USDA Natural Resources
Conservation Service

Ecological site F047XA542UT
High Mountain Stony Sandy Loam (lodgepole pine)

Last updated: 9/19/2019
Accessed: 05/11/2024

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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

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 Unita 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 F (-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 minerology is generally mixed and the soils are very shallow to very deep, generally well drained, and loamy or loamy –skeletal.

Ecological site concept

The soils of this site formed in slope alluvium and till derived from various sandstone, quartzite and shale. They are well drained and moderately deep to deep. Rock fragments may or may not be present on the soil surface, but make up approximately 30 percent of the soil profile by volume. Twigs, pine needles and other litter may cover the surface of the mineral soil. Available water-holding capacity ranges from 3 to 4 inches in the upper 40 inches of soil. Permeability is moderate to moderately rapid. The soil moisture regime is udic and the soil temperature regime is cryic.

Table 1. Dominant plant species

Tree	(1) *Plnus contorta*
Shrub	(1) *Paxistima myrsinites*
Herbaceous	(1) *Calamagrostis rubescens*

Physiographic features

Mountain Slopes, Glacial Till, and Moraines

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Moraine
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	2,438–3,200 m
Slope	8–55%

Climatic features

Table 3. Representative climatic features

Frost-free period (characteristic range)	40-70 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	762-1,016 mm
Frost-free period (average)	60 days
Freeze-free period (average)	
Precipitation total (average)	889 mm

Influencing water features

Soil features

Table 4. Representative soil features

Parent material	(1) Slope alluvium–metamorphic and sedimentary rock (2) Till–metamorphic and sedimentary rock
Surface texture	(1) Very cobbly sandy loam (2) Very cobbly
Family particle size	(1) Sandy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	102–152 cm
Soil depth	102–152 cm
Surface fragment cover <=3"	15–35%
Surface fragment cover >3"	15–25%
Available water capacity (0-101.6cm)	7.62–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.1–6.5
Subsurface fragment volume <=3" (0-101.6cm)	20–30%
Subsurface fragment volume >3" (0-101.6cm)	15–30%

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 (Galatowitsch 1990). 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 (Parson 1996). In the 1860s, Europeans brought cattle and horses to the area, grazing large numbers of them on unfenced parcels year-long (Parson 1996). 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, tree harvest, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

