USDA Natural Resources Conservation Service

Ecological site R018XI125CA
Very Steep Skeletal Hillslopes

Last updated: 4/24/2024
Accessed: 05/12/2025

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): 018X–Sierra Nevada Foothills

Major Land Resource Area (MLRA) 18, Sierra Nevada Foothills is located entirely in California and runs north to south adjacent to and down-slope of the west side of the Sierra Nevada Mountains (MLRA 22A). MLRA 18 includes rolling to steep dissected hills and low mountains, with several very steep river valleys. Climate is distinctively Mediterranean (xeric soil moisture regime) with hot, dry summers, and relatively cool, wet winters. Most of the precipitation comes as rain; average annual precipitation ranges from 15 to 55 inches in most of the area (precipitation generally increases with elevation and from south to north). Soil temperature regime is thermic; mean annual air temperature generally ranges between 52 and 64 degrees F. Geology is rather complex in this region; there were several volcanic flow and ashfall events, as well as tectonic uplift, during the past 25 million years that contributed to the current landscape.

LRU notes

This LRU (designated XI) is located on moderate to steep hills in the Sierra Nevada Foothills east of Sacramento, Stockton, and Modesto, CA. Various geologies occur in this region: metavolcanics, granodiorite, slate, marble, argillite, schist and quartzite, as well as ultramafic bands to a limited and localized extent. It includes mesa formations from volcanic flows, where vernal pool habitats occur. Soil temperature regime is thermic and soil moisture regime is xeric. Elevation ranges between 300 and 3400 feet above sea level. Precipitation ranges from 14 to 42 inches annually. Most precipitation falls between the months of November and March in the form of rain. Dominant vegetation includes annual grasslands, blue oak (Quercus douglasii), interior live oak (Quercus wislizeni), chamise (Adenostoma fasciculatum), buckbrush (Ceanothus cuneatus), and foothill pine (Pinus sabiniana).

Classification relationships

CLASSIFICATION RELATIONSHIPS
This site is located within M261F, the Sierra Nevada Foothills Section, (McNab et al., 2007) of the National Hierarchical Framework of Ecological Units (Cleland et al., 1997), M261Fb, the Lower Foothills Metamorphic Belt Subsection.

Level III and Level IV ecoregions systems (Omernik, 1987, and EPA, 2011) are: Level III, Central California Foothills and Coastal Mountains and Level IV, Ecoregion 6b, Northern Sierran Foothills, Ecoregion 6c, Comanche Terraces.

Ecological site concept

This site occurs on skeletal soils on very steep hills (55 to 70% slope), generally on south-facing backslopes in metasedimentary or metavolcanic parent material. Mean annual precipitation typically ranges from 27 to 34 inches, and elevation ranges from 800-1600 feet.

Steep terrain coupled with rocky soils and often south-facing aspects limits woody production. Most of the acres where this ecological site is found belong to Mocassinhill or Gopheridge components, both of which are moderately deep and loamy-skeletal. Mocassinhill is a Humic Haploxerept originating from colluvium formed from metasedimentary parent material. Gopheridge weathered from greenstone or other metavolcanic rocks and is an Ultic Haploxeralf. A minor component correlated to this site is the Jasperpeak soil. Jasperpeak is also loamy-skeletal but is shallow and found on metavolcanic parent material and classifies as a Lithic Haploxeralf.

The dominant vegetation in this ecological site consists of annual grasses and forbs and occasional shrubs or stunted trees. Common species include wild oat (Avena fatua), soft brome (Bromus hordeaceus), California poppy (Eschscholzia sp.), fiddleneck (Amsinkia spp.), and various clover (Trifolium spp.) species. Annual grasses make up between 70% and 85% of the annual production, while forbs generally make up between 15% and 30%. Woody vegetation of any type is < 1% of the annual production.

Associated sites

F018XI201CA	**Moderately Deep Thermic Foothills** This site commonly occurs nearby.

