USDA Natural Resources
Conservation Service

Ecological site R018XI101CA
Shallow Latite Ridgetops

Last updated: 4/24/2024
Accessed: 05/01/2024

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 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 ecological site occurs on plateaus and erosion remnants formed from volcanic lava flows. This site comprises a fine-scale mosaic with mounds, intermounds, vernal pools, and bedrock outcrops occurring at a scale too fine to be delineated at the current soil mapping scale.

Goldwall and Toomes soils are the two main components representing this site. Both components are shallow and vary in depth (between 3 to 20 inches) across very fine scales. Goldwall components generally represent the intermound portion of the landscape while Toomes is found on the slightly deeper mounds. Surface fragments tend to be highly variable on this ecological site. On that part of the site that is drier annual grasses (Pacific fescue (Vuplia microstachys var. pauciflora) and soft brome (Bromus hordeaceus) are common, as are native annuals such as California goldfields (*Lasthenia californica*), miniature lupine (Lupinus bicolor), butter-n-eggs (*Triphysaria eriantha*), and whitetip clover (*Trifolium variegatum*).

Another vitally important, although rare, soil component on this site is the Aquic Haploxeralfs. These soils are associated with vernal pools found in broad valleys on the mesas. These soils are moderately deep to very deep, poorly drained, and formed in alluvium over residuum from latite. The surface texture is loam, with clay loam and cobbly loam and very cobbly loam subsurface textures. During the early spring when the water table is high, plants such as Pacific foxtail (Alopecurus saccatus), eryngo (Eryngium), and meadowfoam (Limnanthes spp.) can be found near or within the pools.

Between-year and within-year differences in hydrology influence the vegetation communities, which are generally dominated by annuals. Vegetation community varies by microsite, and the wetter (vernal pool) communities are strongly influenced by total winter precipitation which ranges between 20 and 35 inches. Vegetation composition typically changes considerably during the same growing season.

Similar sites

R018XA101CA	**Basalt Flow Plateaus** Site relationships being developed.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Vulpia microstachys var. pauciflora* (2) *Trifolium depauperatum*

Physiographic features

This ecological site occurs on lava plateaus, between elevations of 1100 and 1950 feet. Slopes are typically between 2 and 8 percent, but may be up to 12 percent on sides of mounds or plateaus.

This site is a complex of soils and plant communities. Frequent ponding occurs for long durations from December through April on the Aquic Palexeralfs soil component which is associated with vernal pools where it is most frequently found on south to southwest aspects.

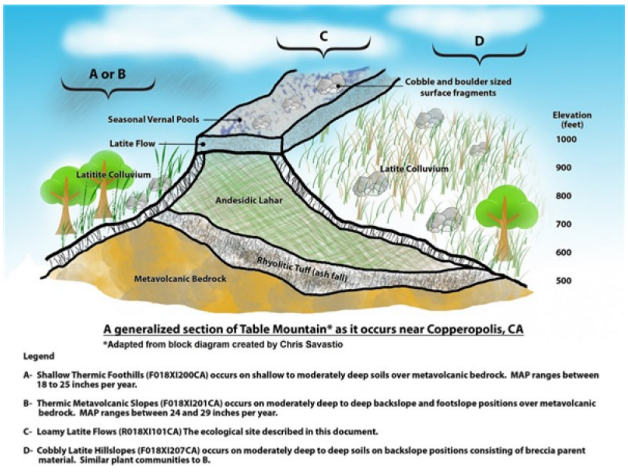

Figure 1. Block diagram of Table Mountain area

Table 2. Representative physiographic features

Landforms	(1) Lava plateau
Runoff class	Medium
Flooding frequency	None
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	335–594 m
Slope	2–12%
Ponding depth	0–5 cm
Aspect	S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	119–732 m
Slope	0–30%
Ponding depth	0–10 cm

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 31 to 34 inches and usually falls from October to May. Mean annual temperature ranges from 59 to 62 degrees F with 160 to 191 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	160-191 days
Freeze-free period (characteristic range)	251-336 days
Precipitation total (characteristic range)	787-864 mm
Frost-free period (actual range)	153-198 days
Freeze-free period (actual range)	229-358 days
Precipitation total (actual range)	762-864 mm
Frost-free period (average)	176 days
Freeze-free period (average)	294 days
Precipitation total (average)	813 mm

