USDA Natural Resources
Conservation Service

Ecological site R018XC105CA
Thermic Foothills

Last updated: 4/24/2024
Accessed: 04/26/2024

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.

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 12 to 55 inches in most of the area (precipitation generally increases with elevation and from south to north). 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

LRU Description:

The Southern Sierra Foothills is defined by extensive granite (diorite, and other intrusive volcanic rocks) geology. Soil temperature regime is thermic (in most southerly and lower elevations, can be hyperthermic). Elevation ranges between about 500 and 3200 feet above sea level. Maximum elevations increase towards the southern end, where precipitation is considerably lower. Precipitation ranges from 14 to 32 inches annually. Most precipitation falls between the months of November and March in the form of rain. Mean annual air temperature ranges between 58 to 64 F. Frost free days range between 195 and 282 days. Dominant vegetation includes annual grasslands, blue oak, interior live oak, chamise (Adenostoma fasciculatum), buckbrush (Ceanothus cuneatus), and foothill pine. At the highest elevations of the LRU, canyon live oak (Quercus chrysolepis), Interior live oak, and California bay (Umbelullaria californica) can be found in the steep drainages. Chamise-yucca plant assemblages can be found on steep, south-facing slopes. Buckeye is common in the concave positions at lower elevations. Riparian trees that are generally absent from the northern LRU's include California Sycamore (Plantanus racemosa) and lemon scented gum (Eucalyptus citriodora). Histories of livestock grazing and settlement due to mining activity have shaped the current landscape.

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), M261Fc, the Lower Granitic Foothills and M261Fd, Southern Granitic Foothills Subsections.

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 6c, Southern Sierran Foothills.

Ecological site concept

This site is characterized by moderately deep to deep soils on hills. This site occurs on igneous intrusive parent materials ranging in composition from granitic to basic rocks. Slopes typically range from 5 to 60%. Precipitation typically ranges from 14 to 23 inches per year, and elevation ranges from 1150 to 2150 feet.

Soil depth and low available water capacity, typical of the lower foothill elevations where higher evapotranspiration demands exist, are the main limits to woody production. Representative moderately deep, well-drained soil components include Ahwahnee, and Vista. Ahwahnee soils form from granitic rocks and are coarse-loamy, mixed, active thermic Mollic Haploxeralfs. Vista parent material is also granitic and these soils are Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts.

This ecological site consists of open blue oak (Quercus douglasii) stands (5 to 20% canopy cover) with smaller trees that rarely exceed 30 feet in height with high cover of annual forbs and grasses. Shrubs in this site are uncommon or make up a very low percentage of the site.

Associated sites

F018XC201CA	**Thermic Granitic Foothills** This site commonly occurs nearby.

Similar sites

R018XC104CA	**Thermic Free Face Foothills** Site relationships being developed.

Table 1. Dominant plant species

Tree	(1) *Quercus douglasii*
Shrub	Not specified
Herbaceous	(1) *Avena fatua* (2) *Bromus hordeaceus*

Physiographic features

This site occurs on elevations typically ranging from 1500 to 3000 feet on slopes typically ranging from 5 to 50%.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Hill (2) Foothills > Hillslope
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	1,500–3,000 ft
Slope	5–60%
Aspect	W, N, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	200–4,135 ft

Slope	2–75%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 18 to 27 inches and usually falls from October to May. Mean annual temperature ranges from 60 to 64 degrees F with 203 to 207 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	203-207 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	18-27 in
Frost-free period (actual range)	201-209 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	16-29 in
Frost-free period (average)	205 days
Freeze-free period (average)	365 days
Precipitation total (average)	22 in

