USDA Natural Resources
Conservation Service

Ecological site R040XB222AZ
Volcanic Hills 7"-10" p.z.

Accessed: 05/11/2025

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.

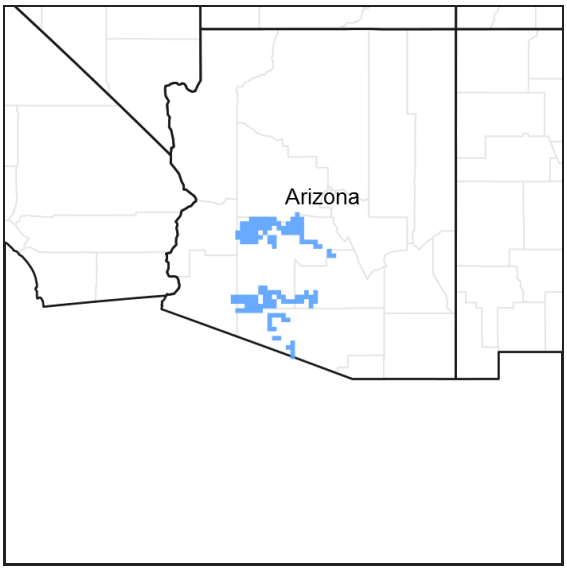


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 040X–Sonoran Basin and Range

AZ 40.2 – Middle Sonoran Desert

Elevations range from 1200 to 2000 feet and precipitation averages 7 to 10 inches per year. Vegetation includes saguaro, palo verde, creosotebush, triangle bursage, brittlebush, prickly pear, cholla, desert saltbush, wolfberry bush muhly, threeawns, and big galleta. The soil temperature regime is hyperthermic and the soil moisture regime is typic aridic. This unit occurs within the Basin and Range Physiographic Province and is characterized by numerous mountain ranges that rise abruptly from broad, plain-like valleys and basins. Igneous and metamorphic rock classes dominate the mountain ranges and sediments filling the basins represent combinations of fluvial, lacustrine, colluvial and alluvial deposits.

Table 1. Dominant plant species

Tree	(1) *Parkinsonia microphylla*
Shrub	(1) *Ambrosia deltoidea* (2) *Larrea tridentata var. tridentata*
Herbaceous	(1) *Muhlenbergia porteri* (2) *Tridens muticus var. elongatus*

Physiographic features

This site occurs on hillslopes and ridgetops. Slopes range from 15% to 65%. Elevations are from 1000 to 2500 feet. Slope aspect is site differentiating at elevations near land resource area boundaries.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Ridge
Elevation	1,000–2,500 ft
Slope	15–65%

Climatic features

Precipitation in the sub-resource area ranges from 7 to 10 inches. Elevations range from 900 to 2050 feet. Winter-summer rainfall ratios range from 40% to 60% in the southern part along the international boundary, to 60% to 40% in the central and northern parts of the sub-resource area. As one moves from east to west in this resource area rains become more unpredictable and variable with Coefficients of Variation of annual rainfall equal to 38% at Florence and 46% at Aguila. Summer rains fall July- September, originate in the Gulf of Mexico, and are convective, usually brief, intense thunderstorms. Summer precipitation is extremely erratic and undependable in this area. Cool season moisture tends to be frontal, originates in the Pacific and Gulf of California, and falls in widespread storms with long duration and low intensity. This is the dependable moisture supply for vegetation in the area. Snow is very rare and usually melts on contact. May-June is the driest time of the year. Humidity is very low.

Winter temperatures are very mild with very few days recording freezing for short periods of time. Summertime temperatures are hot to very hot with many days in June-July exceeding 105 degrees F. Frost-free days range from 280 at stations in major river valleys with cold air drainage to 320 to 350 days at upland stations.

Both the spring and the summer growing seasons are equally important for perennial grass, forb and shrub growth. Cool and warm season annual forbs and grasses can be common in their respective seasons with above average rainfall. Perennial forage species can remain green throughout the year with available moisture.

Table 3. Representative climatic features

Frost-free period (average)	350 days
Freeze-free period (average)	0 days
Precipitation total (average)	10 in

Influencing water features

Soil features

These are shallow soils formed on intermediate igneous parent materials; andesite, dacite, diorite, and on shale. Parent material kind includes slope alluvium. Parent material origin includes rhyolite. Surface texture modifier includes very cobbly and stony. Bedrock is usually hard and unweathered. They are slightly calcareous, loamy textured and have very well developed covers of cobble, stones, and gravel. Numerous areas of rock outcrop occur intermingled with soil areas. Outcrops can be as high as 35% of the area. Plant-soil moisture relationships are fair to good.