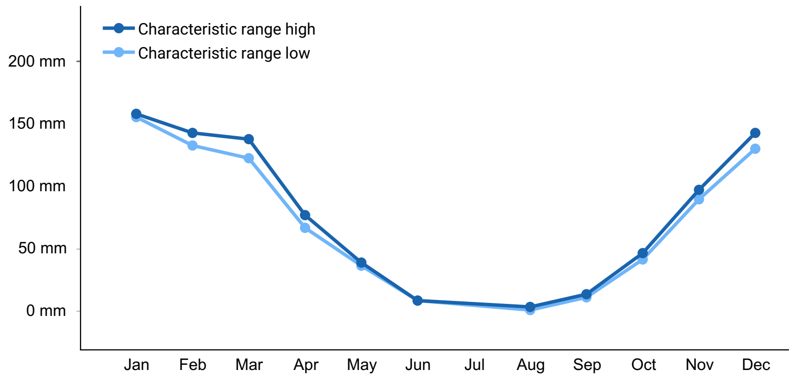

Figure 2. Monthly precipitation range

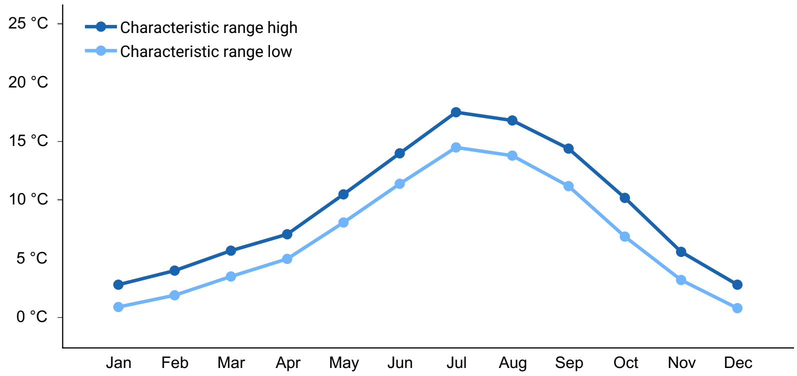

Figure 3. Monthly minimum temperature range

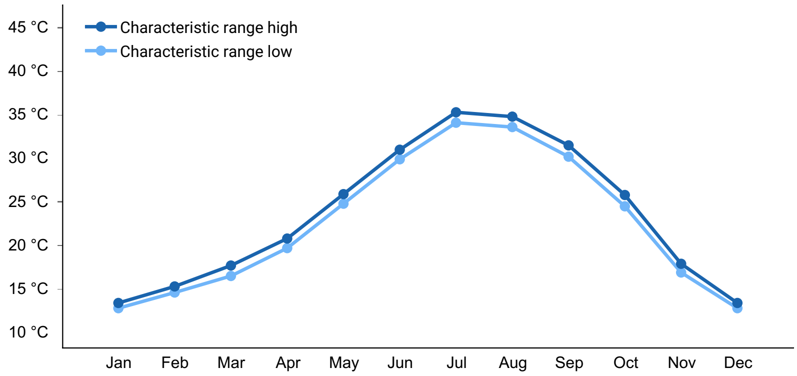

Figure 4. Monthly maximum temperature range

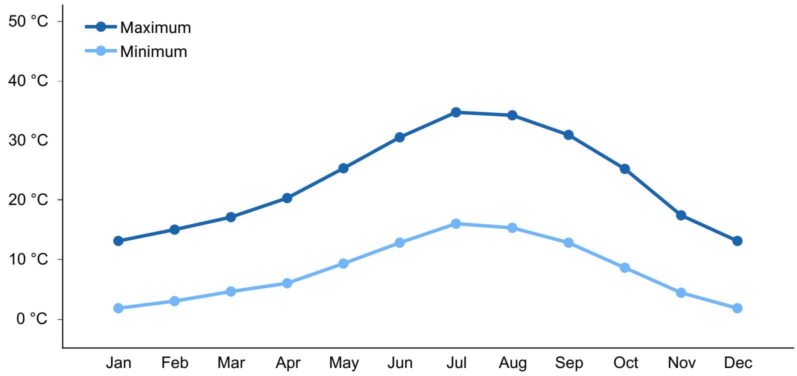

Figure 5. Monthly average minimum and maximum temperature

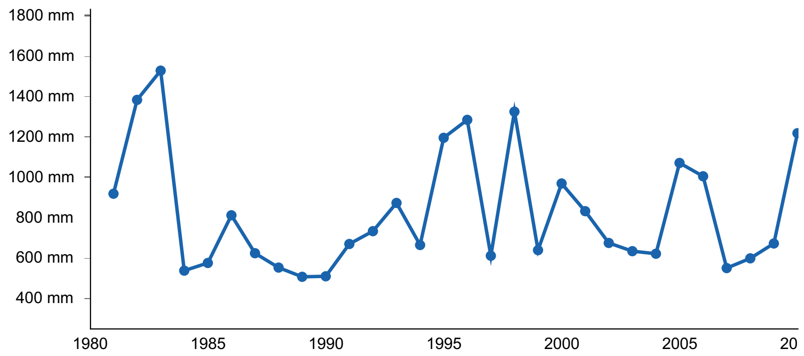

Figure 6. Annual precipitation pattern

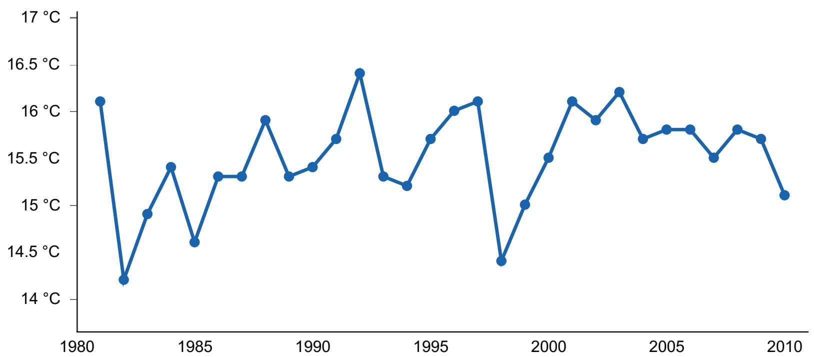

Figure 7. Annual average temperature pattern

Climate stations used

- (1) SONORA [USC00048353], Jamestown, CA
- (2) NEW MELONES DAM HQ [USC00046174], Angels Camp, CA

Influencing water features

In areas where water is perched in small depressions, vernal pools may be present.

Wetland description

N/A

Soil features

The soils in this ecological site are formed from residuum derived from latite. The dominant soils, Hideaway, Toomes and Goldwall series, occur within a microtopographic complex of mounds (Toomes) and intermounds (Goldwall).These soils are very shallow to shallow, have a loamy to loamy skeletal, particle size control section and are moderately well to well drained. Toomes classifies as a Loamy, mixed, superactive, thermic Lithic Haploxerept. Goldwall and Hideaway are both Lithic Xerorthents, with Goldwall being loamy and Hideaway being loamy-skeletal. Surface textures include sandy loams, loams and very stony loams (Hideaway). Rock fragments less than 3 inches in diameter range from 0 to 25% on the soil surface and from 2 to 20% by volume in the subsurface. Rock fragments greater than 3 inches in diameter range from 0 to 28% cover on the surface and from 0 to 21% by volume in the subsurface. These soils have an AWC (Available Water Capacity) of 0.4 to 2.5 inches. Soil reaction in the upper 10 inches of the profile ranges from 4.9 to 6 and in the subsurface ranges from pH 4.6 to 6.2.

