

# Ecological site R018XI104CA

## Thermic Ultramafic North-Facing Steep Slopes

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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, down-slope, and east 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 is defined by soil formed from ultramafic bedrock on north-facing aspects (30-70% slopes). These soils are characterized by low Ca:Mg ratios (generally < 2 in the subsurface horizons) and high heavy metal concentrations (Cr, Ni, Zn, Cu, Fe Co Cd, etc.) These higher concentrations of metals are toxic to many plants and often cause stunted growth or reduced productivity. The influence of soil chemistry is readily apparent on vegetation

composition, production, and species distribution, with strikingly different plant communities than in the adjacent non-serpentinite derived soils (see Kruckeberg, 1984; McGahan et al., 2009. Vegetation expression on soils formed from serpentinite vary from completely barren ground to chaparral (Lazarus et al., 2011), to altered species composition and conifer density in forest communities (e.g. coastal Oregon, Kruckeberg, 1984). These variations depend on the chemical composition and degree of alteration of the parent material as well as the climate and topography of the particular site.

This ecological site concept is primarily defined by the parent material type, and to a secondary degree aspect, which consists of north to east facing aspects. The vegetation community, primarily the shrub component, is more diverse than what is observed in other ultramafic sites that occur on drier, south facing slopes. In this ecological site, toyon (*Heteromeles arbutifolia*), buckthorn (*Rhamnus* spp.), and manzanita (*Arctostaphylos* spp.) compete with buckbrush for dominance. The production RV is about 380 lbs per acre and ranges between 96 and 662 lbs per acre.

#### Supporting Documentation

Kruckeberg, A. R. 1984. California serpentines: flora, vegetation, geology, soils, and management problems. University of California Press: Berkeley and Los Angeles, CA.

Lazarus, B. E., J. H. Richards, V. P. Claassen, R. E. O'Dell, and M. A. Ferrell. 2011. Species and specific plant-soil interactions influence plant distribution on serpentine soils. *Plant and Soil* 342:327-344.

McGahan, D. G., R. J. Southard, and V. P. Claassen. 2009. Plant-Available calcium varies widely in soils on serpentinite landscapes. *Soil Science Society of America Journal* 73:2087-2095.

#### Associated sites

R018XI102CA	<b>Thermic Ultramafic Foothills Extremely High Magnesium Content (Ca:Mg Ratio Less Than 0.5)</b> This site commonly occurs nearby.
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#### Similar sites

R018XI102CA	<b>Thermic Ultramafic Foothills Extremely High Magnesium Content (Ca:Mg Ratio Less Than 0.5)</b> Site relationships being developed.
R018XI103CA	<b>Thermic Ultramafic Foothills Moderately High Magnesium Content (Ca:Mg Ratio 0.5 To 2)</b> Site relationships being developed.

**Table 1. Dominant plant species**

Tree	(1) <i>Pinus sabiniana</i>
Shrub	(1) <i>Heteromeles arbutifolia</i> (2) <i>Ceanothus cuneatus</i>
Herbaceous	Not specified

#### Physiographic features

This site is tentatively set up for ultramafic soils in the Red Hills area of CA630. This ecological site occurs on steep slopes (30 to 70%) on all aspects. The cooler aspects (north to west) where deeper soils exist have a distinctive community type favoring a more diverse mix of shrubs.

**Table 2. Representative physiographic features**

Landforms	(1) Foothills > Hill (2) Foothills > Saddle
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None

