USDA Natural Resources Conservation Service

Ecological site F018XI200CA
Low Elevation Foothills

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 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 on 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 and Stockton, 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 ft 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 is characterized by shallow or coarser-textured moderately deep soils occurring on low hills (relief 100 to 300 feet). This site occurs on all hillslope positions, except toeslopes, on metamorphic and granitic hills. Slopes typically range from 1 to 50%. Precipitation typically ranges from 25 to 29 inches per year, and elevation ranges from 150 feet to 2100 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 soil components include Auburn, Andregg, and Whiterock soils. Generally these are shallow, weakly developed soils. Auburn and Whiterock soils are loamy Lithic Haploxerepts or Xerorthents. Andregg soils are moderately deep, coarse-loamy Ultic Haploxerolls occurring in granite parent material.

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. Annual forbs and grasses together make up more than 80% of the annual production.

Associated sites

F018XI201CA	**Moderately Deep Thermic Foothills** This site commonly occurs nearby.
F018XI202CA	**Deep Thermic Steep Hillslopes** This site commonly occurs nearby.
F018XI205CA	**Thermic Granitic Foothills** This site commonly occurs nearby.

Similar sites

F018XI201CA	**Moderately Deep Thermic Foothills** Site relationships being developed.
R018XI107CA	**Shallow, Undulating Volcanic Hills** Site relationships being developed.

Table 1. Dominant plant species

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

Physiographic features

This site is characterized by shallow or coarser-textured moderately deep soils occurring on low hills (relief 100 to 300 feet). This site occurs on all hillslope positions, except toeslopes, on metamorphic and granitic hills. Elevation typically ranges from 150 to 2100 feet. Slopes typically range from 1 to 50%.

Table 2. Representative physiographic features

Hillslope profile	(1) Summit (2) Shoulder (3) Backslope (4) Footslope
Landforms	(1) Foothills > Hill (2) Foothills > Hillslope
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	150–2,100 ft
Slope	1–50%

Aspect	SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	110–3,600 ft
Slope	0–75%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 25 to 29 inches and usually falls from October to May. Mean annual temperature is 59 to 64 degrees F with 247 to 335 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	247-335 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	25-29 in
Frost-free period (actual range)	224-358 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	24-30 in
Frost-free period (average)	291 days
Freeze-free period (average)	365 days
Precipitation total (average)	27 in