Table 5. Representative soil features

Parent material	(1) Residuum–latite (2) Residuum–basalt

Surface texture	(1) Very stony loam (2) Sandy loam
Family particle size	(1) Loamy (2) Loamy-skeletal
Drainage class	Moderately well drained to well drained
Permeability class	Moderately rapid
Depth to restrictive layer	8–33 cm
Soil depth	8–33 cm
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–28%
Available water capacity (0-101.6cm)	1.02–6.35 cm
Soil reaction (1:1 water) (0-25.4cm)	4.6–6
Subsurface fragment volume <=3" (0-152.4cm)	2–20%
Subsurface fragment volume >3" (0-152.4cm)	0–21%

Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to well drained
Permeability class	Moderately rapid
Depth to restrictive layer	3–51 cm
Soil depth	3–51 cm
Surface fragment cover <=3"	0–40%
Surface fragment cover >3"	0–46%
Available water capacity (0-101.6cm)	0.76–10.16 cm
Soil reaction (1:1 water) (0-25.4cm)	3.7–7.3
Subsurface fragment volume <=3" (0-152.4cm)	0–42%
Subsurface fragment volume >3" (0-152.4cm)	0–62%

Ecological dynamics

This ecological site is present on elevated mesas formed from latite lava flows. One such lava flow originated near Sonora Pass (Gorny et al., 2009), flowing 80 miles through an ancient river channel, filling the channel and hardening in place. The latite flow is more resistant to weathering than the surrounding rock, so it exists as an elevated, long, thin mesa. The tops of many of these mesas are fairly flat, gently sloping to the west, and characterized by complex undulating topography composed of bedrock outcrops, mounds-and-intermounds, vernal pools, and bedrock fissures. This complex topography formed due to the structural resistance of the latite bedrock, and reworking of surface material by ancient streams, and in present times forms a mosaic of plant communities across the mesa.

Direct rain precipitation is the primary source of water for the mesa. The dense latite bedrock impedes the downward movement of water, causing the soils to become saturated or ponded for short durations in spring. Precipitation infiltrates into the soils or creates surface runoff over the soils and bedrock outcrops. Small ephemeral streams develop over moss covered bedrock drainageways, and vernal pools fill in small depressions after rain events. The vernal pools are flashy, and depending upon size and connectivity, may fill and drain repeatedly over the rainy season. These vernal pools are classified as Northern Basal Flow Vernal Pools (Keeler et al. 1998). After the winter and spring rainy season, the soils dry through the summer, becoming too dry to support shrubs and most perennial species. Therefore, this area primarily supports annuals that flourish for a short period when water is available. A few hardy perennials have endured by adapting to these harsh wet-dry conditions.

This ecological site is dominated by micro-relief swales and grassy hummocks with some channelization occurring among bedrock outcrops (see below, photo of Community Type 5). The percent cover of surface cobbles and gravels varies from site to site (see Representative Soil Features section), with no apparent effect on plant production. Among the mounds and bedrock outcrops there is high variability in soil depth and wetness due to hummocky relief and the formation of basins and swales. The mounds are generally dominated by Pacific fescue (*Vulpia microstachys* var. pauciflora), non-native brome and wild oats, but a diversity of forbs is also present. In spring there is a colorful wildflower display. Soils are taxonomically the same in the mound and intermound micro-topographies, but have differences that effect the vegetation. The soils on the mounds are typically 10 to 20 inches deep and are well drained, whereas the soils in the intermounds are often less than 10 inches deep over bedrock and are somewhat poorly drained. Deeper soils and better drainage on the mounds supports higher vegetation production. Shallower soils with low permeability on intermounds supports native grasses and forbs such as Pacific fescue, California goldfields (*Lasthenia californica*), cowbag clover (*Trifolium depauperatum*), whitetip clover (*Trifolium variegatum*), and johnny-tuck (*Triphysaria eriantha*). Vernal pools in broad valleys have moderately deep soils, with aquic soil features. Douglas' meadowfoam (*Limnanthes douglasii*) is common along the margins of the vernal pools in the interconnecting swales. Within the vernal pools, eryngo (Eryngium spp.) or annual semaphoregrass (*Pleuropogon californicus*) are dominant. Among the bedrock outcrops are areas with a very a thin layer of soil (< 1 inch), where 20 to 30 percent cover of spikemoss (Selaginella spp.) and a diversity of other forbs and grasses can be found.

Rodents, insects and amphibians rely on the different topographic positions for forage and shelter. The mounds provide drier nesting sites, while the pools provide seasonal water and late season forage. Pocket gopher activity has been associated with mound-intermound development on moderately to very deep soils near Merced California. These soils contained a restrictive duripan, and it was found that gophers preferentially moved sediments from the intermound upslope, onto drier mound positions at a rate two times greater than the rate of natural erosion (Reed and Amundson, 2007). It is unknown whether this same phenomenon is occurring on these elevated mesas. The shallower soils on this site may not provide optimum habitat for pocket gophers
.
Vernal pools are a biologically unique and important component of this of this ecological site. Vernal Pools are defined as: “Seasonally flooded landscape depressions underlain by a subsurface which limits drainage. They result from an unusual combination of soil conditions, summer-dry Mediterranean climate, topography and hydrology, and support a specialized biota, including a relatively large number of threatened and/or endangered species” (Cheatham 1976, Zedler 1987, Holland and Jain 1988). The Environmental Protection Agency (EPA) definition includes: “These wetlands range in size from small puddles to shallow lakes and are usually found in a gently sloping plain of grassland. Although generally isolated, they are sometimes connected to each other by small drainages known as vernal swales” (EPA online, http://water.epa.gov/type/wetlands/vernal.cfm, December 16, 2009).