Elevation	229–600 m
Slope	30–70%
Ponding depth	Not specified
Aspect	W, NW, N

**Table 3. Representative physiographic features (actual ranges)**

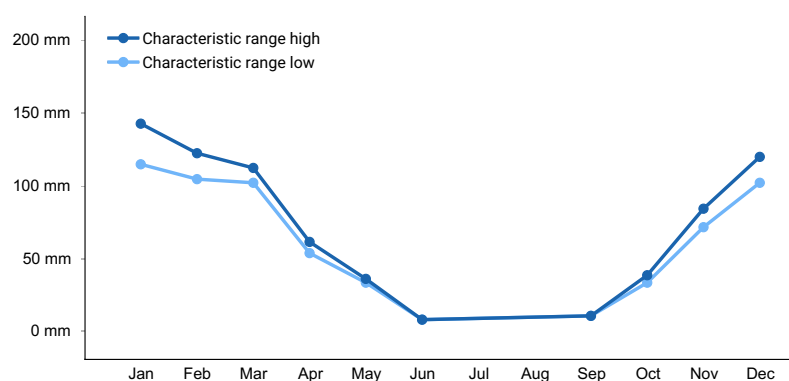
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	229–600 m
Slope	30–70%
Ponding depth	Not specified

## Climatic features

This ecological site is found in a broad Mediterranean climatic region, with hot, dry summers and cool, wet winters. Average annual precipitation ranges between 25 to 29 inches per year, mostly occurring between November and April in the form of rain. Mean annual temperature ranges between 50 and 74 degrees F. The frost free period is 234 to 332 days and the freeze-free period is approximately 258 to 300 days.

**Table 4. Representative climatic features**

Frost-free period (characteristic range)	234-332 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	635-737 mm
Frost-free period (actual range)	209-357 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	610-762 mm
Frost-free period (average)	283 days
Freeze-free period (average)	365 days
Precipitation total (average)	686 mm