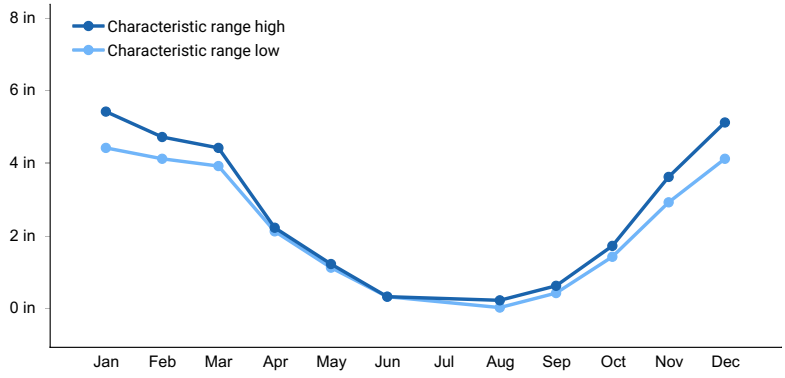


Figure 1. Monthly precipitation range

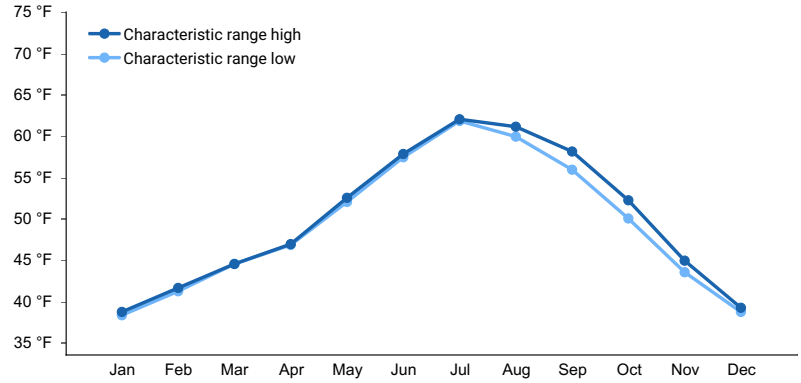


Figure 2. Monthly minimum temperature range

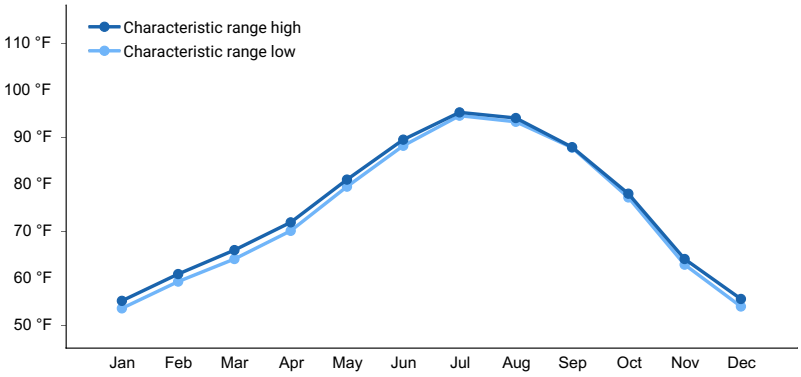


Figure 3. Monthly maximum temperature range

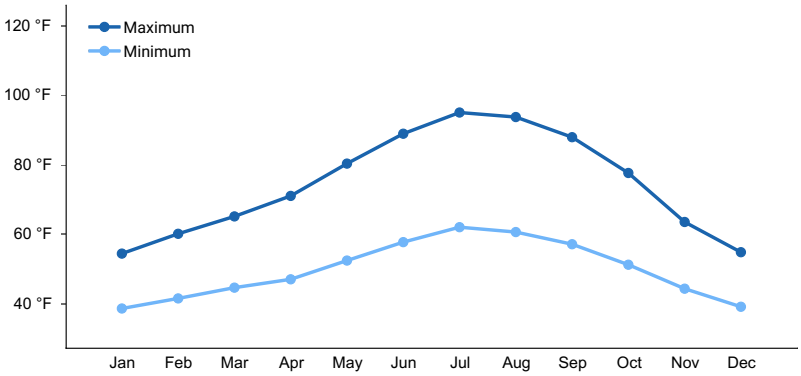


Figure 4. Monthly average minimum and maximum temperature

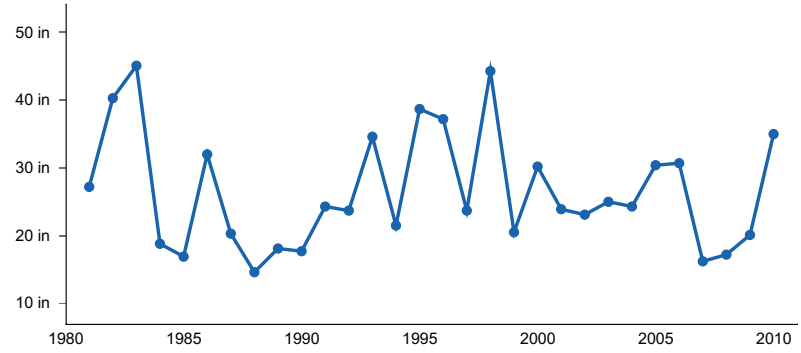


Figure 5. Annual precipitation pattern

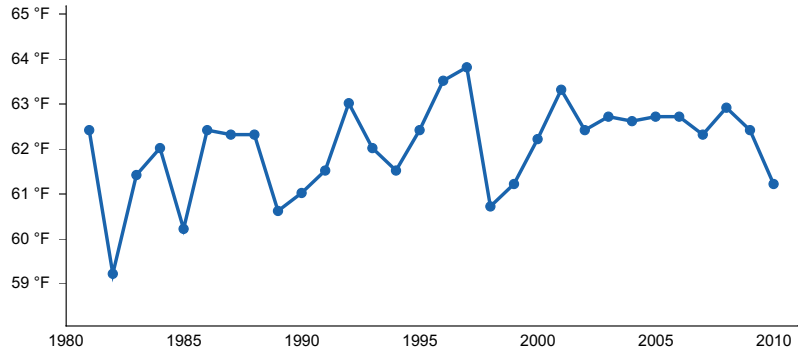


Figure 6. Annual average temperature pattern

Climate stations used

- (1) OROVILLE [USC00046521], Oroville, CA
- (2) CAMP PARDEE [USC00041428], Valley Springs, CA