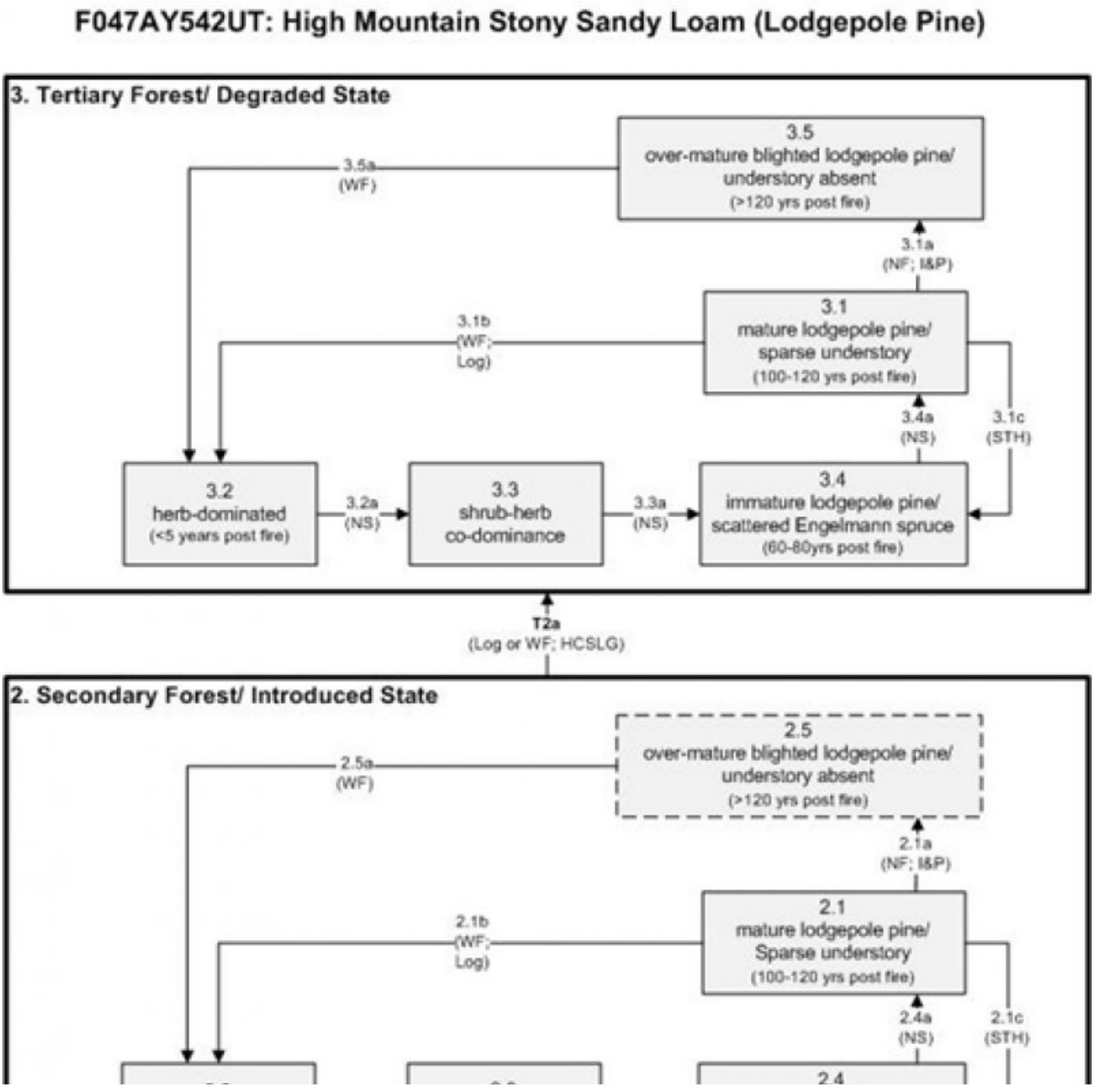
The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes

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, and/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 & 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 and transition model