Similar sites

R018XI107CA	**Shallow, Undulating Volcanic Hills** Site relationships being developed.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Avena fatua* (2) *Eschscholzia*

Physiographic features

This site occurs in foothill landscapes on very steep hills, (55 to 70% slope) where it is predominantly found on south-facing slopes backslopes. Elevations typically range from 800 to 1600 feet.

Table 2. Representative physiographic features

Hillslope profile	(1) Backslope
Landforms	(1) Foothills > Hill (2) Foothills > Canyon
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	244–488 m
Slope	55–70%
Aspect	S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	91–792 m

Slope	50–90%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 27 to 34 inches and usually falls from October to May. Mean annual temperature ranges from 58 to 62 degrees F with 170 to 299 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	170-299 days
Freeze-free period (characteristic range)	279-365 days
Precipitation total (characteristic range)	686-864 mm
Frost-free period (actual range)	155-349 days
Freeze-free period (actual range)	236-365 days
Precipitation total (actual range)	610-864 mm
Frost-free period (average)	239 days
Freeze-free period (average)	317 days
Precipitation total (average)	762 mm

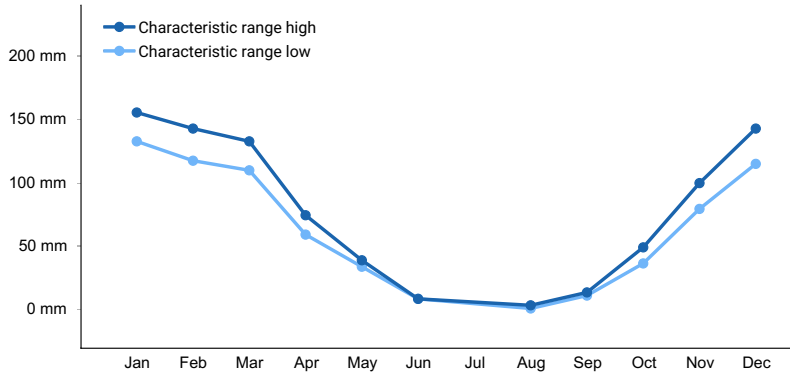


Figure 1. Monthly precipitation range

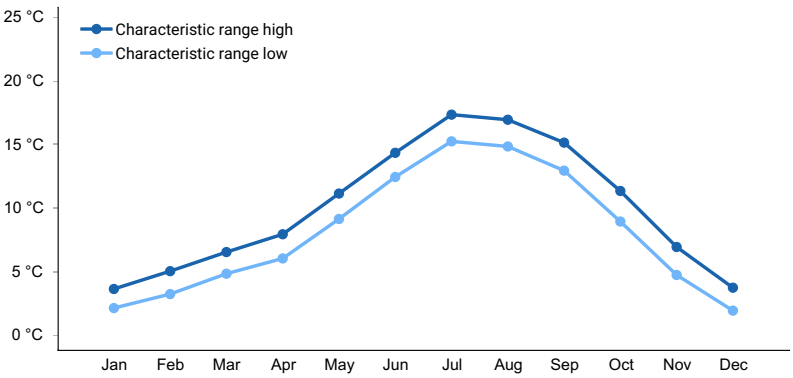


Figure 2. Monthly minimum temperature range

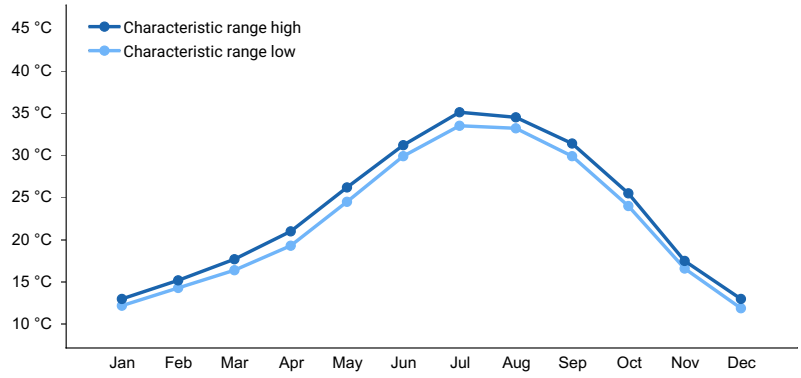


Figure 3. Monthly maximum temperature range

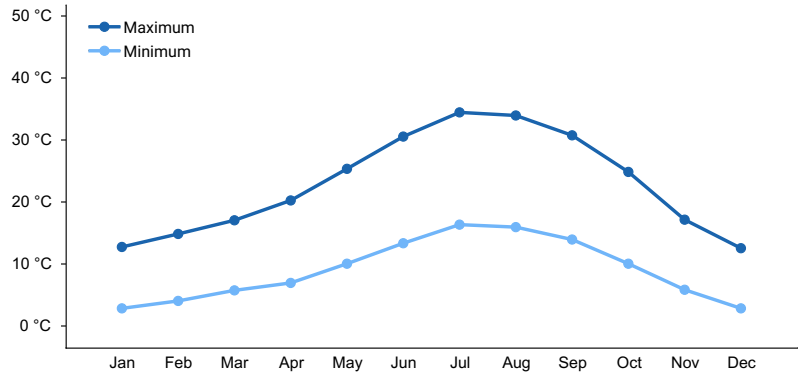


Figure 4. Monthly average minimum and maximum temperature

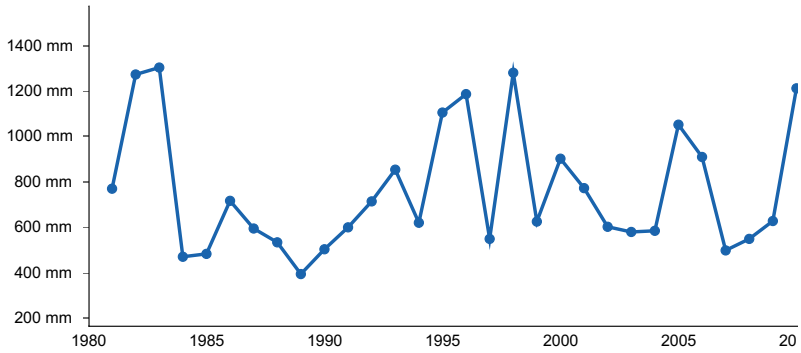


Figure 5. Annual precipitation pattern

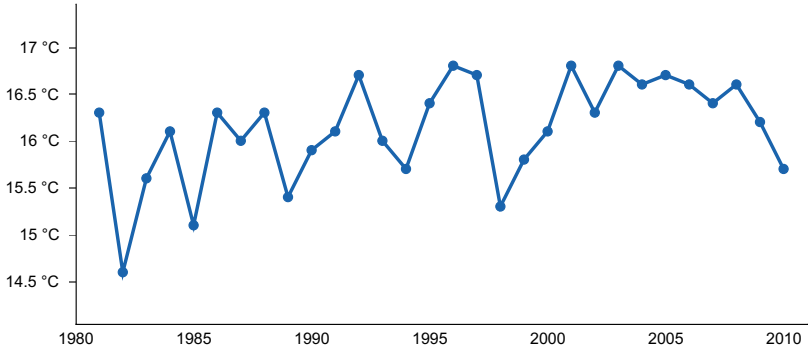


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SONORA [USC00048353], Jamestown, CA
- (2) NEW MELONES DAM HQ [USC00046174], Angels Camp, CA
- (3) SUTTER HILL CDF [USC00048713], Jackson, CA

- (4) CAMP PARDEE [USC00041428], Valley Springs, CA

Influencing water features

Due to the topographic position, this site does not have water features.

