USDA Natural Resources
Conservation Service

Ecological site R018XE104CA
Thermic Granitic Hills

Last updated: 4/24/2024
Accessed: 05/21/2024

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

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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 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

LRU 18XE is located on moderate to steep mountains and hills in the Tehachapi Foothills east of Bakersfield. This LRU covers the lower slopes around the southern end of the Greenhorn Mountains, the western sides of Breckenridge Mountain and the Tehachapi Mountains. The elevation ranges from 500 to 6500 feet above sea level and the geology of the region is predominately granitoid (both unaltered and metamorphosed). Similar to LRU 18XC to the north, vegetation series include blue oak, needlegrass and annual grasslands, as well as chamise, ceanothus, mixed oaks, and foothill pine, although this LRU tends to be more arid than with an annual precipitation range of only 8 to 31 inches per year. The lower precipitation and higher evaporative losses mean that these soils may not be able to completely leach excess salts, leading to a build-up of calcium and/or sodium in the subsoil. The soil temperature regime in this LRU is thermic and the soil moisture regimes are both xeric and aridic.

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 6ae, Tehachapi Foothills.

Ecological site concept

This site is characterized by shallow to moderately deep soils occurring on hills. This site occurs on soils formed mainly in granitic and some metamorphic rocks. Slopes typically range from 5 to 60%. Precipitation typically ranges from 11 to 20 inches per year, and elevation ranges from 2366 to 4000 feet.

Deep soils at low foothill elevations where high evapotranspiration demands exist result in communities of low statured blue oaks intermingled with annual grasses and forbs. At the high end of the elevation range of this site, coarse-loamy textures and moderately deep soils with lower water storage than surrounding soils, may constrain the growth of the trees. Common soils correlated to this ecological site are Walong (Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls), Arujo (Fine-loamy, mixed, superactive, thermic Pachic Argixerolls) and Feethill (Fine-loamy, mixed, superactive, thermic Typic Argixerolls).

This ecological site consists of open (5 to 20% canopy cover) blue oak (Quercus douglasii) stands of small trees that rarely exceed 30 feet in height, with high cover of annual forbs and grasses. The grass component includes wild oat (Avena fatua), soft chess (Bromus hordeaceus), ripgut brome (Bromus diandrus), red brome (Bromus madritensis ssp. Rubens), squirreltail (Elymus elymoides), annual barley (Hordeum spp.) and annual fescues (Festuca sp.). Some common forbs include fillaree (Erodium), and burclover (Medicago polymorpha). Annual production ranges from 800 to 2200 lbs per acre.

Associated sites

R018XE103CA	**Loamy Low Hills** This site commonly occurs nearby.

Similar sites

R018XE102CA	**Steep Clayey Shallow** Site relationships being developed.
R018XE103CA	**Loamy Low Hills** Site relationships being developed.

Table 1. Dominant plant species

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

Physiographic features

This site occurs at elevations ranging from 2365 to 4000 feet on slopes with gradient generally ranging from 20 to 55%.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Hillslope
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	716–1,219 m
Slope	20–55%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None

Elevation	152–1,768 m
Slope	2–85%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 12 to 16 inches and usually falls from October to May. Mean annual temperature ranges from 57 to 60 degrees F with 132 to 200 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	132-200 days
Freeze-free period (characteristic range)	187-365 days
Precipitation total (characteristic range)	305-406 mm
Frost-free period (actual range)	112-213 days
Freeze-free period (actual range)	174-365 days
Precipitation total (actual range)	305-483 mm
Frost-free period (average)	165 days
Freeze-free period (average)	275 days
Precipitation total (average)	356 mm