Soils mapped on this site include: SSA-645 Aguila-Carefree area MU's Gachado(STV phase) > 15% slopes-51, 52 & 103, Lomitas-52; SSA-661 Eastern Pinal-Southern Gila counties MU's Gachado(STV phase) > 15% slopes-610 & Lomitas-610.

Table 4. Representative soil features

Parent material	(1) Slope alluvium–andesite
Surface texture	(1) Very gravelly sandy loam (2) Extremely gravelly loam (3) Cobbly
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Soil depth	4–20 in
Surface fragment cover <=3"	35–65%
Surface fragment cover >3"	1–15%
Available water capacity (0-40in)	0.2–1.6 in
Calcium carbonate equivalent (0-40in)	2–10%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	7.9–8.4
Subsurface fragment volume <=3" (Depth not specified)	35–65%
Subsurface fragment volume >3" (Depth not specified)	1–15%

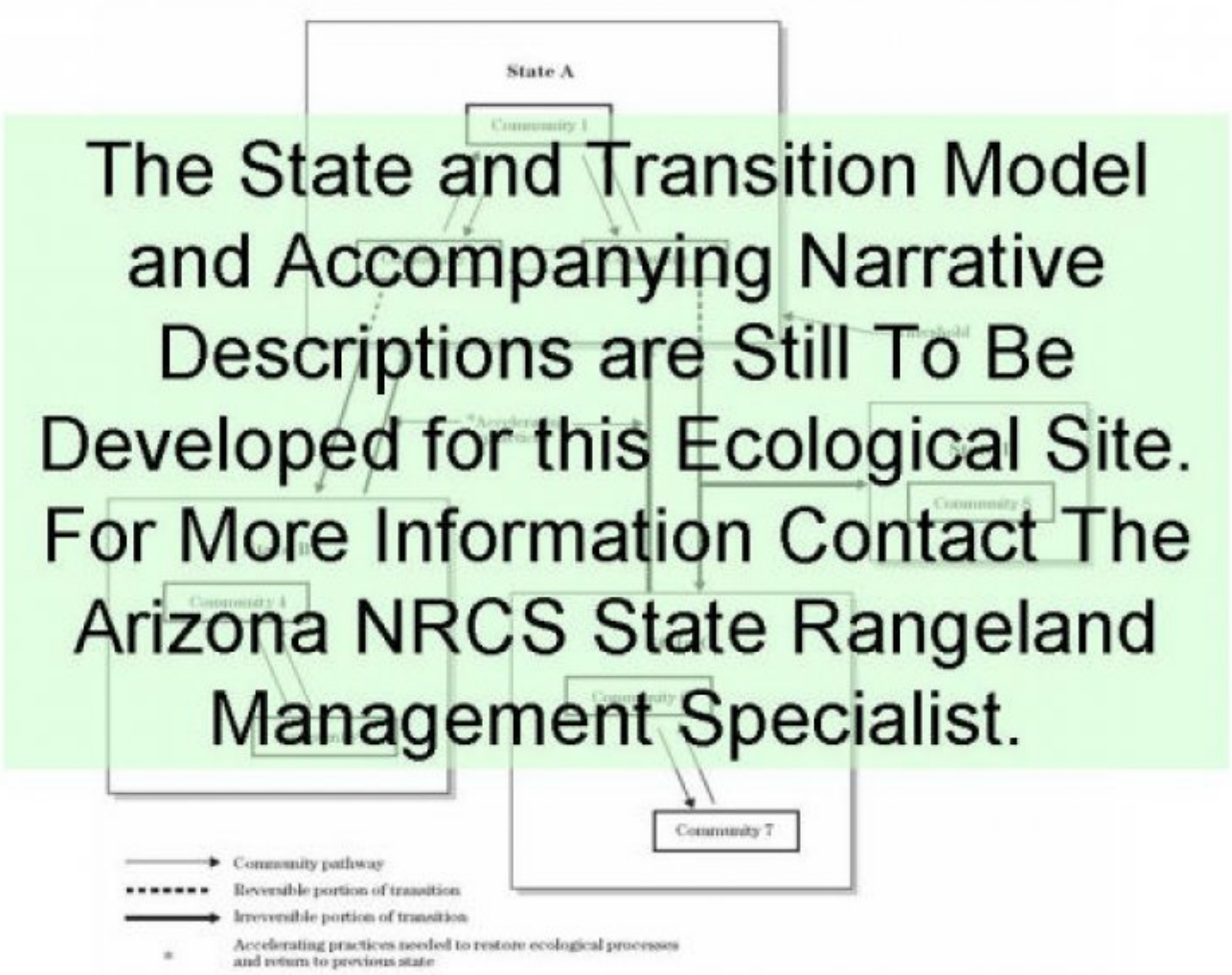
Ecological dynamics

The plant communities found on an ecological site are naturally variable. Composition and production will vary with yearly conditions, location, aspect, and the natural variability of the soils. The Historical Climax Plant Community represents the natural potential plant communities found on relict or relatively undisturbed sites. Other plant communities described here represent plant communities that are known to occur when the site is disturbed by factors such as fire, grazing, or drought.

Production data provided in this site description is standardized to air dry weight at the end of the summer growing season. The plant communities described in this site description are based on near normal rainfall years.

NRCS uses a Similarity Index to compare existing plant communities to the plant communities described here. Similarity Index is determined by comparing the production and composition of a plant community to the production and composition of a plant community described in this site description. To determine Similarity Index, compare the production (air dry weight) of each species to that shown in the plant community description. For each species, count no more than the maximum amount shown for the species, and for each group, count no more than the maximum amount shown for the group. Divide the resulting total by the total normal year production shown in the plant community description. If the rainfall has been significantly above or below normal, use the total production shown for above or below normal years. If field data is not collected at the end of the summer growing season, then the field data must be corrected to the end of the year production before comparing it to the site description. The growth curve can be used as a guide for estimating production at the end of the summer growing season.

State and transition model



The State and Transition Model and Accompanying Narrative Descriptions are Still To Be Developed for this Ecological Site. For More Information Contact The Arizona NRCS State Rangeland Management Specialist.

State 1
Historical Climax Plant Community

Community 1.1
Historical Climax Plant Community