Vernal pools are important ecological hot spots, which have been vanishing as land is converted for development or agriculture. Estimates vary, but the remaining vernal pools occupy only 5 to 30 percent of their historic area. Vernal pools have several obligate rare and endangered plant and animal species, which have adapted to the harsh wet-dry characteristic of these pools. Several vernal pool plants have adapted by changing the morphology of their leaves for an aquatic stage and a dry stage. For example, vernal pool eryngo species (Eryngium spp.) produce winter leaves that are tubular, hollow and septate. As the pool dries, these hollow tubular leaves are replaced with well developed leaf blades. Arthropods were not inventoried during the development of this ecological site, but some vernal pools support small crustaceans because fish predators are absent. For example, the tadpole shrimp (Lepidurus packardi) is a rare vernal pool species. This shrimp in the order Notostraca, has maintained the same morphology as its ancestral fossils from 250 million years ago. They have survived by laying eggs that can remain dry for up to 10 years or more, immediately hatching when wetted (Goettle, 1997).

Ecological Dynamics:

Fire, recreational use, and cattle grazing have the potential to affect the dynamics of this ecological site. Currently there is no evidence to suggest that these dynamics are occurring, so they are not included in the STM.

The historic fire regime for this ecological site is not known, and the post fire regeneration community was not observed. Studies suggest that fire in the central valley may have occurred on a 2 to 3 year cycle, and is now on a 20 to 30 year cycle (Howard 2006). This site differs from the central valley annual grasslands both in geologic formation and vegetation. Presently this site is dominated by vegetation that provides poor fuels to carry fire. If historically, there were more perennial grasses, perhaps fuels may have been able to carry fire. Since this site is on an elevated mesa it may be more prone to lighting strikes than the surrounding areas. However, due to the low fuels, fire size may be small and of low intensity.

In the event of a fire this site may recover pre-fire composition by the next season. Annual forbs may increase immediately after fire, including the non-native longbeak stork's bill (Gerhardt and Collinge, 2003). Native geophytes such as bluedicks and onions, may not be impacted by fire because their corms are buried deeper in the soil. Pacific fescue will regenerate from soil stored and off site seed after fire (Howard 2006). Seed mortality rates depend upon the type of seed, and the depth of burial. Longbeak stork's bill, may recover well after fire, because the seeds have a unique appendage that “drills” the seeds into the soil. The seeds of most annual forbs on the site may have high mortality from fire, but regeneration will occur from off-site seed. The effects of fire in annual grasslands are relatively short lived, and the cover of oats (Avena spp.) can recover by the next season (Gerhardt and Collinge, 2003).

This ecological site is used for public recreation and grazing land. Public trails and several private dirt roads cross the top of the mesa. Altered hydrologic conditions such as stream diversions, surface leveling, or infilling of pools due to this use were not observed. The private land is used for low intensity cattle grazing.

In systems where light to moderate grazing is already occurring, there may be stabilizing effects to the plant and animal communities that would be negated if the grazing pressures were removed. For example, Marty (2005) found that native plant species remained higher in continuously grazed vernal pools than in pools where grazing was removed. Marty also documented that cessation of grazing can lead to build up of residual dry matter which in turn tends to decrease species richness. Nevertheless, it may be beneficial for land managers to monitor vernal pools for algal crust formation, which may develop from increased nutrient inputs (eutrophication). In short, land managers and owners should proceed with caution when considering land use alternatives within the vernal pool systems. Functional vernal pools that are ungrazed may experience altered nutrient cycling regimes and soil compaction, leading to changes in native biota, when, and after, domestic livestock are introduced to the system. However, in systems where domestic livestock grazing is already in place, unexpected negative effects may occur after permanent removal of livestock. Total cessation of grazing can severally alter the hydrology of vernal pools. In the previously cited example (Marty, 2005), a discontinuation of grazing pressure resulted in approximately 50 days less of average maximum ponding when compared with continuously grazed pools. This change in hydrology may affect several species that depend on extended periods of inundation to complete their lifecycles. The study's main implication is that “if a site is grazed and demonstrates high diversity, it should be left grazed, unless there is a compelling, scientifically-based reason to change the management regime.” (Marty, 20005).