Wetland description

N/A

Soil features

The soils in this ecological site are formed from the colluvium and residuum of metavolcanic and metasedimentary rock. These soils are moderately deep, the particle size control sections are loamy-skeletal, and surface textures are loam, very gravelly loam and/or channery loam. The bedrock is a restrictive layer found between 29 and 40 inches of depth. Gravels (< 3 inch diameter) on the soil surface range from between 0 to 4% cover while larger fragments (= 3 inch diameter) range from between 1 and 14% surface cover. Within the soil profile gravels range between 9 and 42% by volume and larger fragments occupy 17 to 38% by volume. The soils in this ecological site are well drained and the permeability class ranges from moderate to moderately rapid. Available Water Capacity (AWC) is between 1.9 and 3.7 inches and the soil pH in the top 10 inches is between 6.5 and 7.5 and in the sub-horizons between 6.4 and 7.7.

Soil components correlated to this ecological site include Gopheridge and Moccasinhill which are both moderately deep and loamy-skeletal. Gopheridge is an ultic haploxeralf weathered from metavolcanic rocks, and Moccasinhill is a Humic Haploxerept that weathers from phyllite, slate, schist, or other metasedimentary rocks

Table 5. Representative soil features

Parent material	(1) Colluvium–metasedimentary rock (2) Colluvium–metavolcanics (3) Residuum–metasedimentary rock (4) Residuum–metavolcanics
Surface texture	(1) Very gravelly, channery loam (2) Loam
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	74–102 cm
Soil depth	74–102 cm
Surface fragment cover <=3"	0–4%
Surface fragment cover >3"	1–14%
Available water capacity (0-101.6cm)	4.83–9.4 cm
Soil reaction (1:1 water) (0-25.4cm)	6.5–7.5
Subsurface fragment volume <=3" (0-152.4cm)	9–42%
Subsurface fragment volume >3" (0-152.4cm)	17–38%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	51–152 cm

Soil depth	51–152 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–40%
Available water capacity (0-101.6cm)	1.78–14.22 cm
Soil reaction (1:1 water) (0-25.4cm)	5.6–8.1
Subsurface fragment volume <=3" (0-152.4cm)	1–70%
Subsurface fragment volume >3" (0-152.4cm)	0–82%