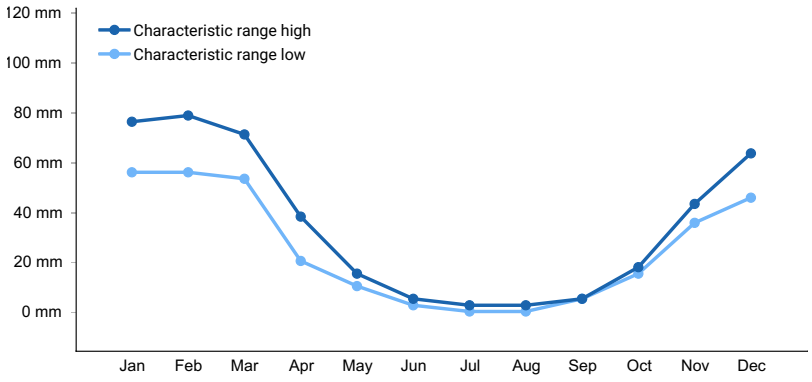

Figure 1. Monthly precipitation range

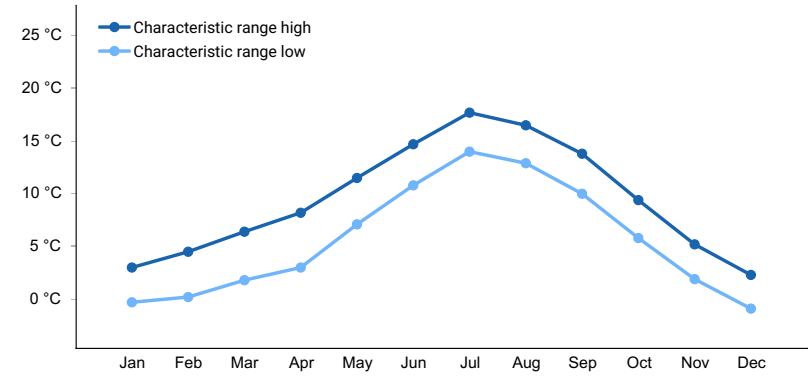

Figure 2. Monthly minimum temperature range

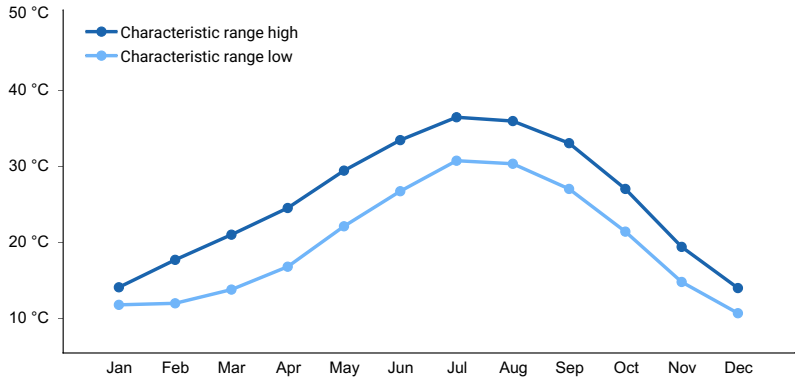

Figure 3. Monthly maximum temperature range

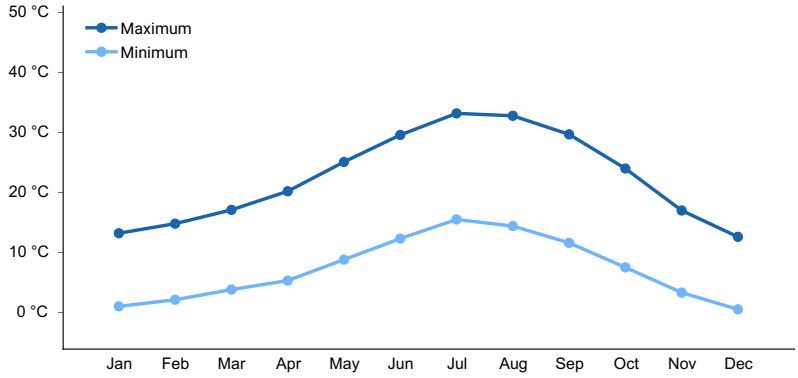

Figure 4. Monthly average minimum and maximum temperature

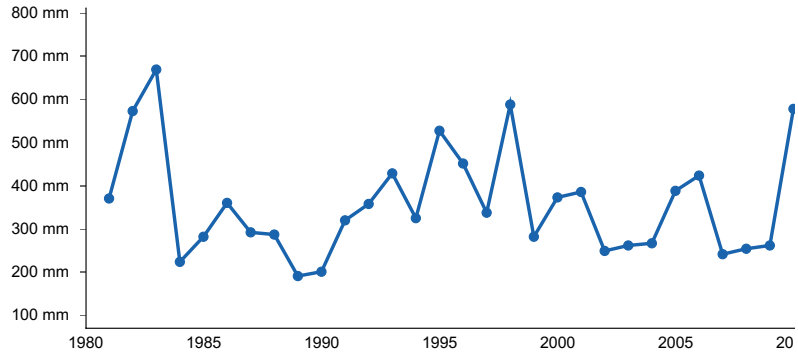

Figure 5. Annual precipitation pattern

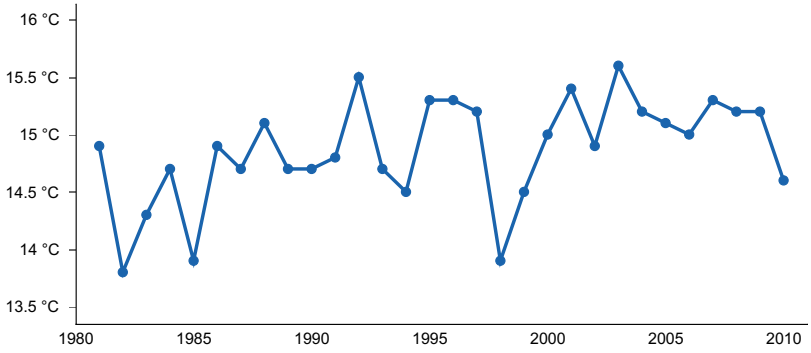

Figure 6. Annual average temperature pattern

Climate stations used

- (1) TEHACHAPI 4 SE [USC00048829], Tehachapi, CA
- (2) TEHACHAPI [USC00048826], Tehachapi, CA
- (3) GLENNVILLE [USC00043463], Glennville, CA

- (4) LEMON COVE [USC00044890], Woodlake, CA
- (5) LINDSAY [USC00044957], Lindsay, 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 in residuum from granitic rocks. Some soils derived from other parent materials (volcanic, metamorphic) have been included due to similar climatic characteristics. The soil depth class ranges from shallow to deep. The bedrock is restrictive. The particle size control section is coarse-loamy, fine-loamy or loamy; the surface texture is sandy loam, gravelly sandy loam or gravelly coarse sandy loam. Gravels on the soil surface range from 10 to 50% cover and larger fragments range from 0 to 20% cover. Gravels (≤3 inch diameter) range from 5 to 20% by volume throughout the profile and larger fragments (>3 inch diameter) range from 0 to 5% by volume