The potential plant community is a diverse mixture of desert shrubs, trees and cacti. The aspect is shrubland. Continuous, heavy grazing removes the small percentage of perennial grass and forbs from the plant community. Cobble and gravel covers are continuous and average 95%. Basal cover of perennial plants is about 2% and bare ground averages 3%. Dark colored surface fragments warm the soil allowing plants to grow in late winter. Cryptogam (moss) cover is lacking or very low and lichens on stones is low even on north aspects. Plant populations of major species are 1000 to 1500 plants per acre for triangle bursage, 20 to 50 trees per acre for paloverde, about 200 per acre for creosotebush, 100 to 150 per acre for wolfberry, 10 to 60 saguaros per acre, about 300 plants per acre for cholla species and 1 to 20 ocotillo per acre. In the northern part of this land resource area, introduced cool season annual grasses like red brome and schismus have invaded native plant communities and have reduced production of native shrubs significantly. Teddy bear cholla predominates on south aspects and buckhorn cholla on north aspects. In some areas basalt flows capping acid igneous parent materials produces a site having the appearance of Basalt Hills, but the plant community is better described by this Volcanic Hills range site description.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	400	–	450
Forb	25	–	75
Grass/Grasslike	25	–	50
Total	**450**	**–**	**575**

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1				10–25	
	slim tridens	TRMU	*Tridens muticus*	0–3	–
	bush muhly	MUPO2	*Muhlenbergia porteri*	0–3	–
	tobosagrass	PLMU3	*Pleuraphis mutica*	0–2	–
	big galleta	PLRI3	*Pleuraphis rigida*	0–2	–
	Parish's threeawn	ARPUP5	*Aristida purpurea var. parishii*	0–2	–
	slender grama	BORE2	*Bouteloua repens*	0–2	–
	red grama	BOTR2	*Bouteloua trifida*	0–2	–
	curly-mesquite	HIBE	*Hilaria belangeri*	0–2	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–2	–
	Fendler's threeawn	ARPUF	*Aristida purpurea var. fendleriana*	0–1	–
	blue threeawn	ARPUN	*Aristida purpurea var. nealleyi*	0–1	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–1	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	0–1	–
	Arizona cottontop	DICA8	*Digitaria californica*	0–1	–
	nineawn pappusgrass	ENDE	*Enneapogon desvauxii*	0–1	–
	tanglehead	HECO10	*Heteropogon contortus*	0–1	–
	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	0–1	–
	spidergrass	ARTE3	*Aristida ternipes*	0–1	–
	spidergrass	ARTEG	*Aristida ternipes var. gentilis*	0–1	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–1	–
2				5–25	
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–5	–
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–5	–
	prairie threeawn	AROL	*Aristida oligantha*	0–5	–
	needle grama	BOAR	*Bouteloua aristidoides*	0–5	–
	sixweeks grama	BOBA2	*Bouteloua barbata*	0–5	–
	Rothrock's grama	BORO2	*Bouteloua rothrockii*	0–3	–
	Arizona brome	BRAR4	*Bromus arizonicus*	0–1	–
	tufted lovegrass	ERPEP2	*Eragrostis pectinacea var. pectinacea*	0–1	–
	Mexican sprangletop	LEFUU	*Leptochloa fusca ssp. uninervia*	0–1	–