**Figure 1. Monthly precipitation range**

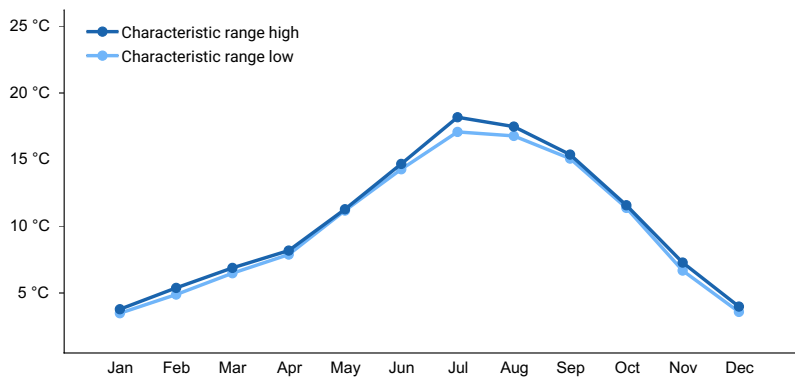


Figure 2. Monthly minimum temperature range

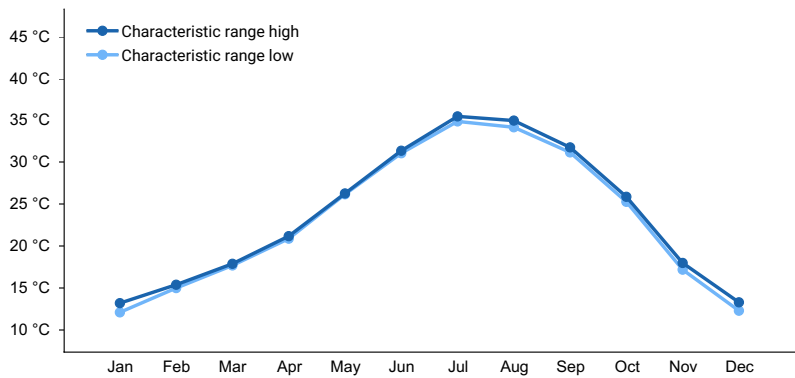


Figure 3. Monthly maximum temperature range

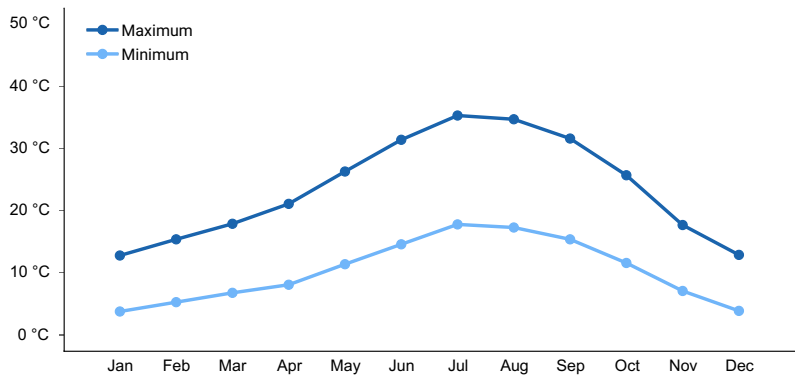


Figure 4. Monthly average minimum and maximum temperature

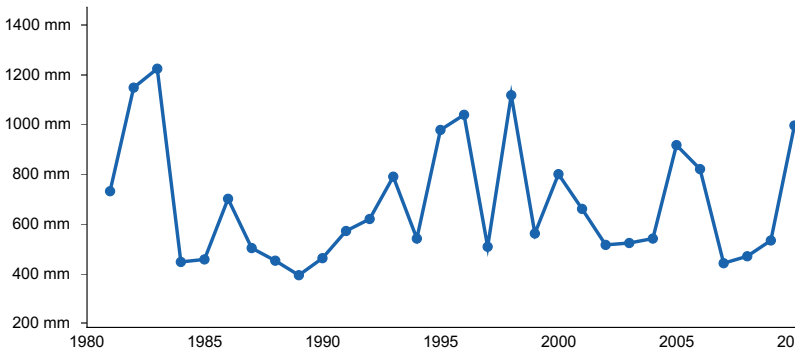
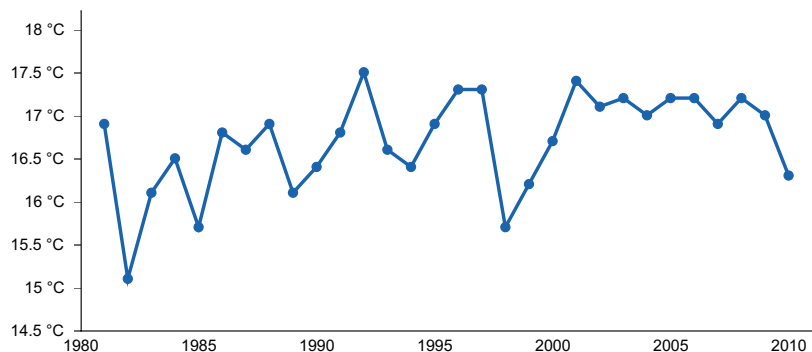


Figure 5. Annual precipitation pattern



**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) NEW MELONES DAM HQ [USC00046174], Angels Camp, 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 the colluvium and residuum of serpentinite and other ultramafic rock. Soils are moderately deep and are loamy-skeletal in the particle size control section. Surface texture is extremely channery loam. The bedrock is a restrictive layer found between 26 and 35 inches of depth. Gravels (< 3 inch diameter) range between 10 to 20% cover, while larger fragments (= 3 inch diameter) cover 4 to 7% of the soil surface. Subsurface gravels range between 10 to 20% and larger fragments occupy 20 to 32% by volume. The soils in this ecological site are well drained and the permeability class is moderately rapid. Available Water Capacity (AWC) is between 3 and 4 inches and the soil reaction ranges from 5.6 to 7.3 throughout the profile.

The most common soil correlated to this ecological site is Crimeahouse (Loamy-skeletal, magnesian, thermic Mollic Haploxeralfs).