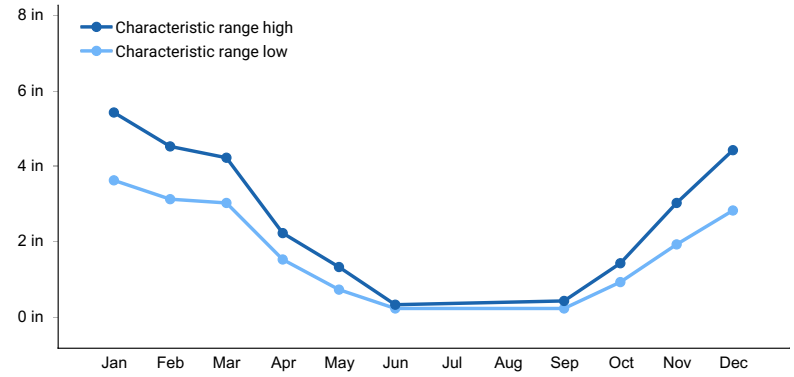


Figure 1. Monthly precipitation range

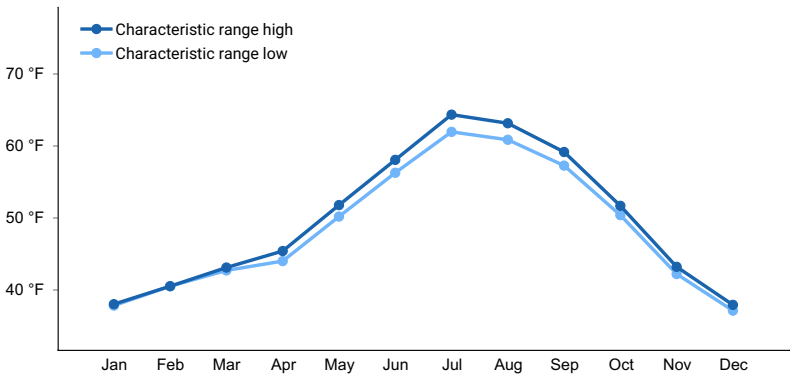


Figure 2. Monthly minimum temperature range

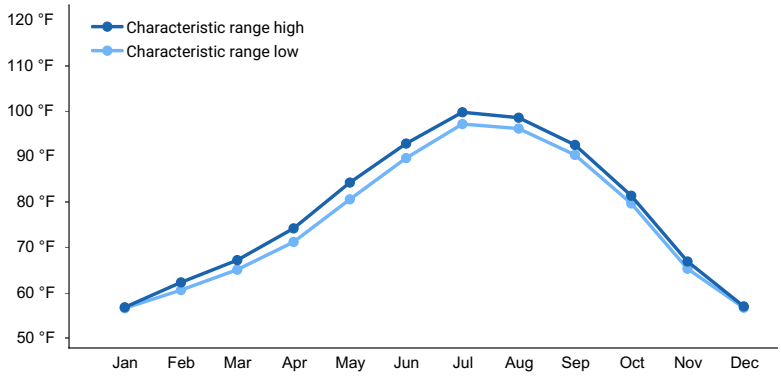


Figure 3. Monthly maximum temperature range

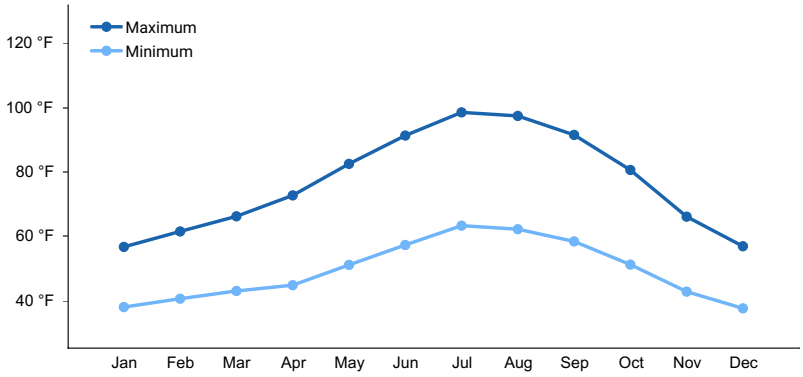


Figure 4. Monthly average minimum and maximum temperature

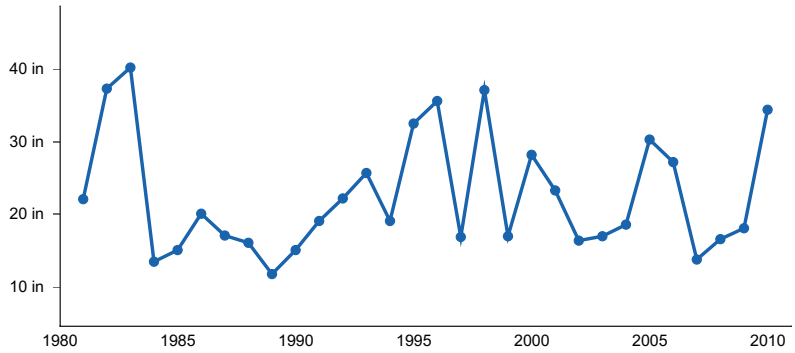


Figure 5. Annual precipitation pattern

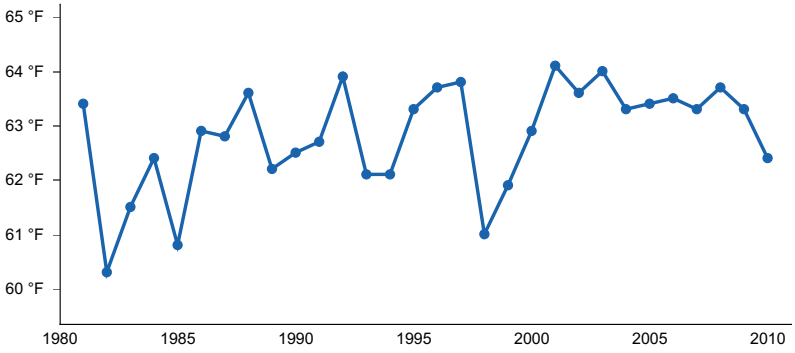


Figure 6. Annual average temperature pattern

Climate stations used

- (1) FRIANT GOVERNMENT CAMP [USC00043261], Friant, CA
- (2) NEW MELONES DAM HQ [USC00046174], Angels Camp, 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 residuum of granitic or dioritic rocks. The typical depth is moderately deep, and the particle size control section is coarse-loamy. Surface texture is coarse sandy loam or sandy loam and the bedrock is a restrictive layer found between 27 and 48 inches of depth. Gravels (< 3 inch diameter) cover approximately 3% of the soil surface, while larger fragments (= 3 inch diameter) don't provide any cover at all. Subsurface gravels make up between 5 to 10% of the soil volume and larger fragments are completely absent. The soils in this ecological site are well drained and the permeability class is rapid. The Available Water Capacity (AWC) is 3.6 to 4.4 inches and the pH of the top 10 inches of the soil ranges from 6 to 6.5 while in the subsoil the range is from 6.1 to 6.7.

Representative soil components include Ahwahnee, and Vista. Ahwahnee soils form from granitic rocks and are coarse-loamy, mixed, active thermic Mollic Haploxeralfs. Vista parent material is also granitic, but these soils are lighter in color and are less developed. Vista soils are classified as coarse-loamy, mixed, superactive, thermic Typic Haploxerepts.

Table 5. Representative soil features

Parent material	(1) Residuum–diorite (2) Residuum–granite
Surface texture	(1) Coarse sandy loam (2) Sandy loam
Family particle size	(1) Coarse-loamy
Drainage class	Well drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	27–48 in
Soil depth	27–48 in
Surface fragment cover <=3"	0–3%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3.6–4.4 in
Soil reaction (1:1 water) (0-10in)	6–6.5
Subsurface fragment volume <=3" (0-60in)	5–8%
Subsurface fragment volume >3" (0-60in)	0%