throughout the profile. Soils in this ecological site are well drained. Permeability ranges from moderate to rapid. Available Water Storage (AWS) in the profile ranges from 1.7 to 6.2 inches. Surface and subsurface pH ranges from 6.6 to 7.2. Common soils correlated to this ecological site are Walong (Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls), Arujo (Fine-loamy, mixed, superactive, thermic Pachic Argixerolls) and Feethill (Fine-loamy, mixed, superactive, thermic Typic Argixerolls).

Table 5. Representative soil features

Parent material	(1) Residuum–granitoid (2) Residuum–granite (3) Residuum–metamorphic and sedimentary rock
Surface texture	(1) Sandy loam (2) Gravelly sandy loam (3) Gravelly coarse sandy loam
Drainage class	Well drained
Permeability class	Moderate to rapid
Depth to restrictive layer	25–127 cm
Soil depth	25–127 cm
Surface fragment cover <=3"	10–50%
Surface fragment cover >3"	0–20%
Available water capacity (0-101.6cm)	4.32–15.75 cm
Soil reaction (1:1 water) (0-25.4cm)	6.6–7.2
Subsurface fragment volume <=3" (0-152.4cm)	5–20%
Subsurface fragment volume >3" (0cm)	0–5%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderate to rapid
Depth to restrictive layer	15–152 cm
Soil depth	15–152 cm

Surface fragment cover <=3"	0–55%
Surface fragment cover >3"	0–55%
Available water capacity (0-101.6cm)	0–18.8 cm
Soil reaction (1:1 water) (0-25.4cm)	5.6–8.4
Subsurface fragment volume <=3" (0-152.4cm)	0–50%
Subsurface fragment volume >3" (0cm)	0–40%