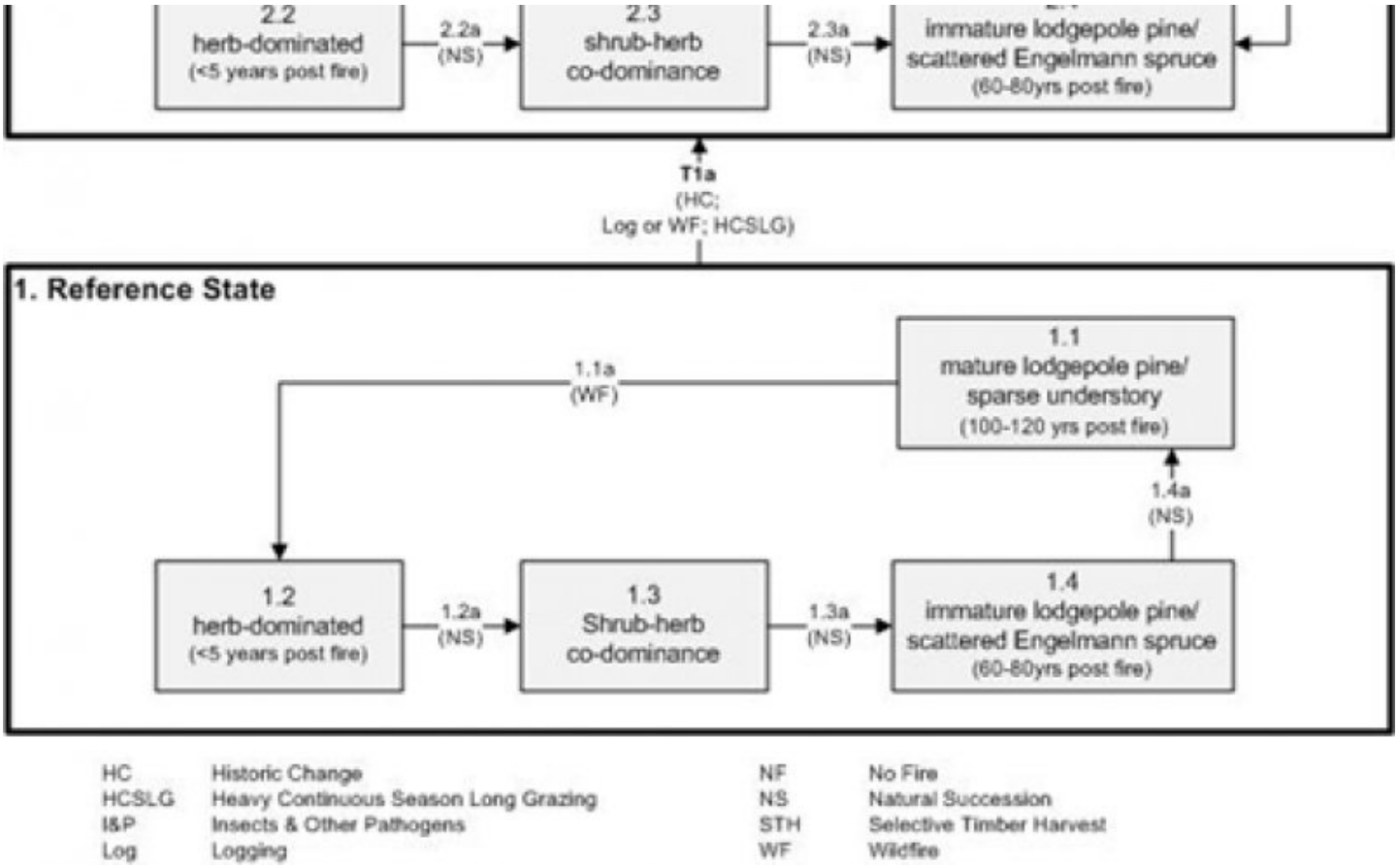


Figure 2. STM

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. At the time of European colonization, what would have been observed on these sites depended on the time since the last wildfire occurred. If the site had not seen fire for about 100 to 120 years, lodgepole pine (*Pinus contorta*) would have been the dominant species occupying the site with a sparse understory (1.1) due to tree competition, overstory shading, and duff accumulation. Wildfire (1.1a) would have replaced these stands with a rich herb-dominated vegetation. (1.2). In the absence of any major disturbance (1.2a, 1.3a, 1.4a), the vegetation would have progressed into more of a shrub-herb co-dominance (1.3), followed by the establishment of lodgepole pine (1.4), and ultimately to fully mature lodgepole pine forest (1.1). Wildfire (1.1a) would have been the primary disturbance factor prior to Euro-American settlement. Early successional stages were shorter in duration. A more complete list of species by lifeform for the Reference State is available in the accompanying tables in the “Plant Community Composition by Weight and Percentage” section of this document.

Community 1.1
Reference State

Community Phase 1.1: mature lodgepole pine/ sparse understory This plant community would have been characterized by a stand of mature lodgepole pine with a sparse understory of pinegrass (*Calamagrostis rubescens*), nodding bluegrass (*Poa reflexa*), and Letterman’s needlegrass (*Achnatherum lettermanii*). Community Pathway 1.1a: Wildfire would have removed the trees, allowing shade-intolerant herbs to flourish briefly. Community Phase 1.2: herb-dominated An herb-dominated plant community would have developed within the first 5 years following the last fire. Pinegrass, nodding bluegrass, Letterman’s needlegrass, and shade-intolerant forbs would have been the dominant grass species. Community Pathway 1.2a: After about 5 years, shrubs would begin to establish in the site. Community Phase 1.3: shrub-herb co-dominance Time since last fire would have been approximately 5 to 60 years. An increasing shrub component would have included Woods’ Rose (*Rosa woodsii*), gooseberry currant (*Ribes montigenum*), grouse whortleberry (*Vaccinium scoparium*), and Oregon boxleaf (*Paxistima myrsinites*), among others. Community Pathway 1.3a: About 60 years after fire, lodgepole pine would