**Table 5. Representative soil features**

Parent material	(1) Colluvium–ultramafic rock (2) Residuum–ultramafic rock
Surface texture	(1) Extremely channery loam
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	66–89 cm
Soil depth	66–89 cm
Surface fragment cover ≤3"	10–20%
Surface fragment cover >3"	4–7%
Available water capacity (0–101.6cm)	7.62–10.16 cm
Soil reaction (1:1 water) (0–25.4cm)	5.6–7.3

Subsurface fragment volume <=3" (0-101.6cm)	10–20%
Subsurface fragment volume >3" (0-101.6cm)	20–32%

**Table 6. Representative soil features (actual values)**

Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	51–99 cm
Soil depth	51–99 cm
Surface fragment cover <=3"	5–30%
Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	4.57–10.67 cm
Soil reaction (1:1 water) (0-25.4cm)	5.5–7.5
Subsurface fragment volume <=3" (0-101.6cm)	5–25%
Subsurface fragment volume >3" (0-101.6cm)	10–35%

## Ecological dynamics

The main controlling factor in soils forming in ultramafic parent material is the chemical composition. The overwhelming abundance of extractable Mg at the cation exchange sites (at the expense of extractable Ca (Brooks, 1987)) prevents many plants from establishing. In addition to very low Ca:Mg ratios, serpentinite, dunite, and peridotite contain elevated levels of heavy metals (Woodruff et al., 2009), Ni Mn, etc. The chemical composition is often heterogeneous in distribution, often due to subtle changes in geology, but also topographical differences. Some ultramafic soils include barren pockets of highly toxic soil, where no plants grow (see Lazarus et al., 2011). At the other extreme, one can find areas where the toxicity is minimal and occasional blue oaks (*Quercus douglasii*) have been observed within the area. Kruckeberg (1984) outlined vegetative response to ultramafic conditions: plants are 1) endemic to serpentine (restricted), 2) not restricted (e.g. local indicators), 3) indifferent to serpentine (Bodenvag), and 4) excluded from serpentine (e.g. blue oak).

Buckbrush (*Ceanothus cuneatus*) falls under the second category of local indicator. Lazarus et al. (2011) found that buckbrush growing in pots from barren serpentinite were able to avoid accumulation of magnesium and other toxic elements to a greater degree than several restricted herbaceous plants. Buckbrush often grows in the understory of adjacent blue oak sites, yet at much lower densities than what is found in R018X1102CA. Given, the ability to avoid heavy metal accumulation, buckbrush is the most common plant species in the Red Hills. Foothill pine, on the other hand is likely a Bodenvag or indifferent species. It also is found in adjacent ecosites, yet its productivity is roughly equal in both ultramafic and non-ultramafic sites alike.

Ultramafic soils have been thought to be refuges for native endemics as well as perennial bunchgrasses (Kruckeberg, 1984; Huenneke, 1990) which might have been more abundant in the historical state. As might be expected, our field work did not yield many rare plants; the ones that we did encounter were in trace amounts.