Ecological dynamics

State and transition model

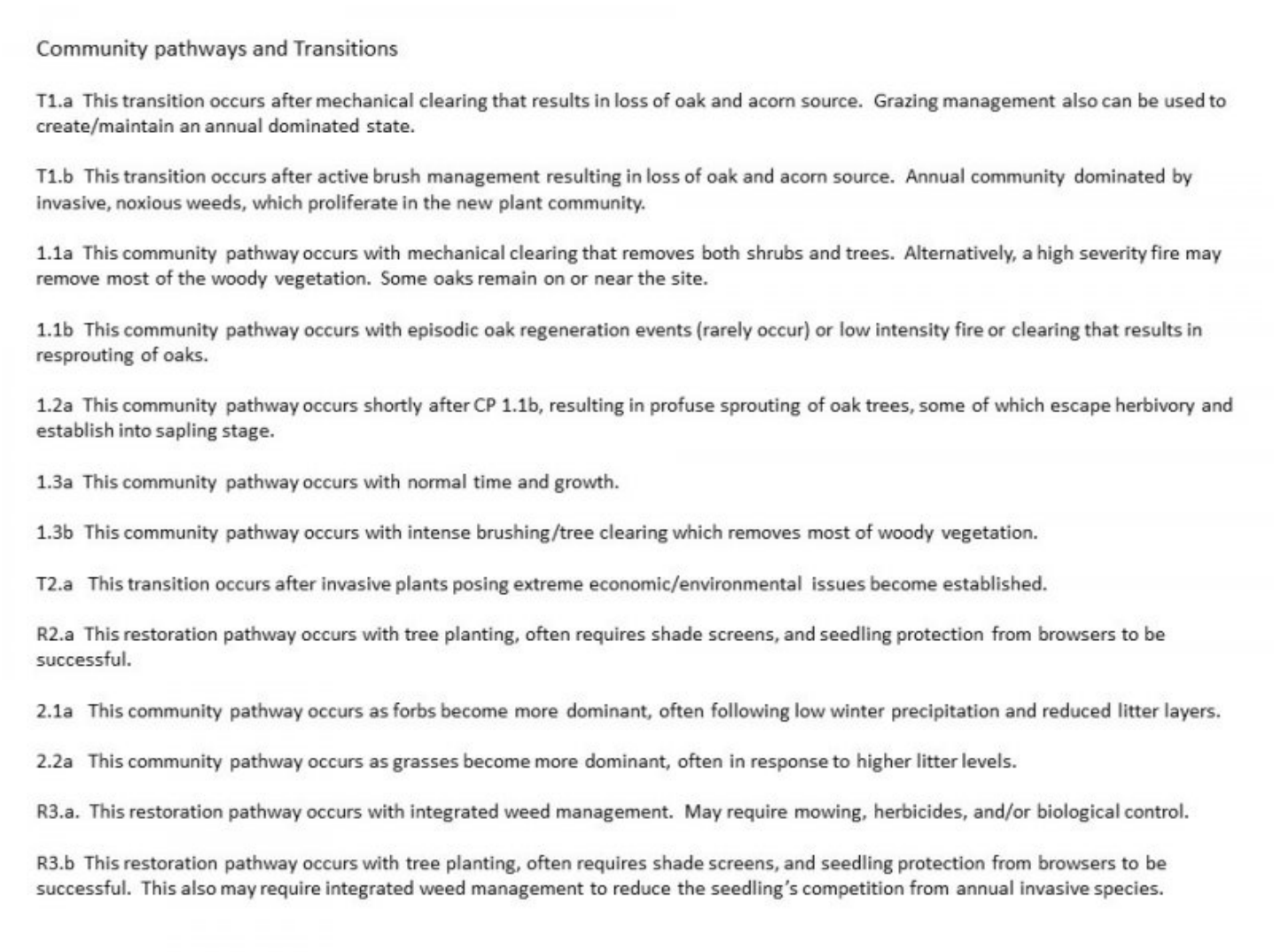

Figure 7. Community Pathways and Transitions (1 of 2)

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, often following increased letter layers and heavy winter precipitation.

Figure 8. Community Pathways and Transitions (2 of 2)