become established in the site. Community Phase 1.4: immature lodgepole pine This phase would have been characterized by a plant community of immature lodgepole pine along with a scattering of sulbapine fir and/or Engelmann spruce (*Picea engelmannii*). This plant community would occur approximately 60 to 80 years after the last fire. Community Pathway 1.4a: About 100 years after fire, lodgepole pine would have become mature and the understory would have become sparse. Transition T1a: from State 1 to State 2 (Reference State to Secondary Forest/ Introduced State) Historic change, including 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. Europeans further altered this vegetation largely through tree harvest, livestock grazing, and changing the fire regime. Continued impacts could prevent the recovery toward potential conifer dominance (State 2, various phases). The reversal of these changes (i.e. a return pathway) back to State 1 is not practical. a. Nature of Forest Community The overstory tree canopy cover is about 55 to 65 percent. Common understory plants are pinegrass, nodding brome, heartleaf arnica, grouseberry, woods rose, gooseberry current, mountain lover, common juniper, and creeping Oregon grape. Understory composition by air-dry weight is about 60 percent perennial grasses and grasslike plants, 5 percent forbs, and 35 percent shrubs. Understory production ranges from 800 pounds per acre in favorable years to about 400 pounds per acre in unfavorable years. Understory production includes the total annual production of all species within 4 ½ feet of the ground surface.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	269	404	538
Shrub/Vine	157	235	314
Forb	22	34	45
Total	**448**	**673**	**897**

State 2
Secondary Forest/ Introduced State

Community 2.1
Secondary Forest/ Introduced State

State 2 is similar to State 1 in form and function, with the exception of the presence of non-native plants and animals, possible extinctions of native species, a different climate, and a secondary stand of trees. State 2 is a description of the ecological site shortly following Euro-American settlement (Alexander 1985, 1988). This state can be regarded as the current potential. With the least amount of disturbance or manipulation of fire regime, a mature stand of lodgepole pine with a sparse understory component is expected at this site (2.1). As with the Reference State, time since last wildfire remains the key factor in determining what vegetation would be encountered here. Wildfire, particularly crown fires, or complete harvesting of the forest (2.1b, 2.5b) will replace these stands with a rich herb-dominated vegetation. (2.2). In the absence of any major disturbance (2.2a, 2.3a, 2.4a), the vegetation will progress into more of a shrub-herb co-dominance (2.3), followed by the establishment of lodgepole pine (1.4), and ultimately to fully mature lodgepole pine forest (1.1). In some areas where wildfire has been prevented, lodgepole pine trees may be over-mature (2.5) and consequently become more susceptible to infestation by insects and other pathogens (2.1a). Community Phase 2.1: mature lodgepole pine/ sparse understory This plant community (2.1) is characterized by a stand of mature lodgepole pine with a sparse understory of pinegrass, nodding bluegrass, Letterman’s needlegrass, and shade-tolerant forbs. This stand will develop approximately 100 to 120 years post fire. Community Pathway 2.1a: With fire exclusion, and well over 100 years since last fire, a lodgepole pine stand will ultimately deteriorate and will become increasingly susceptible to infestation of insects or other pathogens. Community Pathway 2.1b: A stand-replacing wildfire or intensive logging will return the vegetation to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years. Community Pathway 2.1c: The removal of only the mature lodgepole pine (a selective timer harvest) will allow the immature lodgepole pine to continue growing. Community Phase 2.2: herb-dominated This plant community will develop within the first 5 years since the last fire. Dominant grasses are pinegrass, nodding bluegrass, Letterman’s needlegrass, along with shade-intolerant forbs such as subalpine fleabane (*Erigeron peregrinus*). A small component of introduced species may be present. Community Pathway 2.2a: This pathway is characterized by natural succession. The combination of heavy season-long livestock grazing and fire exclusion will accelerate woody plant recovery and diminish the understory. Community Phase 2.3: shrub-herb co-dominance A plant