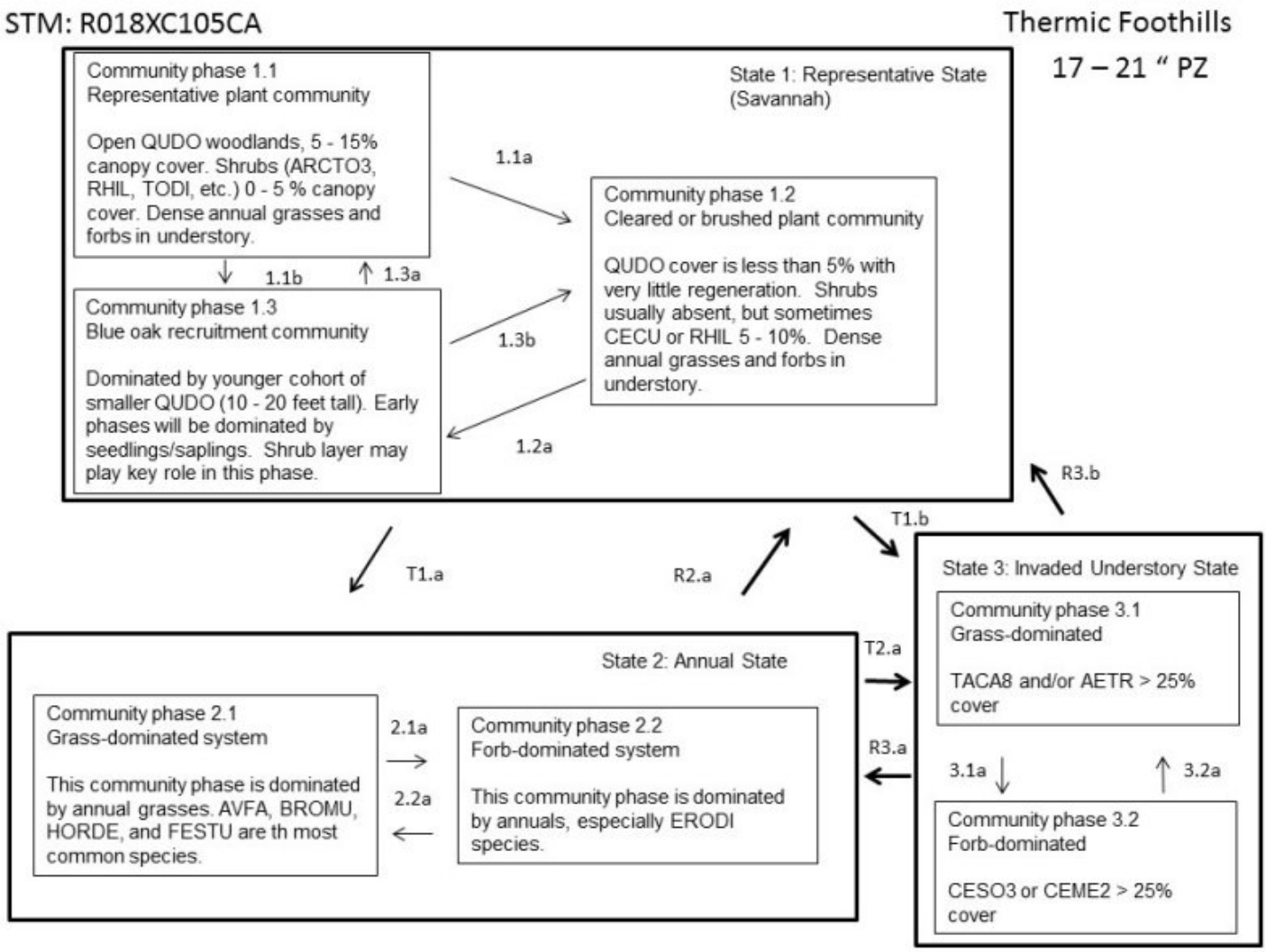
Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderately rapid to rapid
Depth to restrictive layer	18–72 in
Soil depth	18–72 in

Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–4%
Available water capacity (0-40in)	2.8–6.8 in
Soil reaction (1:1 water) (0-10in)	5.1–7.3
Subsurface fragment volume <=3" (0-60in)	0–30%
Subsurface fragment volume >3" (0-60in)	0–6%

Ecological dynamics

State and transition model



Community pathways and Transitions

T1.a This transition occurs after mechanical clearing that results in loss of oak and acorn source. Grazing management also can be used to create/maintain an annual dominated state.

T1.b This transition occurs after active brush management resulting in loss of oak and acorn source. Annual community dominated by invasive, noxious weeds, which proliferate in the new plant community.

1.1a This community pathway occurs with mechanical clearing that removes both shrubs and trees. Alternatively, a high severity fire may remove most of the woody vegetation. Some oaks remain on or near the site.

1.1b This community pathway occurs with episodic oak regeneration events (rarely occur) or low intensity fire or clearing that results in resprouting of oaks.

1.2a This community pathway occurs shortly after CP 1.1b, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

1.3a This community pathway occurs with normal time and growth.

1.3b This community pathway occurs with intense brushing/tree clearing which removes most of woody vegetation.

T2.a This transition occurs after invasive plants posing extreme economic/environmental issues become established.

R2.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

2.1a This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

2.2a This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

R3.a. This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

R3.b This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling's competition from annual invasive species.

Community pathways and Transitions- continued

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

3.2a This community pathway occurs as invasive grass species become dominant.

State 1

Community 1.1
Representative plant community

Open QUDO woodlands, 5 - 15% canopy cover. Shrubs (ARCTO3, RHIL, TODI, etc.) 0 - 5 % canopy cover. Dense annual grasses and forbs in understory.