Ecological dynamics

State and transition model

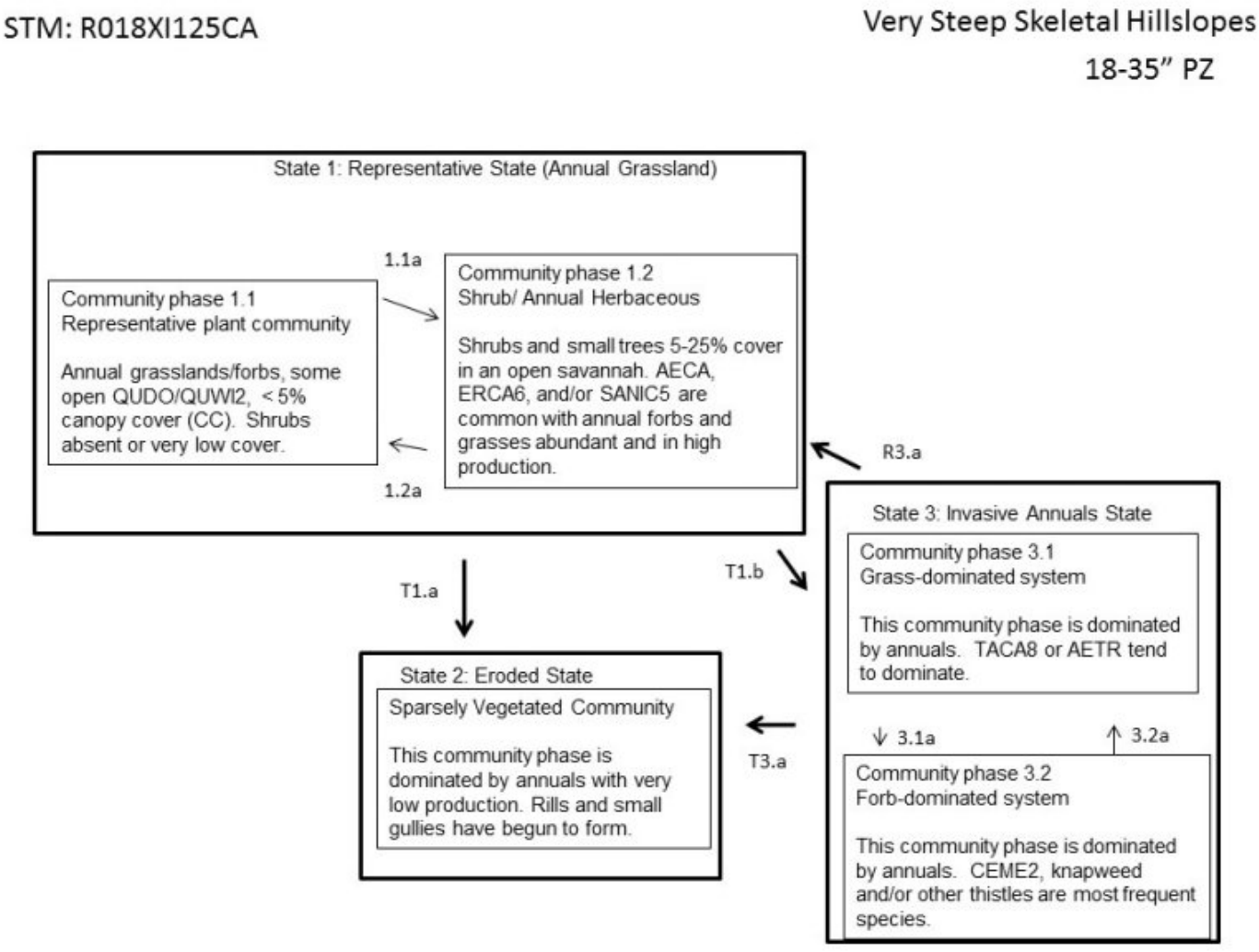


Figure 7. State and Transition Model

Community pathways and Transitions

T1.a This transition occurs when heavy or prolonged rainfall events occur following ground fires. These conditions cause the steep, unvegetated hillslopes to be vulnerable to erosion, with consequent rill and gully formation and therefore a loss of soil and productivity.

T1.b This transition occurs when undesirable invasive plants reach a critical threshold and inundate the area.

1.1a This community pathway occurs with recruitment of trees and/or shrubs from adjacent sites.

1.2a This community pathway occurs with mortality of trees and/or shrubs.

T3.a This transition occurs when heavy or prolonged rainfall events occur following ground fires. These conditions cause the steep, unvegetated hillslopes to be vulnerable to erosion, with consequent rill and gully formation and therefore a loss of soil and productivity.

R3.a This restoration pathway can occur with successfully executed weed management programs.

3.1a This community pathway occurs as invasive forbs become more dominant, often following low winter precipitation and reduced litter layers.

3.2a This community pathway occurs as invasive grass species become dominant, often in response to increases in litter following high winter precipitation years.