## State and transition model

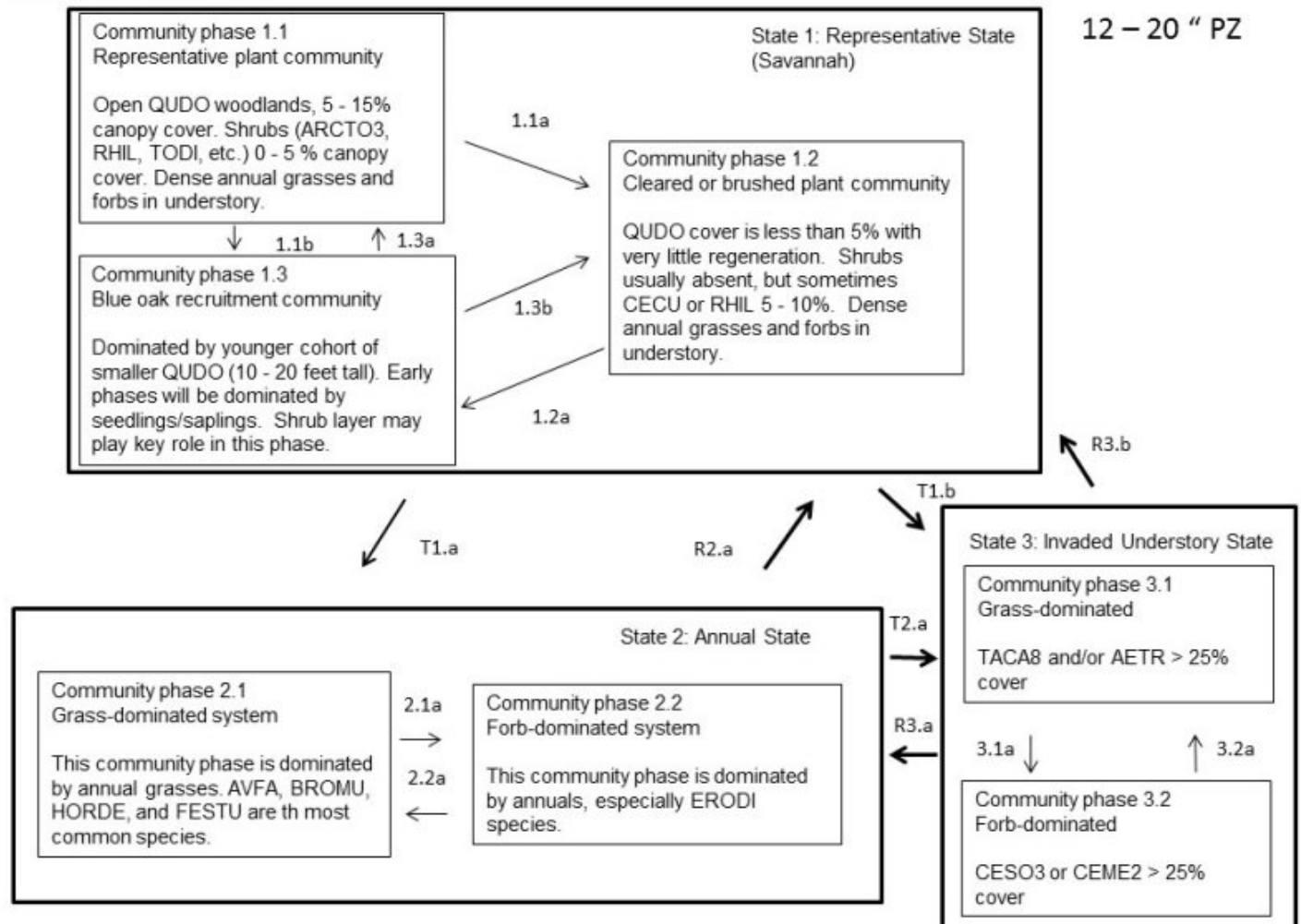


Figure 7. State and Transition Model

## 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.

**Figure 8. Community Pathways and Transitions (Pg.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 9. Community Pathways and Transitions (Pg. 2 of 2).