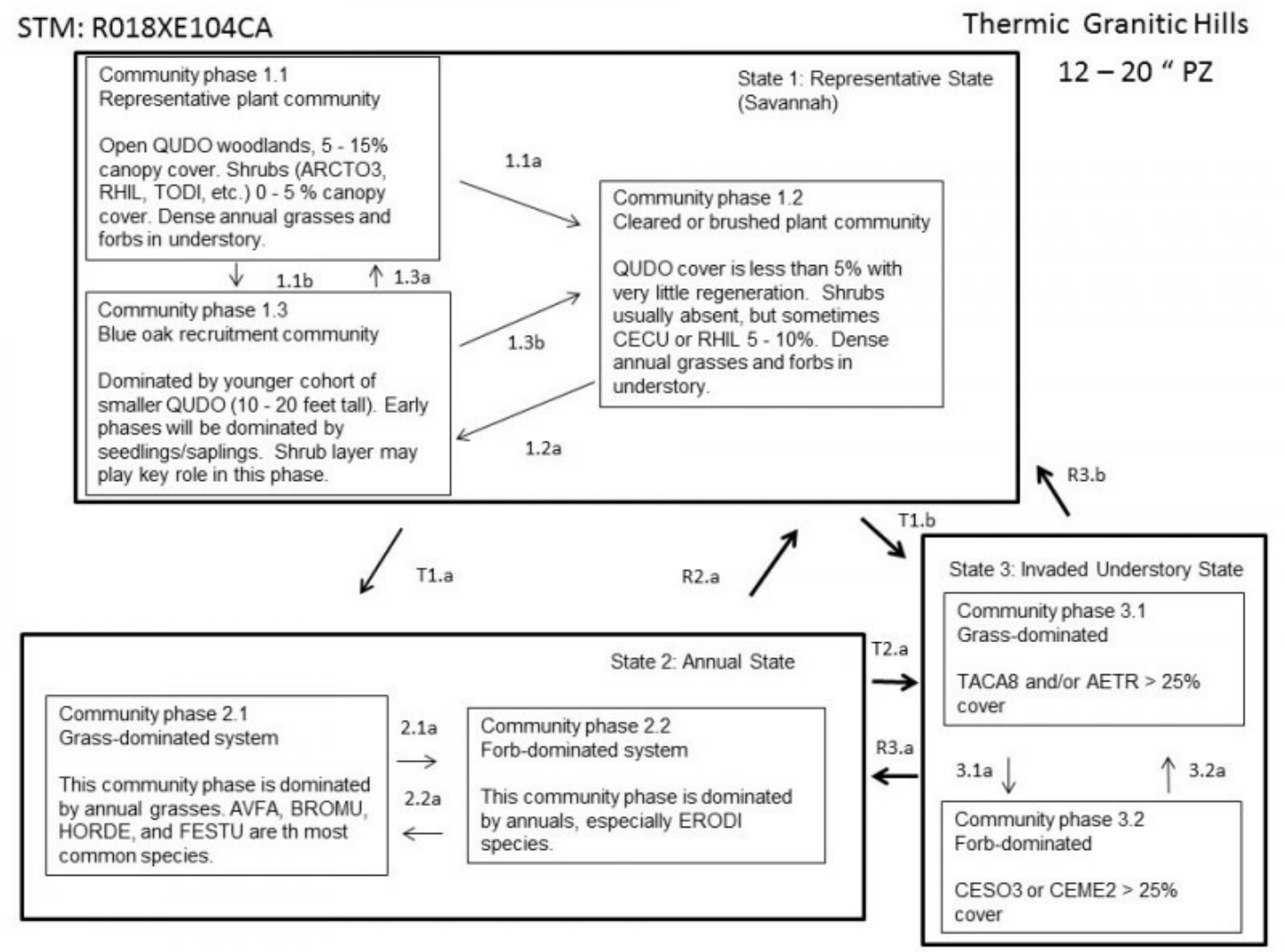

Figure 9. State and Transition Model.