Influencing water features

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

Wetland description

N/A

Soil features

The soils in this ecological site are formed from colluvium and residuum of granitic, metavolcanic and metasedimentary rocks. These soils are very shallow to moderately deep and have loamy particle size control sections with surface textures ranging from loams to silt loams. The bedrock is restrictive and is found between 9 and 35 inches of depth. The soils in this ecological site are well drained and the permeability class ranges from moderately rapid to rapid. Gravels (< 3 inch diameter) range between 0 to 5% of surface cover and larger fragments (= 3 inch diameter) cover between 0 and 25% of the surface. Within the soil profile gravels range between 2 to 24% and larger fragments occupy 0 to 13% by volume. Available Water Capacity (AWC) ranges from 1.2 to 5.5 inches. Soil reaction in the top 10 inches of the profile ranges from 5.6 to 6.5 and from 10 inches down the range is from 5.6 to 6.7.

Representative soil components include Auburn, Andregg, and Whiterock soils. Auburn soils are shallow to moderately deep, weathering from amphibolite schist. They are loamy, mixed, superactive, thermic Lithic Haploxerepts. They occur on drier portions of the landscape where there is generally not enough water moving through the profile for an argillic horizon to occur. Andregg soils are moderately deep, coarse-loamy Ultic Haploxerolls occurring on granitic parent material. Whiterock soils are possibly the most limiting; they are very shallow to shallow derived from metasedimentary parent material. They classify as loamy, mixed, superactive, nonacid, thermic Lithic Xerorthents.

This ecological site is associated with the following mapunits within Sacramento County (CA067):

National Mapunit Symbol, Mapunit Name, Component(s)

hhlh, Auburn silt loam, 2 to 30 percent slopes, Auburn
hhlf, Argonaut-Auburn complex, 3 to 8 percent slopes, Auburn
hhql, Vleck-Amador-Pits, mine complex, 15 to 50 percent slopes, Amador
hhlj, Auburn-Argonaut-Rock outcrop complex, 8 to 30 percent slopes, Auburn
hhlb, Andregg coarse sandy loam, 8 to 15 percent slopes, Andregg
hhl9, Andregg coarse sandy loam, 2 to 8 percent slopes, Andregg
hhld, Andregg-Urban land complex, 8 to 15 percent slopes, Andregg

hhlc, Andregg-Urban land complex, 2 to 8 percent slopes, Andregg

This ecological site is associated with the following mapunits within San Joaquin County (CA077):

2rx24, Amador sandy loam, 2 to 15 percent slopes, Amador
2rx20, Pardee cobbly loam, 2 to 15 percent slopes, Pardee

This ecological site is associated with the following mapunits within the Butte Area (CA612):

trmj, Ultic Haploxeralfs, thermic, high terrace, 15 to 30 percent slopes, Ultic Haploxeralfs
trmk, Ultic Haploxeralfs, thermic, high terrace, 2 to 15 percent slopes, Ultic Haploxeralfs
hh4z, Dunstone-Argonaut taxadjunct-Sunnyslope , 2 to 15 percent slopes, Sunnyslope
hh7l, Dunstone-Loafercreek-Katskillhill , 2 to 15 percent slopes, Dunstone

This ecological site is associated with the following map units within Yuba County (CA618):

hg63, Pardee gravelly loam, 3 to 8 percent slopes, Pardee
hg64, Pardee-Ranchoseco complex, 0 to 3 percent slopes, Pardee
hg2w, Auburn-Timbuctoo-Argonaut complex, 8 to 15 percent slopes, Argonaut
hg1l, Argonaut-Auburn complex, 3 to 8 percent slopes, Argonaut
hg1n, Argonaut-Auburn complex, 8 to 15 percent slopes, Argonaut
phg1, Argonaut-Auburn complex, 3 to 8 percent slopes, Argonaut