Dominant plant species

- blue oak (*Quercus douglasii*), tree
- manzanita (*Arctostaphylos*), shrub
- hollyleaf redberry (*Rhamnus ilicifolia*), shrub
- Pacific poison oak (*Toxicodendron diversilobum*), shrub

Community 1.2
Cleared or brushed plant community

QUDO cover is less than 5% with very little regeneration. Shrubs usually absent, but sometimes CECU or RHIL 5 - 10%. Dense annual grasses and forbs in understory.

Dominant plant species

- blue oak (*Quercus douglasii*), tree

Community 1.3
Blue oak recruitment community

Dominated by younger cohort of smaller QUDO (10 - 20 feet tall). Early phases will be dominated by seedlings/saplings. Shrub layer may play key role in this phase.

Dominant plant species

- blue oak (*Quercus douglasii*), tree
- manzanita (*Arctostaphylos*), shrub
- hollyleaf redberry (*Rhamnus ilicifolia*), shrub
- Pacific poison oak (*Toxicodendron diversilobum*), shrub

Pathway 1.1a
Community 1.1 to 1.2

This community pathway occurs with mechanical clearing that removes both shrubs and trees. Alternatively, a high severity fire may remove most of the woody vegetation. Some oaks remain on or near the site.

Pathway 1.1b
Community 1.1 to 1.3

This community pathway occurs with episodic oak regeneration events (rarely occur) or low intensity fire or clearing that results in resprouting of oaks.

Pathway 1.2a
Community 1.2 to 1.3

This community pathway occurs shortly after CP 1.1b, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

Pathway 1.3a
Community 1.3 to 1.1

This community pathway occurs with normal time and growth.

Pathway 1.3b
Community 1.3 to 1.2

This community pathway occurs with intense brushing/tree clearing which removes most of woody vegetation.

State 2
Annual State

Community 2.1
Grass-dominated system

This community phase is dominated by annual grasses. AVFA, BROMU, HORDE, and FESTU are th most common species.

Dominant plant species

- wild oat (*Avena fatua*), grass
- soft brome (*Bromus hordeaceus*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- barley (*Hordeum*), grass

Community 2.2
Forb-dominated system

This community phase is dominated by annuals, especially ERODI species.

Dominant plant species

- longbeak stork's bill (*Erodium botrys*), other herbaceous
- redstem stork's bill (*Erodium cicutarium*), other herbaceous

Pathway 2.1a
Community 2.1 to 2.2

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

Pathway 2.2a
Community 2.2 to 2.1

This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

State 3
Invaded Understory State

Community 3.1

Community 3.2

Pathway P
Community 3.1 to 3.2

Pathway P
Community 3.2 to 3.1

Transition T1.a
State 1 to 2

This transition occurs after mechanical clearing that results in loss of oak and acorn source. Grazing management also can be used to create/maintain an annual dominated state.

Transition T1.b
State 1 to 3

This transition occurs after active brush management resulting in loss of oak and acorn source. Annual community dominated by invasive, noxious weeds, which proliferate in the new plant community.

Restoration pathway R2.a
State 2 to 1

This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

Transition T2.a
State 2 to 3

This transition occurs after invasive plants posing extreme economic/environmental issues become established.

Restoration pathway R3.b
State 3 to 1

This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling's competition from annual invasive species.

Restoration pathway R3.a
State 3 to 2

This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

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

Other References
Abrams, M.D. 1990. Adaptations and responses to drought in Quercus species of North America. Tree Physiology 7(1-4): 227-238.

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

Bolsinger, C. L. 1988. The hardwoods of Califonia's timberlands, woodlands, and savannas. Portland, OR: Pacific Northwest Forest and Range Experiment Station, Forest Service, USDA.

Callaway, R.M. 1992. Morphological and physiological responses of three California oak species to shade. International Journal of Plant Science. 153(3): 434-441.

Hickman, G.W., Perry, E.J. and R.M. Davis. 2011. Wood Decay Fungi in Landscape Trees. University of California. Integrated Pest Management Program. Agriculture and Natural Resources. Pest Notes 74109.

Howard, J.L. 1992. Pinus sabiniana. In: Fire Effects Information System. (Online) USDA, Forest Service Rocky Mountain Research Station, Fire Sciences Lab (Producer). Accessed: http://www.fs.fed.us/database/feis/[April 20, 2017]

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.

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.

USDA, Forest Service, Missoula Fire Sciences Laboratory. 2012. Information from LANDFIRE on fire regimes of California oak woodlands. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/fire_regimes/CA_oak_woodlands/all.html[2018, March 21].

Contributors

Michael Higgins
Nathan Roe

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	04/26/2024
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:**