State and transition model

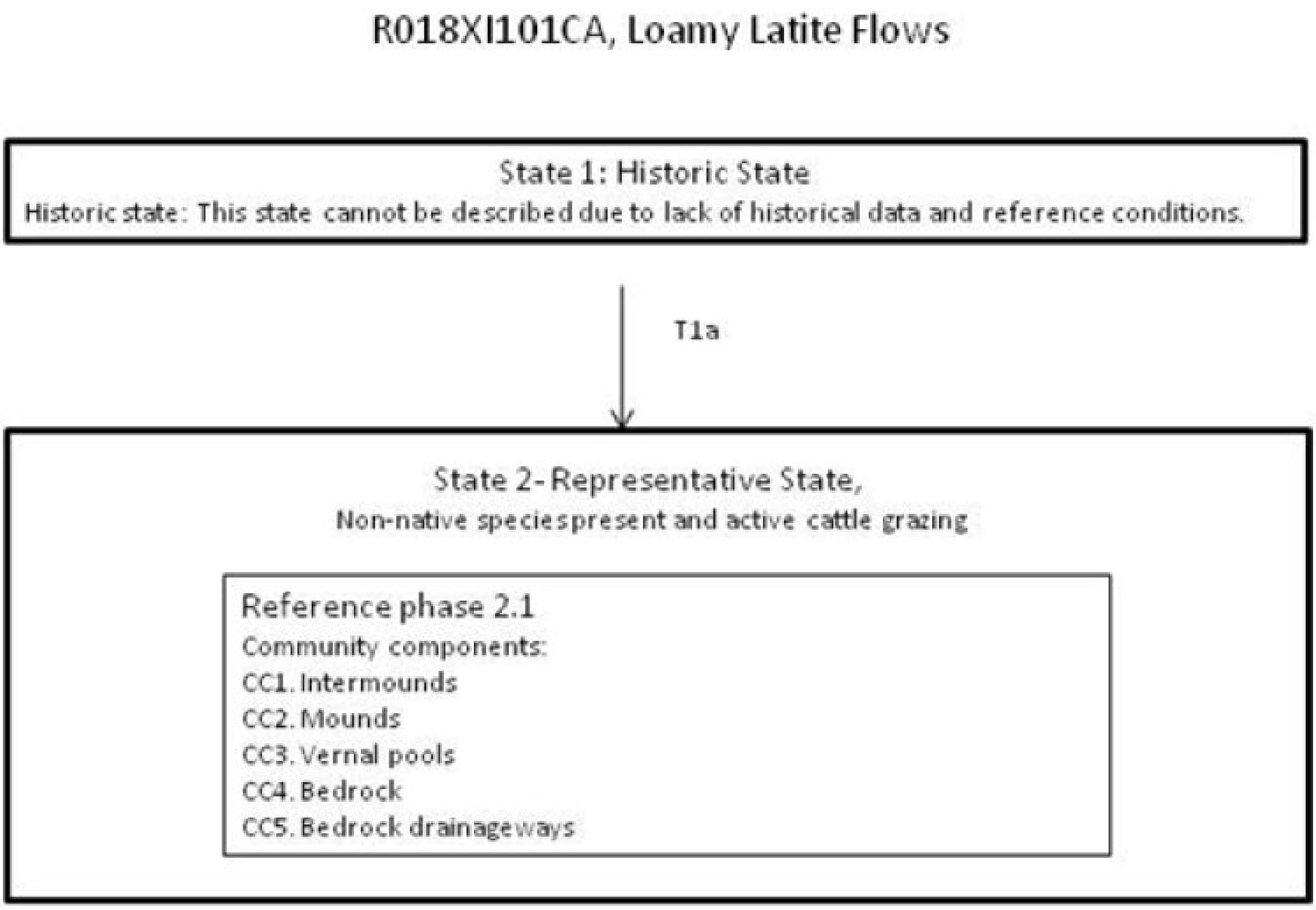

Figure 8. Loamy Latite Flow Model

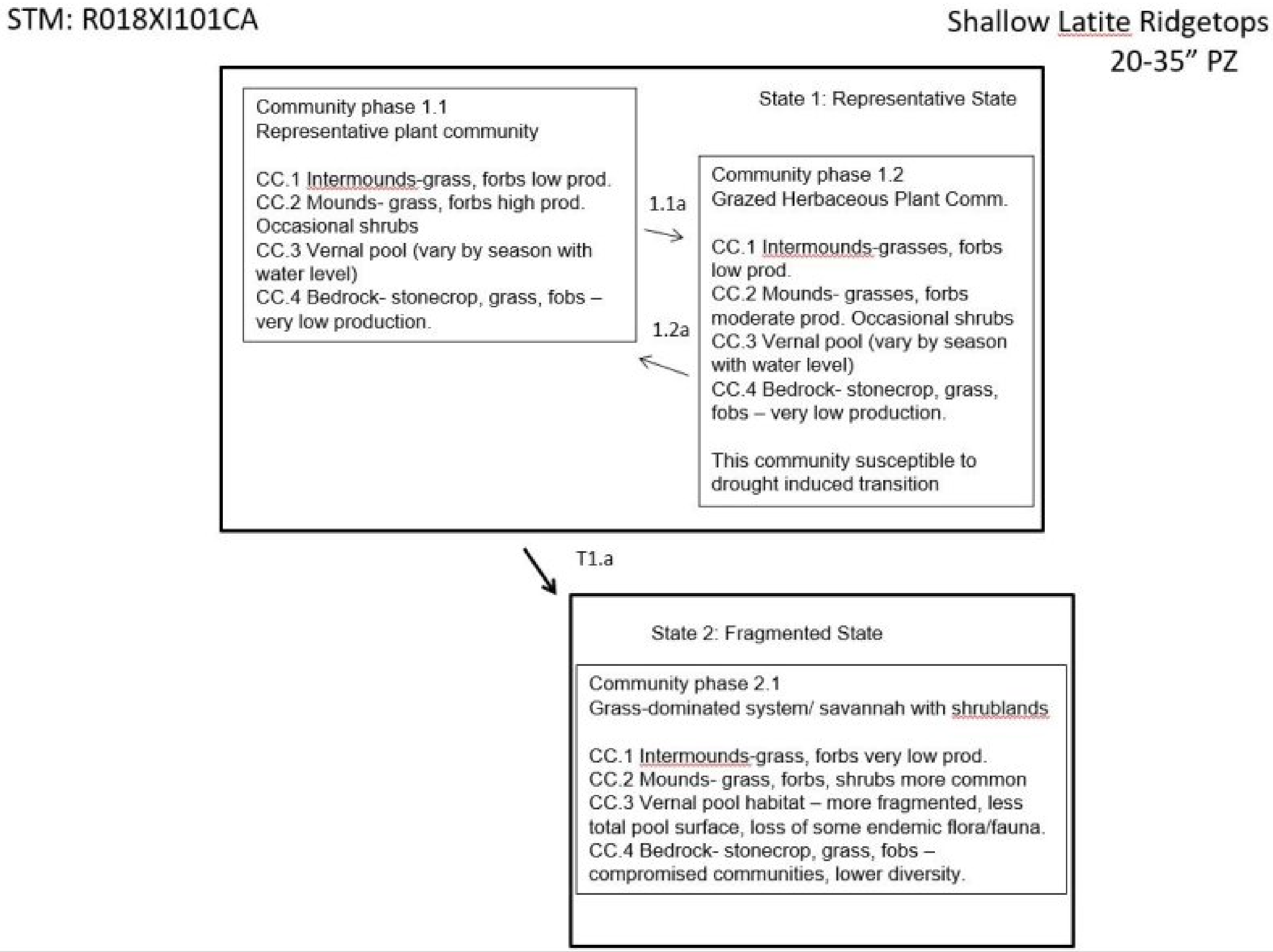

Figure 9. State and Transition Model

Community Pathways and Transition

T1.a This transition occurs because of climate change. Generally, more variability in the timing and amount of annual precipitation coupled with warmer winter temperatures may lead to further fragmentation and/or less biodiversity in the ephemeral pools, where they do occur. Extinction events may occur for many endemic fauna and flora species within and around the pools. Deeper soils within the complex may increasingly support shrubs (chaparral species) and nutrient and hydrological cycling regimes may be significantly altered. Overgrazed plant communities are less resilient and more likely to cross this threshold than ungrazed and lightly (or sustainably) grazed sites.