This ecological site is associated with the following mapunit within the Nevada County Area (CA619):

phg1, Argonaut-Auburn complex, 3 to 8 percent slopes, Argonaut

This ecological site is associated with the following mapunits within Placer County, Western Part (CA620):

hfz5, Caperton gravelly coarse sandy loam, 2 to 30 percent slopes
hfz6, Caperton-Andregg coarse sandy loams, 2 to 15 percent slopes
hhlc, Andregg-Urban land complex, 2 to 8 percent slopes
hfyf, Andregg coarse sandy loam, 2 to 9 percent slopes
hfyj, Andregg coarse sandy loam, rocky, 2 to 15 percent slopes
hfyr, Auburn-Argonaut-Rock outcrop complex, 2 to 15 percent slopes

This ecological site is associated with the following mapunits within the El Dorado Area (CA624):

hj0v, Perkins gravelly loam, moderately deep variant, 2 to 5 percent slopes
hhys, Auburn very rocky silt loam, 30 to 50 percent slopes
hhyq, Auburn silt loam, 2 to 30 percent slopes

This ecological site is associated with the following map unit within the Amador Area (CA628):

hj3h, Exchequer and Auburn very rocky loams, 3 to 31 percent slopes
hj5x, Pardee cobbly loam, 3 to 31 percent slopes
hj3g, Exchequer and Auburn loams, 3 to 31 percent slopes
hj2p, Auburn silt loam, 0 to 31 percent slopes
hj2s, Auburn very rocky silt loam, 3 to 9 percent slopes, eroded

This ecological site is associated with the following map units within the Central Sierra Foothills Area (CA630):

2x294, Bonanza-Loafercreek-Gopheridge complex, 15 to 30 percent slopes
2rx24, Amador sandy loam, 2 to 15 percent slopes
2rx20, Pardee cobbly loam, 2 to 15 percent slopes
2x295, Jasperpeak-Gopheridge complex, 30 to 60 percent slopes
2x4c9, Flanly loam, 8 to 30 percent slopes
2x4c8, Flanly-Verjeles complex, 0 to 8 percent slopes

2x296, Loafercreek-Bonanza complex, 3 to 15 percent slopes
2rx18, Miltonhills-Amador complex, 15 to 45 percent slopes
20mnb, Copperopolis-Whiterock complex, 15 to 30 percent slopes, rocky
20mn9, Copperopolis-Whiterock complex, 3 to 15 percent slopes, rocky
20mn8, Copperopolis-Whiterock complex, 2 to 8 percent slopes, rocky
2lp8c, Urban land-Copperopolis complex, 0 to 15 percent slopes
2n89h, Aquic Haploxeralfs-Loafercreek-Dunstone complex, 1 to 12 percent slopes
2mywp, Bonanza-Loafercreek complex, 3 to 15 percent slopes
2mftj, Moccasinhill-Copperopolis complex, 30 to 60 percent slopes

This ecological site is associated with the following map units within the Stanislaus County Area, Western Part (CA632):

2rx24, Amador sandy loam, 2 to 15 percent slopes
2x294, Bonanza-Loafercreek-Gopheridge complex, 15 to 30 percent slopes
2x295, Jasperpeak-Gopheridge complex, 30 to 60 percent slopes
2rx20, Pardee cobbly loam, 2 to 15 percent slopes
2mywp, Bonanza-Loafercreek complex, 3 to 15 percent slopes
2n89h, Aquic Haploxeralfs-Loafercreek-Dunstone complex, 1 to 12 percent slopes
2rx18, Miltonhills-Amador complex, 15 to 45 percent slopes

This ecological site is associated with the following mapunits within the Eastern Stanislaus Area (CA644):

2x295, Jasperpeak-Gopheridge complex, 30 to 60 percent slopes
2x294, Bonanza-Loafercreek-Gopheridge complex, 15 to 30 percent slopes
hjhy, Whiterock silt loam, 0 to 8 percent slopes
hjhw, Whiterock rocky silt loam, 8 to 30 percent slopes
20mn9, Copperopolis-Whiterock complex, 3 to 15 percent slopes, rocky
20mn8, Copperopolis-Whiterock complex, 2 to 8 percent slopes, rocky
2n89h, Aquic Haploxeralfs-Loafercreek-Dunstone complex, 1 to 12 percent slopes
2mywp, Bonanza-Loafercreek complex, 3 to 15 percent slopes

This ecological site is associated with the following mapunits within the Merced Area (CA648):

20mn9, Copperopolis-Whiterock complex, 3 to 15 percent slopes, rocky
20mn8, Copperopolis-Whiterock complex, 2 to 8 percent slopes, rocky