Figure 8. Community Pathways and Transitions

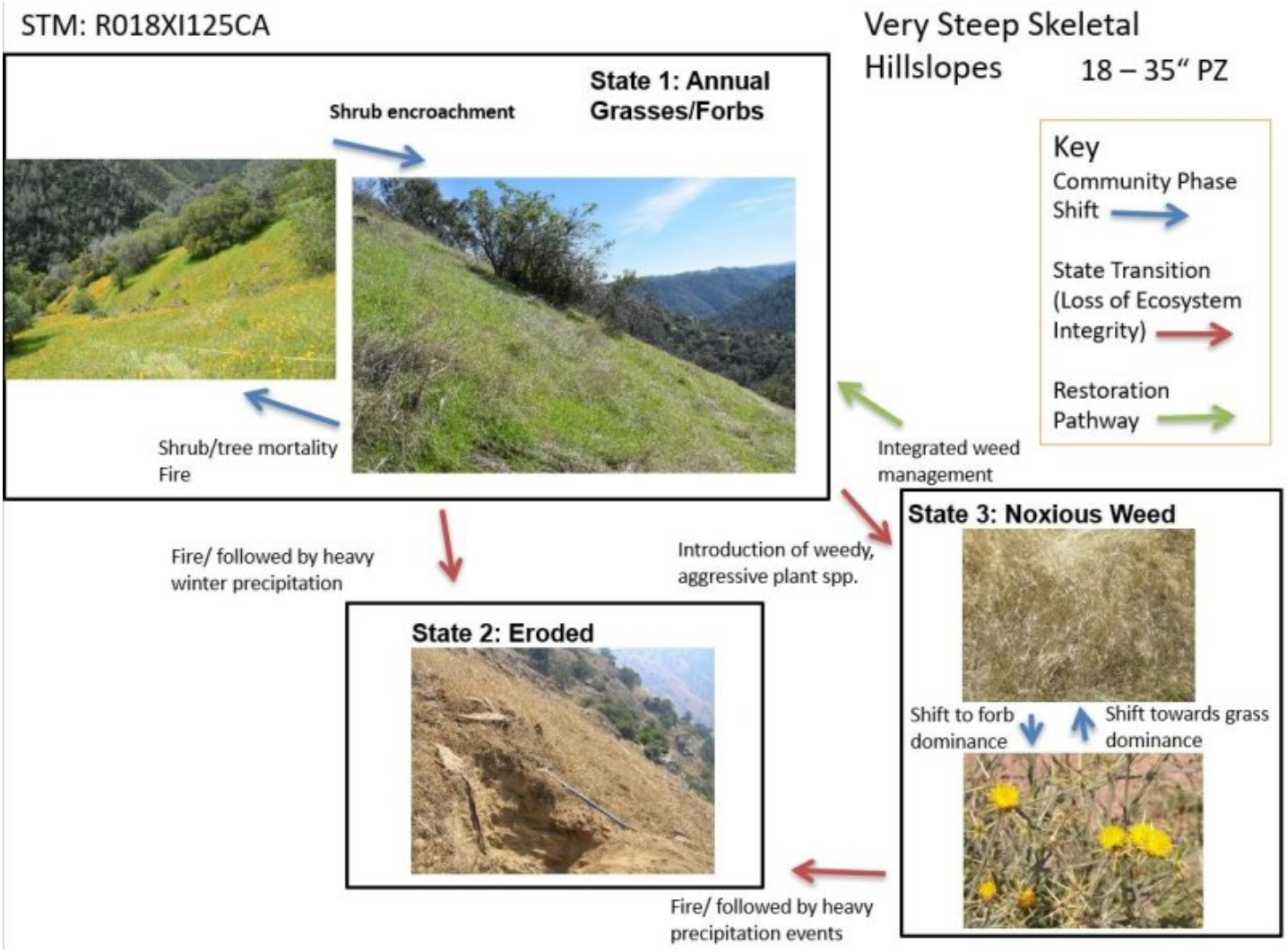


Figure 9. STM Photos

State 1
Representative State (Annual Grassland)

Community 1.1
Representative plant community

Annual grasslands/forbs, some open QUDO/QUWI2, < 5% canopy cover (CC). Shrubs absent or very low cover

Community 1.2
Shrub/ Annual Herbaceous

Shrubs and small trees 5-25% cover in an open savannah. AECA, ERCA6, and/or SANIC5 are common with annual forbs and grasses abundant and in high production.

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Shrub/ Annual Herbaceous

This community pathway occurs with recruitment of trees and/or shrubs from adjacent sites.

Pathway 1.2a
Community 1.2 to 1.1

Shrub/ Annual Herbaceous

Representative plant community

This community pathway occurs with mortality of trees and/or shrubs.

State 2
Eroded State

Community 2.1
Sparsely Vegetated Community

This community phase is dominated by annuals with very low production. Rills and small gullies have begun to form.