1.1a Changes to plant communities based on mismanagement of livestock (sheep, cows, horses, etc.) grazing operations. These changes may vary on the degree and type of mismanagement (i.e. livestock density exceeding carrying capacity, continuous grazing with no rest periods, or allowing livestock in vernal pool areas during critical life stages (i.e. late winter, early spring) of flora/fauna). Changes also vary by community type. Intermound and mound communities may experience species composition changes and may be less productive. Shrub encroachment may be enhanced, as well. Vernal pools and bedrock plant/animal communities are more vulnerable. Increased livestock/ or lack of fencing may lead to nutrient concentration in pools, algal blooms, reduction in biodiversity, and extinction of rare plant and animal species.

1.2a Return to more resilient ecosystems, due to conservation practices applied to the livestock operation. Note that total cessation of grazing does not always lead to maximum biodiversity, especially after domestic livestock has been part of the system for a considerable time period. Therefore, it is imperative that land managers/livestock producers carefully consider options in order to strike a favorable balance to the ecosystem, yet take advantage of seasonal forage.

Figure 10. Community Pathways and Transitions

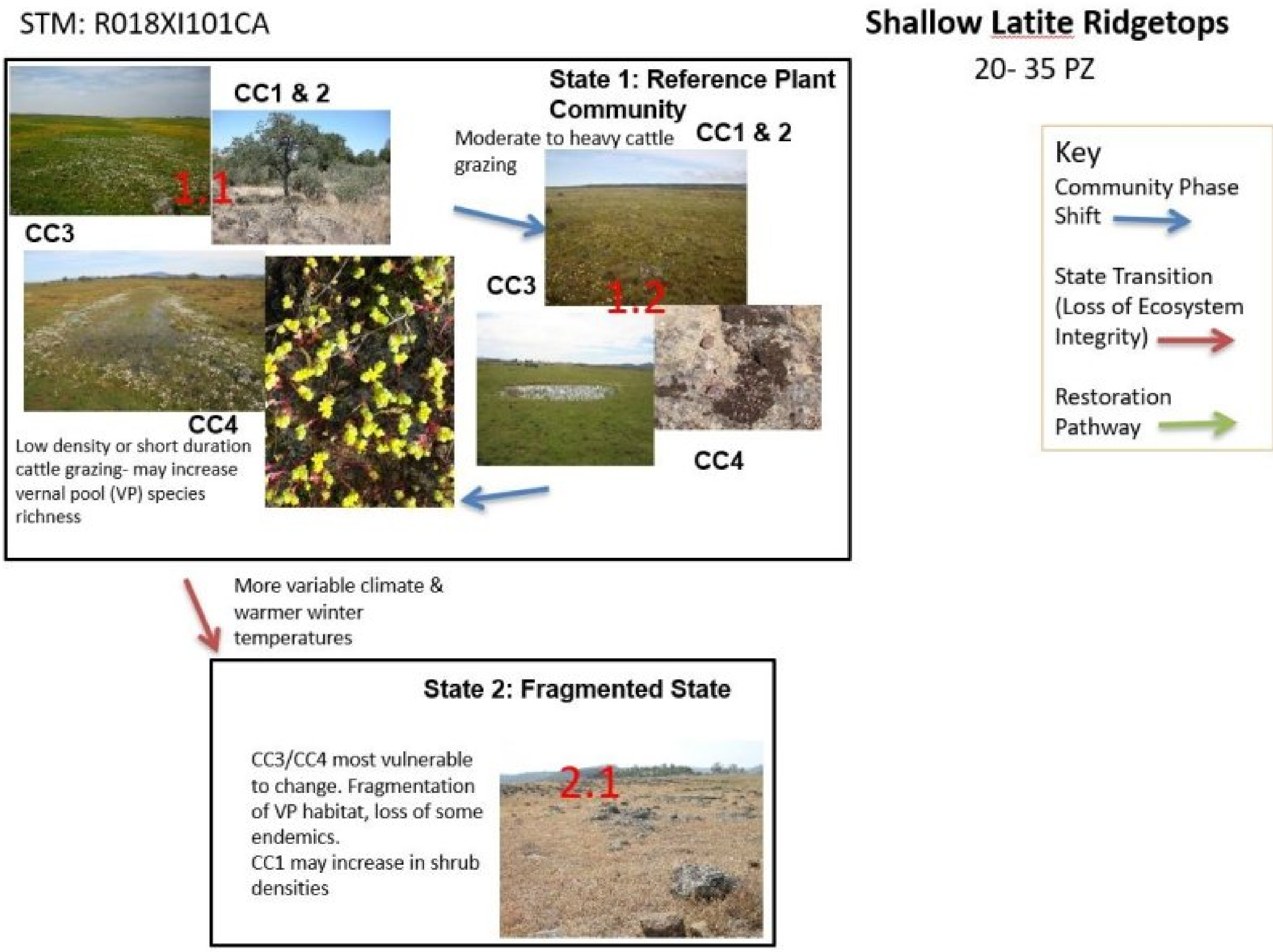

Figure 11. STM Photos

State 1
Representative State

Community 1.1
Representative plant community

Figure 12. CC1


Figure 13. CC2


Figure 14. CC3


Figure 15. CC4

CC.1 Intermounds-grass, forbs low prod. CC.2 Mounds- grass, forbs high prod. Occasional shrubs CC.3 Vernal pool (vary by season with water level) CC.4 Bedrock- stonecrop, grass, fobs – very low production

Community 1.2
Grazed Herbaceous Plant Comm.