This ecological site is associated with the following mapunits within the Mariposa Area (CA649):

2x296, Loafercreek-Bonanza complex, 3 to 15 percent slopes
2x295, Jasperpeak-Gopheridge complex, 30 to 60 percent slopes
2x4c9, Flanly loam, 8 to 30 percent slopes
2x4c8, Flanly-Verjeles complex, 0 to 8 percent slopes
2x294, Bonanza-Loafercreek-Gopheridge complex, 15 to 30 percent slopes
20mn9, Copperopolis-Whiterock complex, 3 to 15 percent slopes, rocky
20mn8, Copperopolis-Whiterock complex, 2 to 8 percent slopes, rocky
2n89h, Aquic Haploxeralfs-Loafercreek-Dunstone complex, 1 to 12 percent slopes
2mywp, Bonanza-Loafercreek complex, 3 to 15 percent slopes

Table 5. Representative soil features

Parent material	(1) Residuum–granitoid (2) Residuum–metavolcanics (3) Residuum–metasedimentary rock (4) Colluvium–granitoid (5) Colluvium–metasedimentary rock (6) Colluvium–metavolcanics

Surface texture	(1) Loam (2) Silt loam
Family particle size	(1) Loamy (2) Coarse-loamy
Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	6–39 in
Soil depth	6–39 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–25%
Available water capacity (0-40in)	1.2–5.5 in
Soil reaction (1:1 water) (0-10in)	5.6–6.5
Subsurface fragment volume <=3" (0-60in)	2–24%
Subsurface fragment volume >3" (0-60in)	0–13%

Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderately slow to rapid
Depth to restrictive layer	4–60 in
Soil depth	4–60 in
Surface fragment cover <=3"	0–49%
Surface fragment cover >3"	0–35%
Available water capacity (0-40in)	0.3–6.8 in
Soil reaction (1:1 water) (0-10in)	4.5–7.3
Subsurface fragment volume <=3" (0-60in)	0–82%
Subsurface fragment volume >3" (0-60in)	0–32%

Ecological dynamics

This ecological site exists along the lower elevations of the Sierra Nevada Foothills and consists of open blue oak savannas dominated by annual grasses and forbs in the understory. Blue oak woodland is the most extended hardwood cover in California (Bolsinger, 1988) distributed primarily around the ranges surrounding the Sacramento and San Joaquin valleys. Historically, many native forbs and some perennial bunchgrasses (Bartolome, 1987) may have been found on this site, but there is a chasm of different opinions concerning which plant lifeform was prevailing at the time that the first Spanish settlers arrived. It is uncertain when exactly most of the introduced herbaceous plants arrived, but Bartolome (1987) estimates that by the mid 1800’s, “most of the annual grasses, filarees, bromes and fescues” from the Mediterranean region had established. In 1850, one traveler in the vicinity of San Jose wrote, “we found ourselves between lofty hills, those to the right (east) being covered by wild oat” (Stewart, 2002). The introduced annuals quickly naturalized to a climate highly similar to their place of origin, i.e. mild, wet winters and dry summers (Bartolome, 1987). This ecological site has an open canopy of blue oak and in some areas, the soil depth, and presence of rocks may prohibit trees from growing.

Disturbance Dynamics:

Fire: Fire has been shaping the Sierra Nevada Foothills landscape for millenna. Native indigenous groups living along the entire length of the foothills used fire for ecosystem alteration for centuries before European establishment. The diverse array of reasons for burning, included hunting purposes, to maintain vegetation (clearing underbrush), and to improve crop yield (Stewart, 2002). It is possible that the openness of the oak savannah communities is a consequence of repeated burning. Native Californians may have burnt in selected plots of the grassland/ oak communities to prepare sites for planting of tobacco. Some records indicate that the Maidu People of Northern California set fires annually to maintain open country (safety purposes) and to promote grasses and herbs over brush (Stewart, 2003).

Grazing: Livestock grazing has occurred for at least 200 years and has likely contributed to the spread of Mediterranean annual grasses such as the genera Bromus and Avena (Jackson, 1985). Grazing impacts can vary depending on the timing and duration, and livestock type (Keeley et. Al., 2003). A separate disturbance factor that often accompanies domestic livestock operations is mechanical clearing. Clearing is sometimes independent from livestock operations, as it is used to reduce fire danger or to generate firewood.

