogany and substantial reduction in the perennial herbaceous component.

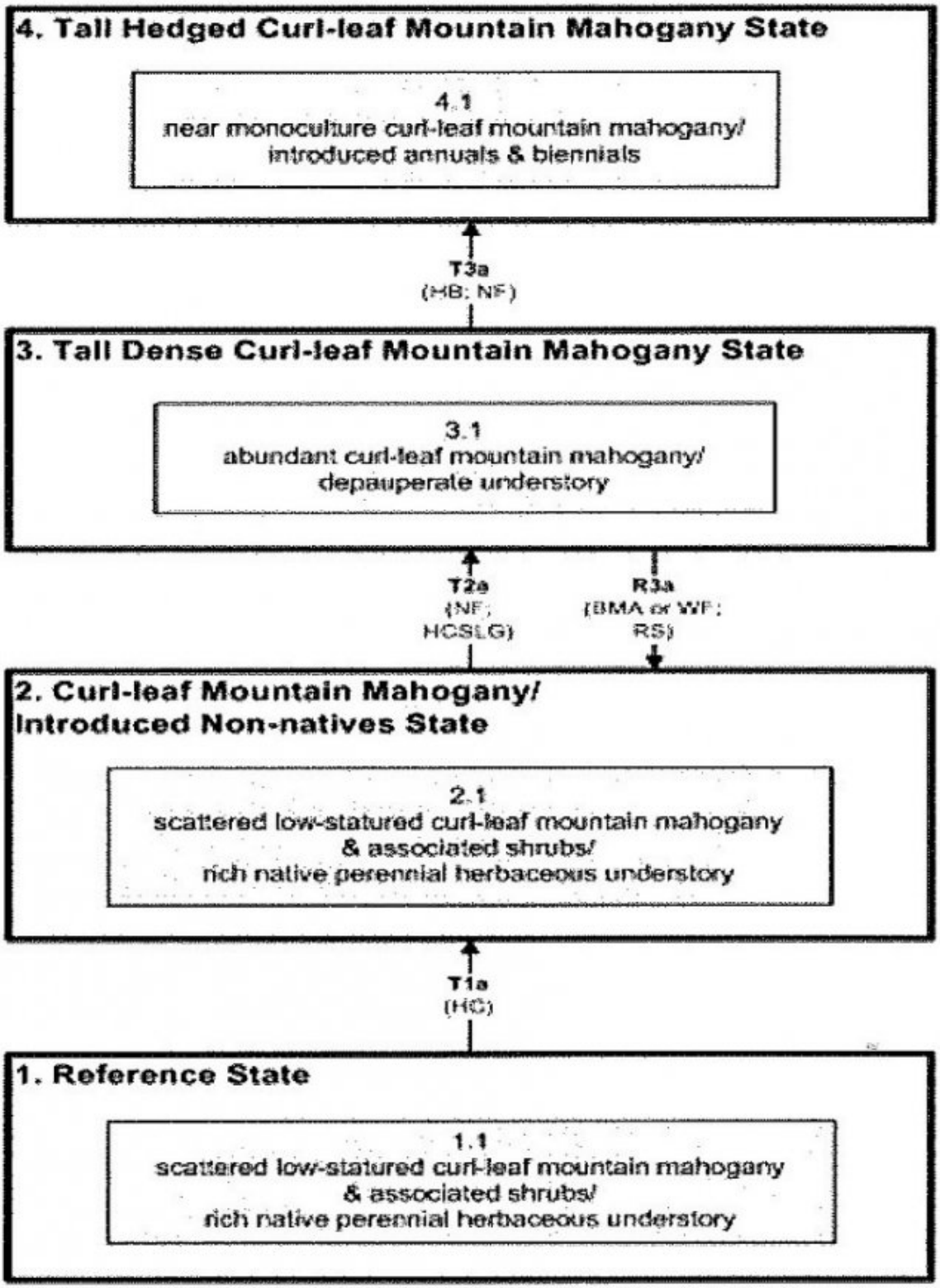
Transition T3a: from State 3 to State 4 (Tall Dense Curl-leaf Mountain Mahogany State to Tall Hedged Curl-leaf Mountain Mahogany State)
The region saw a marked increase in mule deer numbers during the 1940s to 1960s. As a preferred forage species for deer, curl-leaf mountain mahogany experienced heavy browsing pressure during that time. Heavy browsing combined with continued lack of fire caused these sites to transition into a near-monoculture of curl-leaf mountain mahogany. A key indicator of the approach to this transition is a loss of young, short mountain mahogany, and an increase in tall, large mountain mahogany trees. Excessive ungulate use will trigger this transition. A restoration pathway can be established by restoring fire to the ecosystem and reducing animal use on these sites.

Restoration Pathway R3a: from State 3 to State 2 (Tall Dense Curl-leaf Mountain Mahogany State to Curl-leaf Mountain Mahogany/ Introduced Non-natives State)
Brush management using prescribed fire, mechanical, or herbicidal (i.e. 2, 4-DTM) treatments, or wildfire, in combination with reseeding efforts should be considered only on gentle to level slopes (these locations however are unusual). Curl-leaf mountain mahogany will not consistently re-sprout after these treatments, and invasive annuals and biennials are very prominent after disturbances. Re-seeding after wildfire must be done promptly or annuals and biennials will takeover.

State 4 Tall Hedged Curl-leaf Mountain Mahogany State
Following a period of intense deer browsing, curl-leaf mountain mahogany will appear hedged. Without fire, mountain mahogany will grow taller and begin to form a monoculture. Introduced annuals and biennials are also quite common in the understory. In this state, the rockiness of the soil makes it self-armoring, thus reducing the effects of erosion. The steep, rocky locations of this site limit proactive management options.

Plant Community Phase 4.1: near monoculture curl-leaf mountain mahogany/ introduced annuals and biennials
This plant community is super-dominated by curl-leaf mountain mahogany with an understory composed mainly of introduced annuals and biennials. The site will remain in this state until wildfire occurs.

State and transition model



BMA	Brush Management – all (chemical, mechanical, fire)	NF	No Fire
HB	Heavy Browsing	RS	Re-seeding
HC	Historic change	WF	Wildfire
HCSLG	Heavy Continuous Season Long Grazing		

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used.

Other references

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Contributors

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Approval

Kendra Moseley, 2/06/2025

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/13/2025
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**