	mucronate sprangletop	LEPA6	*Leptochloa panicea*	0–1	–
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–1	–
	littleseed muhly	MUMI	*Muhlenbergia microsperma*	0–1	–
	witchgrass	PACA6	*Panicum capillare*	0–1	–
	Hall's panicgrass	PAHA	*Panicum hallii*	0–1	–
	Bigelow's bluegrass	POBI	*Poa bigelovii*	0–1	–
	Eastwood fescue	VUMIC	*Vulpia microstachys var. ciliata*	0–1	–
	Pacific fescue	VUMIP	*Vulpia microstachys var. pauciflora*	0–1	–
Forb					
3				10–25	
	tree tobacco	NIGL	*Nicotiana glauca*	1000–5000	–
	slender janusia	JAGR	*Janusia gracilis*	2–5	–
	narrowleaf silverbush	ARLA12	*Argythamnia lanceolata*	0–3	–
	New Mexico silverbush	ARNE2	*Argythamnia neomexicana*	0–3	–
	slender poreleaf	POGR5	*Porophyllum gracile*	0–3	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–3	–
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–1	–
	Parry's beardtongue	PEPA24	*Penstemon parryi*	0–1	–
	bluedicks	DICAC5	*Dichelostemma capitatum ssp. capitatum*	0–1	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–1	–
	moleplant	EULA4	*Euphorbia lathyris*	0–1	–
	California fagonbush	FALA	*Fagonia laevis*	0–1	–
	desert rosemallow	HICO	*Hibiscus coulteri*	0–1	–
	Newberry's velvetmallow	HONE	*Horsfordia newberryi*	0–1	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–1	–
	rough menodora	MESC	*Menodora scabra*	0–1	–
	San Felipe dogweed	ADPO	*Adenophyllum porophylloides*	0–1	–
	trailing windmills	ALIN	*Allionia incarnata*	0–1	–
4				5–50	
	desert Indianwheat	PLOV	*Plantago ovata*	0–10	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–10	–
	common fiddleneck	AMMEI2	*Amsinckia menziesii var. intermedia*	0–5	–
	western tansymustard	DEPI	*Descurainia pinnata*	0–3	–
	combseed	PECTO	*Pectocarya*	0–3	–
	Emory's rockdaisy	PEEM	*Perityle emoryi*	0–1	–
	cliffbrake	PELLA	*Pellaea*	0–1	–
	phacelia	PHACE	*Phacelia*	0–1	–
	Mojave woodyaster	XYTOT	*Xylorhiza tortifolia var. tortifolia*	0–1	–
	New Mexico plumeseed	RANE	*Rafinesquia neomexicana*	0–1	–
	chia	SACO6	*Salvia columbariae*	0–1	–
	ragwort	SENEC	*Senecio*	0–1	–
	sleepy silene	SIAN2	*Silene antirrhina*	0–1	–
	Coulter's globemallow	SPCO2	*Sphaeralcea coulteri*	0–1	–