Disease and Pathogens: Some diseases of blue oak damage the heartwood of the trunk and large limbs (McDonald, 1990). Several fungi cause wood decay in the limbs and trunks of oaks (Hickman et al., 2011). Sulphur conk, (Laetiporus sulphureus), hedgehog fungus (Hydnum erinaceum) and the artist's fungus (Ganoderma applanatum) can all cause significant damage to living oaks (i.e. heartwood rot.). Other diseases such as shoestring fungus rot (Armillaria mellea) gradually weakens trees at the base until they fall. Diseases of California foothill pine include western gall rust (Periderium harknessii) and dwarf-mistletoe (*Arceuthobium occidentale* and *A. campylopodum* forma campylopodum) (Howard, 1992).

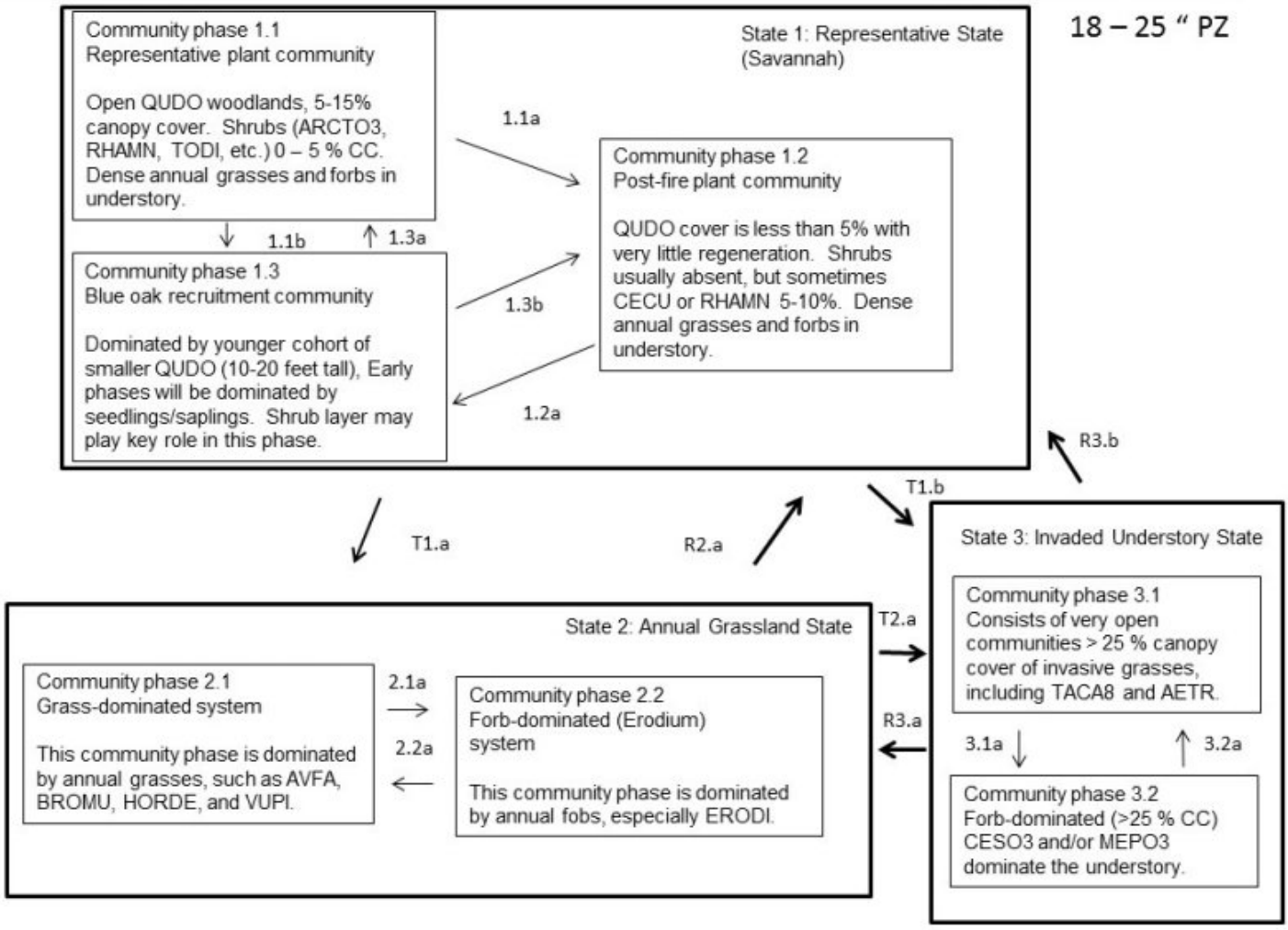
Drought: Blue oak is one of the most drought resistant deciduous trees in California (Callaway, 1992; Abrams, 1990).