Figure 16. CC1&CC2


Figure 17. CC3


Figure 18. CC4

CC.1 Intermounds-grasses, forbs low prod. CC.2 Mounds- grasses, forbs moderate prod. Occasional shrubs CC.3 Vernal pool (vary by season with water level) CC.4 Bedrock- stonecrop, grass, fobs – very low production. This community susceptible to drought induced transition

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Grazed Herbaceous Plant Comm.

Changes to plant communities based on mismanagement of livestock (sheep, cows, horses, etc.) grazing operations. These changes may vary on the degree and type of mismanagement (i.e. livestock density exceeding carrying capacity, continuous grazing with no rest periods, or allowing livestock in vernal pool areas during critical life stages (i.e. late winter, early spring) of flora/fauna). Changes also vary by community type. Intermound and mound communities may experience species composition changes and may be less productive. Shrub encroachment may be enhanced, as well. Vernal pools and bedrock plant/animal communities are more vulnerable. Increased livestock/ or lack of fencing may lead to nutrient concentration in pools, algal blooms, reduction in biodiversity, and extinction of rare plant and animal species.

Pathway 1.2a
Community 1.2 to 1.1

Grazed Herbaceous Plant Comm.

Representative plant community

Return to more resilient ecosystems, due to conservation practices applied to the livestock operation. Note that total cessation of grazing does not always lead to maximum biodiversity, especially after domestic livestock has been part of the system for a considerable time period. Therefore, it is imperative that land managers/livestock producers carefully consider options in order to strike a favorable balance to the ecosystem, yet take advantage of seasonal forage.

State 2
Fragmented State

Community 2.1
Grass-dominated system/ savannah with shrublands

CC.1 Intermounds-grass, forbs very low prod. CC.2 Mounds- grass, forbs, shrubs more common CC.3 Vernal pool habitat – more fragmented, less total pool surface, loss of some endemic flora/fauna. CC.4 Bedrock- stonecrop, grass, fobs – compromised communities, lower diversity.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	67	1009	1457
Forb	56	224	504
Total	**123**	**1233**	**1961**

Transition T1.a
State 1 to 2

This transition occurs because of climate change. Generally, more variability in the timing and amount of annual precipitation coupled with warmer winter temperatures may lead to further fragmentation and/or less biodiversity in the ephemeral pools, where they do occur. Extinction events may occur for many endemic fauna and flora species within and around the pools. Deeper soils within the complex may increasingly support shrubs (chaparral species) and nutrient and hydrological cycling regimes may be significantly altered. Overgrazed plant communities are less resilient and more likely to cross this threshold than ungrazed and lightly (or sustainably) grazed sites.

Restoration pathway R2.a
State 2 to 1

This restoration pathway represents considerable investment of resources to restore hydrology and plant communities.

Additional community tables

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Intermound Grasses**			56–392	
	Pacific fescue	VUMIP	*Vulpia microstachys var. pauciflora*	6–392	5–35
	annual agoseris	AGHE2	*Agoseris heterophylla*	0–112	0–5
	longbeak stork's bill	ERBO	*Erodium botrys*	1–90	0–14
	soft brome	BRHO2	*Bromus hordeaceus*	0–84	0–15
	cowbag clover	TRDE	*Trifolium depauperatum*	2–22	2–5
	whitetip clover	TRVA	*Trifolium variegatum*	0–17	0–3
	California goldfields	LACA7	*Lasthenia californica*	0–11	0–3
	Douglas' meadowfoam	LIDO2	*Limnanthes douglasii*	0–11	0–2
	miniature lupine	LUBI	*Lupinus bicolor*	0–11	0–1
	annual hairgrass	DEDA	*Deschampsia danthonioides*	0–6	0–1
	ripgut brome	BRDI3	*Bromus diandrus*	0–3	0–1
	johnny-tuck	TRER6	*Triphysaria eriantha*	0–2	0–2
	bluedicks	DICA14	*Dichelostemma capitatum*	0–1	0–1
	popcornflower	PLAGI	*Plagiobothrys*	0–1	0–1
	knotweed	POLYG4	*Polygonum*	0–1	0–1
	oat	AVENA	*Avena*	0–1	0–1
	annual fescue	VUMY	*Vulpia myuros*	0–1	0–1
	toad rush	JUBU	*Juncus bufonius*	0–1	0–1
	annual bluegrass	POAN	*Poa annua*	0–1	0–1