State 3
Invasive Annuals State

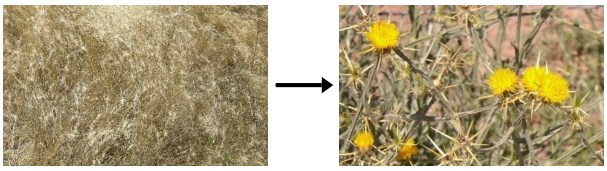
Community 3.1
Grass-dominated system

This community phase is dominated by annuals. TACA8 or AETR tend to dominate.

Community 3.2
Forb-dominated system

This community phase is dominated by annuals. CEME2, knapweed and/or other thistles are most frequent species.

Pathway 3.1a
Community 3.1 to 3.2



Grass-dominated system | Forb-dominated system

This community pathway occurs as invasive forbs become more dominant, often following low winter precipitation and reduced litter layers.

Pathway 3.2a
Community 3.2 to 3.1

Forb-dominated system | Grass-dominated system

This community pathway occurs as invasive grass species become dominant, often in response to increases in litter following high winter precipitation years.

Transition T1.a
State 1 to 2

This transition occurs when heavy or prolonged rainfall events occur following ground fires. These conditions cause the steep, unvegetated hillslopes to be vulnerable to erosion, with consequent rill and gully formation and therefore a loss of soil and productivity.

Transition T1.b
State 1 to 3

This transition occurs when undesirable invasive plants reach a critical threshold and inundate the area.

Restoration pathway R3.a
State 3 to 1

This restoration pathway can occur with successfully executed weed management programs.

Restoration pathway T3.a
State 3 to 2

This transition occurs when heavy or prolonged rainfall events occur following ground fires. These conditions cause the steep, unvegetated hillslopes to be vulnerable to erosion, with consequent rill and gully formation and therefore a loss of soil and productivity.

Additional community tables

Inventory data references

Inventory data to be collected using future projects based on priorities.

References

Natural Resources Conservation Service. . National Ecological Site Handbook.

Other references

Bartolome, J. W. 1987. California annual grassland and oak savannah. Rangelands 9:122-125.

Harrison, S. 1999. Native and alien species at the local and regional scales in a grazed California grassland. Oecologica 121: 99-106.

Harrison, S., Inouye, B. and H. Safford. 2003. Ecological heterogeneity in the effects of grazing and fire on grassland diversity. Conservation Biology 17: 837-845.

Hobbs, R.J., Yates, S. and H.A. Mooney. 2007. Long-term data reveal complex dynamics in relation to climate and disturbance. Ecological Monographs 77: 545-568.

Jackson, L. 1985. Ecological origins of California's Mediterranean grasses. Journal of Biogeography 12:349-361.

Keeley, J. E., Lubin, D. and Fotheringham, C. J. 2003. Fire and grazing impacts on plant diversity and alien plant invasions in the southern Sierra Nevada. Ecological Applications 13:1355-1374.

McDonald, P.M. 1990. Quercus douglasii Hook & Arn. Blue oak. In: Burns, Russell M; Honkala, Barbara H, tech. cords. Silvics of North America. Vol. 2: Hardwoods. Agricultural Handbook 654. Washington DC: USDA, Forest Service: 631-639.

Perakis, S.S. and C.H. Kellogg. 2007. Imprint of oaks on nitrogen availability and delta N-15 in California grassland-savanna: a case of enhanced N inputs? Plant Ecology 191: 209-220.

Seabloom, E., Borer, E., Boucher, V., Burton, R., Cottingham, K., Goldwasser, L., Gram, W., Kendall, B. and F. Micheli. 2003. Competition, seed limitation, disturbance, and reestablishment of California native annual forbs. Ecological Applications 13: 575-592.

Stewart, O. C., H. T. Lewis (ed.) and M. K. Anderson (ed.) 2002. Forgotten fires: Native Americans and the transient wilderness. University of Oklahoma Press: Norman, OK.

Contributors

Andy Paolucci
John Proctor
Nathan Roe
Dave Evans

Approval

Kendra Moseley, 4/24/2024

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	05/12/2025
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:**