## R018XI104CA Thermic Ultramafic North-facing Steep Slopes

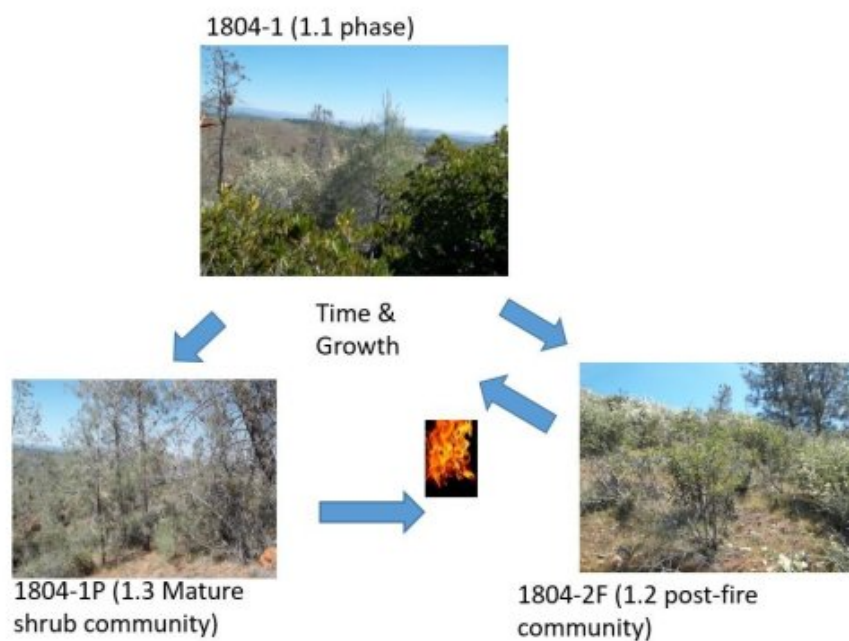


Figure 10. State 1 Community Phases with Photos

### State 1

## Reference State

State 1 represents the historic range of variability for this ecological site. This state no longer exists due to the ubiquitous naturalization of non-native species in the Sierra Nevada Foothills. Ultramafic soils often offer a refuge to many native endemic herbaceous species. Some of the endemics are still intact, but are growing scarce due to the onslaught of invasive annuals. Data for this State does not exist, but dynamics and composition would have been similar to State 2, except with only native species, especially forbs, present.

## Community 1.1

### Reference community



Figure 11. Time and Growth

Add narrative here

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	76	187	302
Grass/Grasslike	7	103	221
Forb	19	113	175
Tree	6	22	45
<b>Total</b>	<b>108</b>	<b>425</b>	<b>743</b>

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	2-4%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	1-35%
Biological crusts	0%
Litter	42-60%
Surface fragments >0.25" and <=3"	5-15%
Surface fragments >3"	2-4%
Bedrock	0-8%
Water	0%
Bare ground	4-9%

**Table 9. Woody ground cover**

Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	1-4%
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	0-4%
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	1-3%
Downed wood, coarse-small (3.00-8.99" diameter; 1,000-hour fuels)	1-3%
Downed wood, coarse-large (>9.00" diameter; 10,000-hour fuels)	0-2%
Tree snags** (hard***)	—
Tree snags** (soft***)	—
Tree snag count** (hard***)	0 per hectare
Tree snag count** (hard***)	0 per hectare

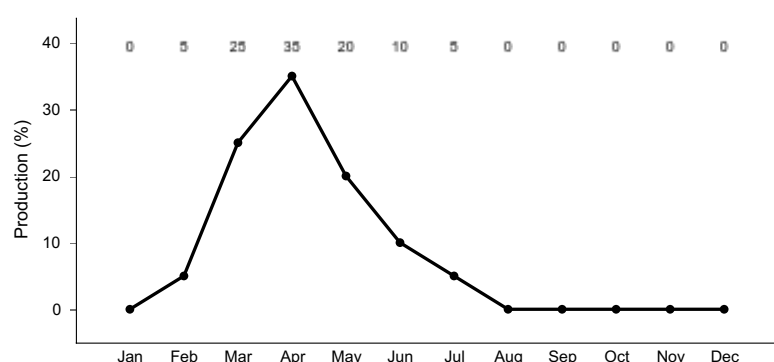
\* **Decomposition Classes:** N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

\*\* >10.16cm diameter at 1.3716m above ground and >1.8288m height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 0.3048m above ground.

\*\*\* Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

**Table 10. Canopy structure (% cover)**

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	—	0-1%	0-2%	1-20%
>0.15 <= 0.3	0-1%	0-1%	2-12%	2-5%
>0.3 <= 0.6	—	1-5%	1-4%	2-8%
>0.6 <= 1.4	—	2-7%	0-1%	—
>1.4 <= 4	0-1%	6-45%	—	—
>4 <= 12	1-4%	—	—	—
>12 <= 24	0-20%	—	—	—
>24 <= 37	—	—	—	—
>37	—	—	—	—



**Figure 13. Plant community growth curve (percent production by month). CA1801, Buckbrush (*Ceanothus cuneatus*). Northern Sierra Nevada Foothills LRU.**