2	**Mound Grasses**			785–1457	
	annual semaphoregrass	PLCA6	*Pleuropogon californicus*	–	1–40
	Douglas' meadowfoam	LIDOD	*Limnanthes douglasii ssp. douglasii*	–	1–20
	eryngo	ERYNG	*Eryngium*	–	1–15
	water-starwort	CALLI6	*Callitriche*	–	0–10
	Pacific foxtail	ALSA3	*Alopecurus saccatus*	–	0–7
	johnny-tuck	TRER6	*Triphysaria eriantha*	–	0–3
	buttercup	RANUN	*Ranunculus*	–	0–2
	annual hairgrass	DEDA	*Deschampsia danthonioides*	–	0–2
	Orcutt grass	ORCUT	*Orcuttia*	–	0–1
	California goldfields	LACA7	*Lasthenia californica*	–	0–1
	pincushionplant	NAVAR	*Navarretia*	–	0–1
3	**Vernal Pool Grasses**			–	
4	**Bedrock Grasses**			28–92	
Forb					
1	**Intermound Forbs**			28–280	
	Pacific fescue	VUMIP	*Vulpia microstachys var. pauciflora*	560–1121	30–60
	longbeak stork's bill	ERBO	*Erodium botrys*	11–392	2–25
	toad rush	JUBU	*Juncus bufonius*	11–168	0–10
	oat	AVENA	*Avena*	11–112	1–20
	annual agoseris	AGHE2	*Agoseris heterophylla*	0–56	0–3
	soft brome	BRHO2	*Bromus hordeaceus*	0–56	0–2
	cowbag clover	TRDE	*Trifolium depauperatum*	6–34	0–2
	johnny-tuck	TRER6	*Triphysaria eriantha*	0–11	0–1
	whitetip clover	TRVA	*Trifolium variegatum*	0–11	0–1
	knotweed	POLYG4	*Polygonum*	0–1	0–1
	ripgut brome	BRDI3	*Bromus diandrus*	0–1	0–1
	rush	JUNCU	*Juncus*	0–1	0–1
	annual bluegrass	POAN	*Poa annua*	0–1	0–1
	annual fescue	VUMY	*Vulpia myuros*	0–1	0–1
	needlegrass	ACHNA	*Achnatherum*	0–1	0–1
2	**Mound Forbs**			56–504	
	spikemoss	SELAG	*Selaginella*	28–224	5–50
	annual agoseris	AGHE2	*Agoseris heterophylla*	1–112	1–12
	cowbag clover	TRDE	*Trifolium depauperatum*	22–90	2–15
	Pacific fescue	VUMIP	*Vulpia microstachys var. pauciflora*	11–84	5–30
	longbeak stork's bill	ERBO	*Erodium botrys*	11–67	1–25
	johnny-tuck	TRER6	*Triphysaria eriantha*	1–56	1–20
	California goldfields	LACA7	*Lasthenia californica*	0–17	0–10
	Sierra mock stonecrop	SEPU4	*Sedella pumila*	0–11	0–1
	whitetip clover	TRVA	*Trifolium variegatum*	0–6	0–1

	dotseed plantain	PLER3	*Plantago erecta*	0–3	0–2
	silver hairgrass	AICA	*Aira caryophyllea*	0–3	0–1
	toad rush	JUBU	*Juncus bufonius*	0–1	0–1
	rush	JUNCU	*Juncus*	0–1	0–1
	annual fescue	VUMY	*Vulpia myuros*	0–1	0–1
	harlequin annual lupine	LUST2	*Lupinus stiversii*	0–1	0–1
	stitchwort	MINUA	*Minuartia*	0–1	0–1
	buckwheat	ERIOG	*Eriogonum*	0–1	0–1
	Indian paintbrush	CASTI2	*Castilleja*	0–1	0–1
3	**Vernal Pool Forbs**			–	
4	**Bedrock Forbs**			56–392	

Animal community

This ecological site is utilized by a diversity of wildlife, including small mammals, lizards, toads, frogs, salamanders, and birds. The low height of the vegetation does not provide good nesting sites for birds. The vernal pools provide important habitat for amphibians and insects.

Hydrological functions

This ecological site provides water and nutrient storage.

Recreational uses

This ecological site is suitable for hiking, and provides scenic vistas and opportunities unique wildlife and wildflower viewing.

Inventory data references

In areas where water is perched in small depressions, vernal pools may be present.

References

Natural Resources Conservation Service. . National Ecological Site Handbook.

Other references

Other References:
Cheatham, N.H. 1976. Conservation of vernal pools. In Jain, S. Vernal pools: their ecology and conservation. Institute of Ecology Publication No. 9. pp. 86-89. University of California, Davis.

Gerhardt, F. and S.K. Collinge. 2003. Exotic plant invasions of vernal pools in the Central Valley of California, USA. Journal of Biogeography, 30:1043–1052.

Goettle, B. 1997. "Living Fossil" in the San Francisco Bay Area?" Tideline. 17(1):1-3.

Gorny, C., C. Busby, C.J. Pluhar, J. Hagan, and K. Putrika. 2009. An in-depth look at distal Sierra Nevada palaeochannel fill: drills cores through the Table Mountain Latite near Knights Ferry. International Geology Review 51(9-11):824-842.

Holechek, J.L., R.D. Pieper, and C.H. Herbel. 2004 Range Management: Principles and Practices, 5th Edition. Pearson Education, Inc., Upper Saddle River, NJ.
Holland, R.F. and S.K. Jain. 1988. Vernal pools. In Barbour, M.J. and J. Major. Terrestrial vegetation of California.

California Native Plant Society Special Publication No. 9. pp. 515-531.

Howard, Janet L. 2006. *Vulpia microstachys*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2013, February 19].

Keeler-Wolf, T., D.R. Elam, K. Lewis and S.A. Flint. 1998. California Vernal Pool Assessment Preliminary Report. California Department of Fish and Game, Sacramento, CA.

Kneitel, Jamie M. and Carrie L. Lessin. 2010. Ecosystem-phase interactions: aquatic eutrophication decreases terrestrial plant diversity in California vernal pools. pp 461-469, Volume 163, Issue 2, Oecologia.

Marty, J. 2005. Effects of cattle grazing on diversity in ephemeral wetlands. Conservation Biology 19:1626-1632.

Reed, S. and R. Amundson. 2007. Sediment, gophers and time: A model for the origin and persistence of mima-mound- vernal pool topography in the Great Central Valley. Pages 15-27 in R. A. Schlising and D.G. Alexander (editors), Vernal Pool Landscapes. Studies from the Herbarium, Number 14. California State University, Chico, CA

Thorp, R.W. 2007. Biology of specialist bees and conservation of showy vernal pool flowers. A review. Pages 51 to 57 in R. A. Schlising and D.G. Alexander (editors), Vernal Pool Landscapes. Studies from the Herbarium, Number 14. California State University, Chico, CA

Contributors

Dave Evans
K. Moseley
Marchel Munnecke
Nathan Roe
John Proctor
Darren Pinnegar

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)	Marchel Munnecke, Dave Evans
Contact for lead author	david.evans@ca.usda.gov
Date	12/18/2014
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:**