State and transition model

STM: F018XI200CA

Low Elevation Foothills

18 – 25 " PZ



Community pathways and Transitions

T1.a This transition occurs after mechanical clearing that results in loss of oak and acorn source. Annual dominated state may be further perpetuated by continual grazing of domestic livestock.

T1.b This transition occurs with the establishment of undesirable invasive plants.

1.1a Patchy, high intensity fire kills some of the oaks, leaving islands of surviving trees. Incomplete mechanical clearing also may result in this plant community.

1.1b This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a resprouting of oaks.

1.2a This community pathway occurs with time and regeneration of oaks, often following low to moderately intense fire and favorable conditions permitting saplings/seedlings to become established.

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

1.3b This community pathway occurs with high intensity fires or tree clearing which removes most of woody vegetation.

T2.a This transition occurs with the establishment of undesirable invasive plants.

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.

3.1a This community pathway occurs as invasive forb species become dominant.

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

State 1
Representative State (Savannah)

Community 1.1
Representative plant community

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

Community 1.2
Post-fire plant community

QUDO cover is less than 5% with very little regeneration. Shrubs usually absent, but sometimes CECU or RHAMN 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.

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Post-fire plant community

1.1a Patchy, high intensity fire kills some of the oaks, leaving islands of surviving trees. Incomplete mechanical clearing also may result in this plant community.

Pathway 1.1b
Community 1.1 to 1.3

Representative plant community

Blue oak recruitment community

1.1b This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a re-sprouting of oaks.

Pathway 1.2a
Community 1.2 to 1.3

Post-fire plant community

Blue oak recruitment community

1.2a This community pathway occurs with time and regeneration of oaks, often following low to moderately intense fire and favorable conditions permitting saplings/seedlings to become established.

Pathway 1.3a
Community 1.3 to 1.1

Blue oak recruitment community

Representative plant community

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

Pathway 1.3b
Community 1.3 to 1.2

Blue oak recruitment community

Post-fire plant community

1.3b This community pathway occurs with high intensity fires or tree clearing which removes most of woody vegetation.

State 2
Annual Grassland State

Community 2.1
Grass-dominated system

This community phase is dominated by annual grasses, such as AVFA, BROMU, HORDE, and VUPI.

Community 2.2
Community phase 2.2Forb-dominated (Erodium) system

This community phase is dominated by annual fobs, especially ERODI.

Pathway 2.1a
Community 2.1 to 2.2

Grass-dominated system

Community phase 2.2Forb-dominated (Erodium) system

2.1a 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

Community phase 2.2Forb-dominated (Erodium) system

Grass-dominated system

2.2a 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 phase 3.1

Consists of very open communities > 25 % canopy cover of invasive grasses, including TACA8 and AETR.

Community 3.2
Community phase 3.2 Forb-dominated (>25 % CC)

CESO3 and/or MEPO3 dominate the understory.

Pathway 3.1a
Community 3.1 to 3.2

3.1a This community pathway occurs as invasive forb species become dominant.

Pathway 3.2a
Community 3.2 to 3.1

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

Transition T1.a
State 1 to 2

T1.a This transition occurs after mechanical clearing that results in loss of oak and acorn source. Annual dominated state may be further perpetuated by continual grazing of domestic livestock.

Transition T1.b
State 1 to 3

T1.b This transition occurs with the establishment of undesirable invasive plants.

Restoration pathway R2.a
State 2 to 1

R2.a 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

T2.a This transition occurs with the establishment of undesirable invasive plants.

Restoration pathway R3.b
State 3 to 1

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.

Restoration pathway R3.a
State 3 to 2

R3.a. 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
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Approval

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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	05/11/2025
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:

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17. **Perennial plant reproductive capability:**