community co-dominated by shrubs and herbs will develop approximately 5 to 60 years post-fire. A small component of introduced species may be present. Community Pathway 2.3a: This pathway is characterized by natural succession. The combination of heavy season-long livestock grazing and fire exclusion will accelerate woody plant recovery and diminish the understory. Community Phase 2.4: immature lodgepole pine/ scattered Engelmann spruce This plant community will develop approximately 60 to 80 years since the last fire. Community Pathway 2.4a: This pathway is characterized by natural succession. The combination of heavy season-long livestock grazing and fire exclusion will accelerate woody plant recovery and diminish the understory. Community Phase 2.5: over-mature blighted lodgepole pine/ understory absent This plant community is the result of fire exclusion for well over 120 years. The lodgepole pine is over-mature and weakened, making it susceptible to infestation by insects or other pathogens. Community Pathway 2.5a: A stand-replacing wildfire or intensive logging will return the vegetation to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years. Transition T2a: from State 2 to State 3 (Secondary Forest/ Introduced State to Tertiary Forest/ Degraded State) The Secondary Forest/ Introduced State will transition to the Tertiary Forest/ Degraded State following a second cycle of timber harvest or stand replacing wildfire and further impacts from heavy continuous season-long grazing. Logging opens up the forest canopy allowing more understory for 20 to 30 years. Secondary and tertiary disturbances will produce an array of vegetation. Key indicators of the approach to this transition are a reduction in species diversity, gaps in the litter and duff layer, and evidence of accelerated soil erosion. Excessive human utilization triggers this transition. A restoration pathway is possible through moderation of human use, and proactive management.

State 3
Tertiary Forest/ Degraded State

Community 3.1
Tertiary Forest/ Degraded State

State 3 is characterized by tertiary forests that are degraded in both understory and tree condition. Fire suppression speeds up the dominance by woody plants. Community Phase 3.1: mature lodgepole pine/ sparse understory This plant community (3.1) is characterized by a stand of mature lodgepole pine. A sparse understory of pinegrass, nodding bluegrass, Letterman’s needlegrass and shade tolerant forbs may be present. This stand will develop approximately 100 to 120 years post-fire. Community Pathway 3.1a: With well over 120 years since the last fire, lodgepole pine will ultimately deteriorate, increasing its susceptibility to infestation by insects or other pathogens. Community Pathway 3.1b: A stand-replacing wildfire or intensive logging will return the vegetation to an early seral herb-dominated phase. Logging opens up the forest canopy allowing more understory for 20 to 30 years. Community Pathway 3.1c: The removal of only the mature lodgepole pine (a selective timber harvest) will allow the immature lodgepole pine to continue growing. Community Phase 3.2: herb-dominated This plant community will develop within the first 5 years since the last fire. Dominant species include pinegrass, nodding bluegrass, Letterman’s needlegrass, and shade intolerant forbs such as subalpine fleabane. A small component of introduced species may be present. Community Pathway 3.2a: This pathway is characterized by natural succession. Community Phase 3.3: shrub-herb co-dominance A plant community co-dominated by shrubs and herbs will develop approximately 5 to 60 years post-fire. A small component of introduced species may be present. Community Pathway 3.3a: This pathway is characterized by natural succession. Community Phase 3.4: immature lodgepole pine/ scattered Engelmann Spruce This plant community will develop approximately 60 to 80 years since the last fire, and is characterized by immature lodgepole pine with scattered Engelmann spruce. Community Pathway 3.4a: This pathway is characterized by natural succession. Community Phase 3.5: over-mature blighted lodgepole pine/ understory absent This plant community is the result of fire exclusion for well over 120 years. The lodgepole pine is over-mature and weakened, increasing its susceptibility to infestation by insects or other pathogens. Community Pathway 3.5a: A stand-replacing wildfire will return the vegetation to an early seral shade-intolerant herb-dominated phase.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Shrubs**			157–314	
Grass/Grasslike					
0	**Grasses**			269–538	
Forb					
0	**Forbs**			22–45	