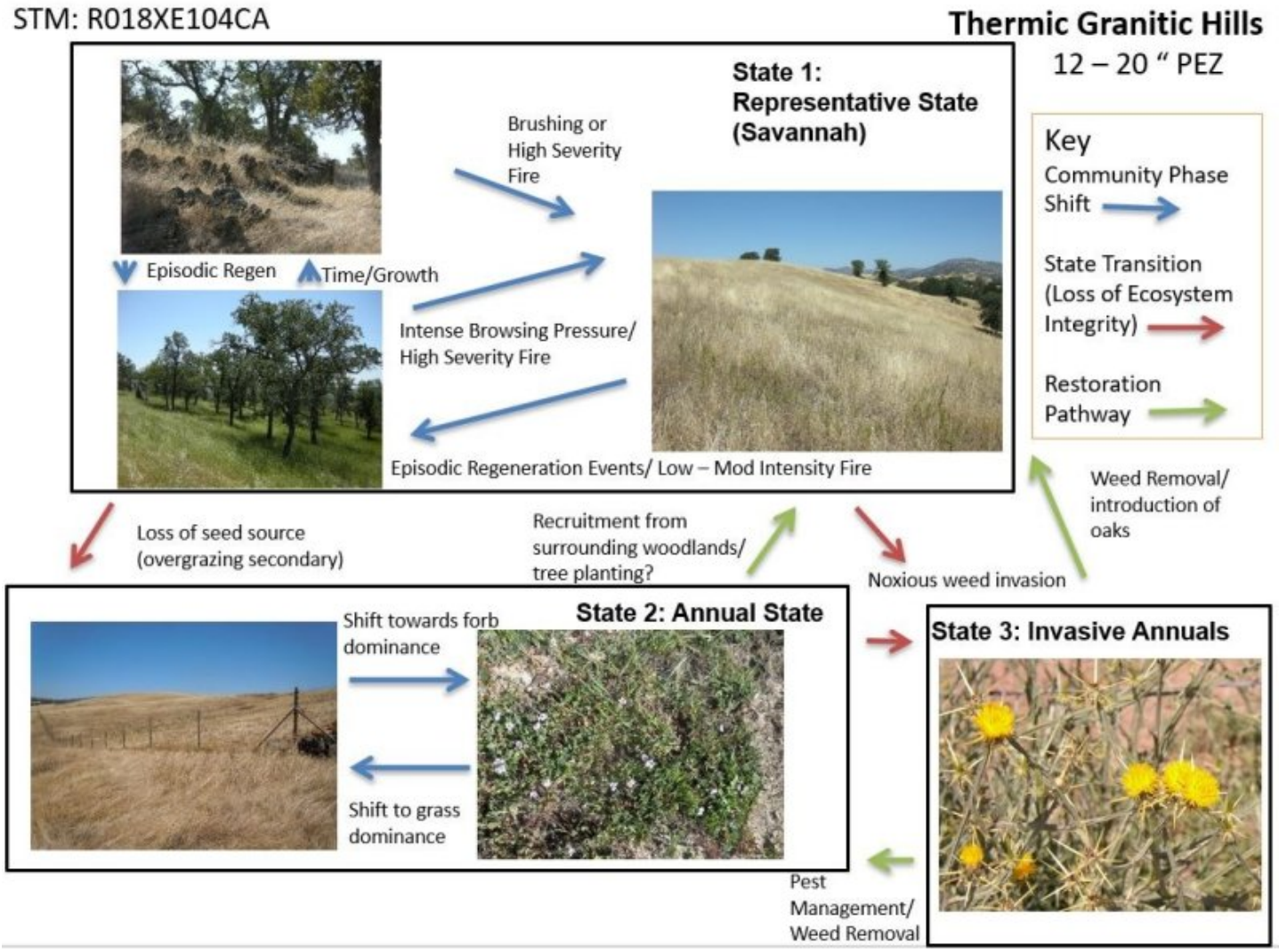

Figure 10. STM Photos

State 1
Representative State (Oak Savannah)

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.

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

Pathway P1.1a
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 P1.1b
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 P1.2a
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 P1.3a
Community 1.3 to 1.1

This community pathway occurs with normal time and growth.

Pathway P1.3b
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 VULPI are the most common species.

Dominant plant species

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

Community 2.2
Forb-dominated system

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

Dominant plant species

- stork's bill (*Erodium*), other herbaceous

Pathway P2.1a
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 P2.2a
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
Grass-dominated

TACA8 and/or AETR > 25% cover

Dominant plant species

- medusahead (*Taeniatherum caput-medusae*), grass
- barbed goatgrass (*Aegilops triuncialis*), grass

Community 3.2
Forb-dominated

CESO3 or CEME2 > 25% cover

Dominant plant species

- yellow star-thistle (*Centaurea solstitialis*), other herbaceous
- Maltese star-thistle (*Centaurea melitensis*), other herbaceous

Pathway P3.1a
Community 3.1 to 3.2

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

Pathway P3.2a
Community 3.2 to 3.1

This community pathway occurs as invasive grass species become dominant, often following increased letter layers and heavy winter precipitation.

Transition T
State 1 to 2

Transition T
State 1 to 3

Restoration pathway R
State 2 to 1

Transition T

State 2 to 3

Restoration pathway R
State 3 to 1

Restoration pathway R
State 3 to 2

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

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.

Contributors

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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	05/21/2024
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:**