	woollynead neststraw	STMI2	*Stylocline micropoides*	0–1	–
	woolly tidestromia	TILA2	*Tidestromia lanuginosa*	0–1	–
	tall mountain larkspur	DESC	*Delphinium scaposum*	0–1	–
	wedgeleaf draba	DRCU	*Draba cuneifolia*	0–1	–
	whisperingbells	EMPE	*Emmenanthe penduliflora*	0–1	–
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	0–1	–
	miniature woollystar	ERDI2	*Eriastrum diffusum*	0–1	–
	fleabane	ERIGE2	*Erigeron*	0–1	–
	buckwheat	ERIOG	*Eriogonum*	0–1	–
	Texas stork's bill	ERTE13	*Erodium texanum*	0–1	–
	California poppy	ESCAM	*Eschscholzia californica ssp. mexicana*	0–1	–
	desert poppy	ESGL	*Eschscholzia glyptosperma*	0–1	–
	spotted hideseed	EUCH	*Eucrypta chrysanthemifolia*	0–1	–
	gilia	GILIA	*Gilia*	0–1	–
	Gordon's bladderpod	LEGO	*Lesquerella gordonii*	0–1	–
	pepperweed	LEPID	*Lepidium*	0–1	–
	Bigelow's linanthus	LIBI2	*Linanthus bigelovii*	0–1	–
	foothill deervetch	LOHU2	*Lotus humistratus*	0–1	–
	desert deervetch	LOMI	*Lotus micranthus*	0–1	–
	coastal bird's-foot trefoil	LOSA	*Lotus salsuginosus*	0–1	–
	Coulter's lupine	LUSP2	*Lupinus sparsiflorus*	0–1	–
	Parry's false prairie-clover	MAPA7	*Marina parryi*	0–1	–
	blazingstar	MENTZ	*Mentzelia*	0–1	–
	Nuttall's povertyweed	MONU	*Monolepis nuttalliana*	0–1	–
	green carpetweed	MOVE	*Mollugo verticillata*	0–1	–
	cloak fern	NOTHO	*Notholaena*	0–1	–
	evening primrose	OENOT	*Oenothera*	0–1	–
	Florida pellitory	PAFL3	*Parietaria floridana*	0–1	–
	carelessweed	AMPA	*Amaranthus palmeri*	0–1	–
	rockcress	ARABI2	*Arabis*	0–1	–
	milkvetch	ASTRA	*Astragalus*	0–1	–
	Coulter's spiderling	BOCO2	*Boerhavia coulteri*	0–1	–
	spiderling	BOERH2	*Boerhavia*	0–1	–
	hoary bowlesia	BOIN3	*Bowlesia incana*	0–1	–
	California suncup	CACA32	*Camissonia californica*	0–1	–
	exserted Indian paintbrush	CAEXE	*Castilleja exserta ssp. exserta*	0–1	–
	mariposa lily	CALOC	*Calochortus*	0–1	–
	white tackstem	CAWR	*Calycoseris wrightii*	0–1	–
	pebble pincushion	CHCA	*Chaenactis carphoclinia*	0–1	–
	lipfern	CHEIL	*Cheilanthes*	0–1	–
	devil's spineflower	CHRI	*Chorizanthe rigida*	0–1	–
	Esteve's pincushion	CHST	*Chaenactis stevioides*	0–1	–
	New Mexico thistle	CINE	*Cirsium neomexicanum*	0–1	–
		CRYPT		0–1	