Animal community

a. Livestock Grazing

This site is suited to cattle and sheep grazing during the summer and fall. Livestock will often concentrate on this site taking advantage of the shade and shelter offered by the tree overstory. Many areas are not used because of steep slopes or lack of adequate water. Attentive grazing management is required due to steep slopes and erosion hazards. Harvesting trees under a sound management program can open up the tree canopy to allow increased production of understory species desirable for grazing.

b. Initial Stocking Rates

Stocking rates vary in accordance with such factors as kind and class of grazing animal, season of use, and fluctuation in climate. Actual use records for individual sites, together with a determination of the degree to which the sites have been grazed and an evaluation of trend in site condition, offer the most reliable basis for developing initial stocking rates.

Selection of initial stocking rates for given grazed units is a planning decision. This decision should be made only after careful consideration of the total resources available, evaluation of alternatives for use and treatment, and establishment of objectives by the decisionmaker.

Wildlife species seeking food and cover in this forest site include moose, elk, mule deer, bear, porcupine, snowshoe hare, owl, and woodpecker.

Wood products

6. Silvicultural Practices

a. Harvest cut selectively or in small patches (size dependent upon site conditions) to enhance forage production.

1. Thinning and improvement cutting – removal of poorly formed, diseased, and low vigor trees of little or no value.

2. Harvest cutting – selectively harvest surplus trees to achieve desired spacing. Save large, healthy, full-crowned trees. Do not select only “high grade” trees during harvest.

b. Prescription burning program may be used to maintain desired canopy cover and manage site reproduction.

c. Selective tree removal on suitable sites to enhance forage production and manage site reproduction.

d. Pest Control – use necessary and approved control for specific pests or diseases.

e. Fire hazard – fire is usually not a problem in mature grazed stands. Install firebreaks or firelines as necessary.

Other information

4. Limitations and Considerations

a. Potential for sheet and rill erosion is moderate to severe depending on slope.

b. Moderate to severe equipment limitations on steeper slopes and on sites having extreme surface stoniness.

c. Proper spacing is the key to a well managed multiple use and multi-product forest.

5. Essential Requirements

a. Adequately protect from uncontrolled burning.

b. Protect soils from accelerated erosion.

c. Apply proper grazing management practices (see management guides)

Table 7. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
lodgepole pine	*PICO*	40	45	30	50	–	–	–	

Other references

Alexander, R. R. 1985. Major habitat types, community types, and plant communities in the Rocky Mountains. USDA- Forest Service Rocky Mountain Forest and Range Experiment Station. General technical report RM-123. 105p.

Alexander 1988. Forest vegetation on National Forests in the Rocky Mountain and Intermountain Regions: Habitat types and community types. USDA- Forest Service Rocky Mountain Forest and Range Experiment Station. General technical report RM-162. 47p.

Galatowitsch, S.M. 1990. Using the original land survey notes to reconstruct pre-settlement landscapes in the American West. Great Basin Naturalist: 50(2): 181-191. Keywords: [Western U.S., conservation, history, human impact]

Parson, R. E. 1996. A History of Rich County. Utah State Historical Society, County Commission, Rich County, Utah. Keywords: [Rich County, Utah, Historic land use, European settlements]

USDA-NRCS. 2003. National Range and Pasture Handbook. in USDA, editor, USDA-Natural Resources Conservation Service-Grazing Lands Technology Institute. Keywords: [Western US, Federal guidelines, Range pasture management]

Contributors

Darryl Trickler, Tim Watson
R. Douglas Ramsey (USU)
John Lowery (USU)
Neil E. West (USU)
Kate Peterson (USU)
Samuel Rivera (USU)
Lisa Langs Stoner (USU)
Leila Schultz (USU)

Approval

Scott Woodall, 9/19/2019

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	
Approved by	
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:**