## Community 1.2

### Post-fire plant community



Figure 14. post-fire community

Add narrative here

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	1	69	364
Forb	—	78	257
Grass/Grasslike	—	45	104
Total	1	192	725

Community 1.3  
Mature shrub community



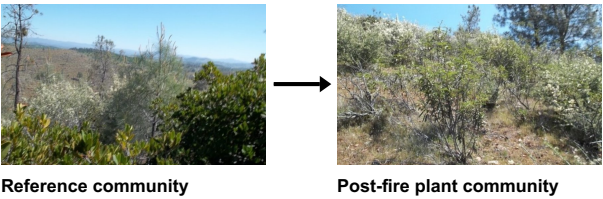
Figure 16. Mature shrub community

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Table 12. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	—	84	185
Grass/Grasslike	2	95	160
Shrub/Vine	1	66	147
Forb	—	50	89
Total	3	295	581

**Pathway 1.1a**  
**Community 1.1 to 1.2**



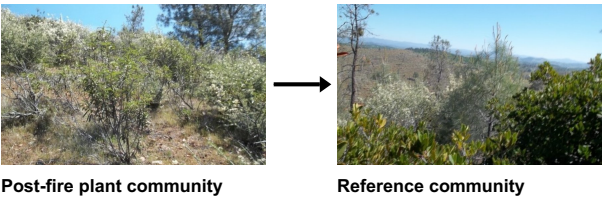
This community pathway occurs after a moderate to high severity burn.

**Pathway 1.1b**  
**Community 1.1 to 1.3**



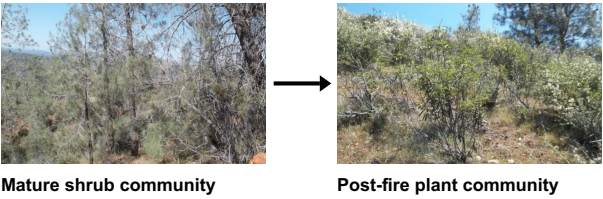
This community pathway occurs after a considerable amount of time without fire. Decadent shrub community with abundant fuel loading and higher density of foothill pine.

**Pathway 1.2a**  
**Community 1.2 to 1.1**



This community pathway occurs over time with normal progression and without major disturbances.

**Pathway 1.3a**  
**Community 1.3 to 1.2**



1.3a This community pathway occurs after a moderate to high severity burn.

**Additional community tables**

Table 13. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Tree</b>					
1	<b>Tree</b>			6–45	
	California foothill pine	PISA2	<i>Pinus sabiniana</i>	6–45	1–15
<b>Shrub/Vine</b>					
2	<b>Shrubs</b>			69–187	
	buckbrush	CECU	<i>Ceanothus cuneatus</i>	28–196	5–25
	toyon	HEAR5	<i>Heteromeles arbutifolia</i>	40–104	3–25
	whiteleaf manzanita	ARMA	<i>Arctostaphylos manzanita</i>	28–67	1–7
	buckthorn	RHAMN	<i>Rhamnus</i>	6–16	1–2
<b>Grass/Grasslike</b>					
3	<b>Annual grasses</b>			3–112	
	purple false brome	BRDI2	<i>Brachypodium distachyon</i>	0–95	0–5
	soft brome	BRHO2	<i>Bromus hordeaceus</i>	1–11	1–13
	red brome	BRRU2	<i>Bromus rubens</i>	1–4	1–7
4	<b>Native grasses</b>			11–135	
	melicgrass	MELIC	<i>Melica</i>	9–117	1–4
	Pacific fescue	VUMIP	<i>Vulpia microstachys var. pauciflora</i>	1–67	1–4
	squirreltail	ELEL5	<i>Elymus elymoides</i>	3–22	1–4
<b>Forb</b>					
5	<b>Forbs</b>			8–175	
	purple sanicle	SABI3	<i>Sanicula bipinnatifida</i>	24–67	1–3
	goldback fern	PETR7	<i>Pentagramma triangularis</i>	4–39	1–5
	bluedicks	DICA14	<i>Dichelostemma capitatum</i>	3–22	0–2
	red hills soap plant	CHGR3	<i>Chlorogalum grandiflorum</i>	0–18	0–2
	dotseed plantain	PLER3	<i>Plantago erecta</i>	4–10	1–5
	vinegarweed	TRLA4	<i>Trichostema lanceolatum</i>	0–9	0–2
	bedstraw	GALIU	<i>Galium</i>	2–4	1–5
	California goldfields	LACA7	<i>Lasthenia californica</i>	1–4	2–5