	cryptantha	CRYPT	*Cryptantha*	0–1	–
	hairy prairie clover	DAMO	*Dalea mollis*	0–1	–
	American wild carrot	DAPU3	*Daucus pusillus*	0–1	–
	desert larkspur	DEPA	*Delphinium parishii*	0–1	–
Shrub/Vine					
5				100–175	
	triangle bur ragweed	AMDE4	*Ambrosia deltoidea*	100–175	–
6				150–200	
	yellow paloverde	PAMI5	*Parkinsonia microphylla*	120–175	–
	water jacket	LYAN	*Lycium andersonii*	2–10	–
	Fremont's desert-thorn	LYFR	*Lycium fremontii*	2–10	–
	creosote bush	LATRT	*Larrea tridentata var. tridentata*	2–5	–
7				25–50	
8				5–50	
	velvet mesquite	PRVE	*Prosopis velutina*	4–43	–
	arrow poision plant	SEBI9	*Sebastiania bilocularis*	0–5	–
	desert lavender	HYEM	*Hyptis emoryi*	0–3	–
	sangre de cristo	JACA2	*Jatropha cardiophylla*	0–3	–
	Sonoran croton	CRSO	*Croton sonorae*	0–3	–
	pelotazo	ABIN	*Abutilon incanum*	0–2	–
	California copperleaf	ACCA3	*Acalypha californica*	0–2	–
	Wright's beebrush	ALWR	*Aloysia wrightii*	0–1	–
	horsetail milkweed	ASSU2	*Asclepias subverticillata*	0–1	–
	brittlebush	ENFA	*Encelia farinosa*	0–1	–
	Nevada jointfir	EPNE	*Ephedra nevadensis*	0–1	–
	bastardsage	ERWR	*Eriogonum wrightii*	0–1	–
	starry bedstraw	GASTE2	*Galium stellatum ssp. eremicum*	0–1	–
	sweetbush	BEJU	*Bebbia juncea*	0–1	–
	spearleaf brickellbush	BRAT	*Brickellia atractyloides*	0–1	–
	Coulter's brickellbush	BRCO	*Brickellia coulteri*	0–1	–
	fragrant bursera	BUFA	*Bursera fagaroides*	0–1	–
	elephant tree	BUMI	*Bursera microphylla*	0–1	–
	ragged rockflower	CRBI2	*Crossosoma bigelovii*	0–1	–
	littleleaf ratany	KRER	*Krameria erecta*	0–1	–
	white ratany	KRGR	*Krameria grayi*	0–1	–
	desert ironwood	OLTE	*Olneya tesota*	0–1	–
	jojoba	SICH	*Simmondsia chinensis*	0–1	–
	American threefold	TRCA8	*Trixis californica*	0–1	–
9	**Succulents**			5–50	
	ocotillo	FOSP2	*Fouquieria splendens*	5–10	–
	organpipe cactus	STTH3	*Stenocereus thurberi*	0–3	–
	senita cactus	PASC14	*Pachycereus schottii*	0–2	–
	beavertail pricklypear	OPBA2	*Opuntia basilaris*	0–2	–
	Emory's barrel cactus	FEEM	*Ferocactus emoryi*	0–2	–

	candy barrelcactus	FEWI	*Ferocactus wislizeni*	0–2	–
	Thornber's nipple cactus	MATH	*Mammillaria thornberi*	0–1	–
	Engelmann's hedgehog cactus	ECEN	*Echinocereus engelmannii*	0–1	–

Animal community

Steep slopes, cobbly and gravelly surfaces and large areas of rock outcrop severely limit livestock distribution. Stocker cattle are best adapted to use areas of this site. The plant community provides limited amounts of usable forage in the winter-spring season. Normal water is lacking.

Water developments are very important to wildlife species on this site. Cover, diversity and topography make this site home to a variety of desert animals. Large mammals use the sute seasonally unless permanent water supplies exist nearby. The high percentage of bluff and rim outcrops make this site a favorite one for bighorn sheep. Javalina bed in numerous caves and rock shelters which occur on this site. Desert tortoises use the smaller caverns on southern exposures for winter dens. Caves and shelters in bluffs are also important for several bat species and for honey bees.

Other information

T&E Species: lesser long-nosed bat

Contributors

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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)	Dave Womack, Dan Robinett, Emilio Carrillo
Contact for lead author	NRCS Tucson Area Office
Date	12/28/2005
Approved by	S. Cassady
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Common on the site only in areas where rock and gravel cover is low. Rills follow joints, fractures and bedding planes in the bedrock parent materials.

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2. **Presence of water flow patterns:** Water flow patterns are common, continuous and cover 15-20% of area.

3. **Number and height of erosional pedestals or terracettes:** No pedestals or terracettes on the site.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 1-5%

5. **Number of gullies and erosion associated with gullies:** none

6. **Extent of wind scoured, blowouts and/or depositional areas:** No evidence of soil movement by wind.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter can move by wind and water. Woody litter remains under shrub canopies.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface resistance to erosion is good uncer shrub canopipes & areas with high rock and gravel cover to moderate in soil interspaces due to crusts formed by raindrop impact.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Weak thir platy to granular, to 3 inches thick.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Canopy 10-20%; 90-95% trees, 2-5% shrubs, 1-2% half shrubs, 1-2% succulents. Cover is well dispersed throughout the site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

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: trees > large shrubs = half shrubs > winter annuals > summer annuals > perennial grasses and forbs > cryptogams (Note: In El Nino years, annual forbs and grasses are #1 in above ground weight.)

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** 0-50% canopy mortality

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14. **Average percent litter cover (%) and depth (in):** Herbaceous litter is not persistent on the site and may be 20-60% in El Nino years.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 300 lbs/ac unfavorable precipitation; 500 lbs/ac normal precipitation; 750 lbs/ac favorable precipitation.

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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:** Sahara mustard (potential)

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17. **Perennial plant reproductive capability:** Not impaired for shrubs, drought impaired for perennial grasses and forbs.