Table 14. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
3	Post-fire matrix shrub			1–73	
4	Cool-phase shrubs			183–364	
	buckbrush	CECU	<i>Ceanothus cuneatus</i>	84–185	20–40
	toyon	HEAR5	<i>Heteromeles arbutifolia</i>	99–174	2–10
	soft brome	BRHO2	<i>Bromus hordeaceus</i>	1–39	1–12
	red brome	BRRU2	<i>Bromus rubens</i>	1–17	1–7
	bluedicks	DICA14	<i>Dichelostemma capitatum</i>	3–17	0–2
	bedstraw	GALIU	<i>Galium</i>	1–9	0–5
	California goldfields	LACA7	<i>Lasthenia californica</i>	1–6	0–2
	dotseed plantain	PLER3	<i>Plantago erecta</i>	1–6	1–2
	buckthorn	RHAMN	<i>Rhamnus</i>	0–6	1–2
	goldback fern	PETR7	<i>Pentagramma triangularis</i>	0–4	0–1
	fescue	VULPI	<i>Vulpia</i>	1–2	1–2
	purple sanicle	SABI3	<i>Sanicula bipinnatifida</i>	0–2	0–1
	annual agoseris	AGHE2	<i>Agoseris heterophylla</i>	0–1	0–1
	Indian paintbrush	CASTI2	<i>Castilleja</i>	0–1	0–1
	desertparsley	LOMAT	<i>Lomatium</i>	0–1	0–1
Grass/Grasslike					
3	Post-fire matrix grasses			0–104	
4	Cool-phase grasses			3–58	
Forb					
3	Post-fire matrix forb			0–257	
	desertparsley	LOMAT	<i>Lomatium</i>	0–112	0–10
	bluedicks	DICA14	<i>Dichelostemma capitatum</i>	0–84	10–13
	buckbrush	CECU	<i>Ceanothus cuneatus</i>	1–73	8–35
	red brome	BRRU2	<i>Bromus rubens</i>	0–63	1–12
	vinegarweed	TRLA4	<i>Trichostema lanceolatum</i>	0–45	0–6
	soft brome	BRHO2	<i>Bromus hordeaceus</i>	1–37	0–20
	California goldfields	LACA7	<i>Lasthenia californica</i>	0–11	0–1
	fescue	VULPI	<i>Vulpia</i>	0–2	1–15
	purple sanicle	SABI3	<i>Sanicula bipinnatifida</i>	0–2	2–8
	annual agoseris	AGHE2	<i>Agoseris heterophylla</i>	0–2	0–8
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0–2	0–2
4	Cool-phase forbs			7–47	

Table 15. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
<b>Tree</b>					
5	Decadent phase trees			0–185	
<b>Shrub/Vine</b>					
5	Decadent phase shrubs			1–147	
<b>Forb</b>					
5	Decadent phase forbs			0–89	

## Inventory data references

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

## References

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## Other references

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**Contributors**

K. Moseley  
Dallas Glass  
Dave Evans  
Nathan Roe  
John Proctor

**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	05/14/2024
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

**Indicators**

1. **Number and extent of rills:**  

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2. **Presence of water flow patterns:**  

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3. **Number and height of erosional pedestals or terracettes:**  

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**  

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5. **Number of gullies and erosion associated with gullies:**  

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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:**

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