USDA Natural Resources
Conservation Service

Ecological site R040XC326AZ
Desert Pavement 3"-7" p.z.

Last updated: 3/04/2025
Accessed: 05/12/2025

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.

MLRA notes

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

Major Land Resource Area (MLRA) 40 is the portion of Sonoran Desert that extends from northwest Mexico into southwestern Arizona and southeastern California. This MLRA is hot desert characterized by bimodal precipitation coupled with hot summers and mild winters. These conditions give rise to a rich biological diversity visually dominated by columnar cactus (saguaro) and leguminous trees (palo verde). 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 basin sediments are combinations of fluvial, lacustrine, colluvial and alluvial deposits.

LRU notes

Land Resource Unit (LRU) 40-3, Colorado Sonoran Desert, is characterized by desert scrub vegetation with a high amount of desert pavement on relict fan remnants. Trees are common in large washes and hillslopes. Elevations range from 300 to 1200 feet, and precipitation averages 3 to 7 inches per year. Vegetation includes creosotebush, white bursage, brittlebush, Mormon tea, teddybear cholla, elephant tree, smoke tree, ocotillo, and big galleta. The soil temperature regime is hyperthermic and the soil moisture regime is typic aridic.

Classification relationships

USDA-NRCS Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin: Western Range and Irrigated Region D Major Land Resource Area 40 - Sonoran Basin and Range Land Resource Unit 3 - Colorado Sonoran Desert Ecological Site Desert Pavement, 3"-7" p.z.

U.S. Environmental Protection Agency, Ecological Regions of North America: Level I, Region 10 North American Deserts Level II, 10.2 Warm Deserts Level III, Ecoregion 81, Sonoran Basin and Range Level IV, 81l, 81n, 81o.

USDA-USFS Ecological Subregions: Sections of the Conterminous United States Section 322 American Semidesert and Desert Province Section 322B, Sonoran Desert.

Ecological site concept

Desert Pavement, 3”-7" p.z., occurs on fan terraces and relict lakebed floors. Terrain is flat or nearly so (slopes less than 4%). The soil surface is armored with interlocking rock cover and typically has a thick vesicular crust. Subsurface soils are highly variable. Vegetation is absent or nearly so. Aspect is barren land.

Associated sites

R040XC311AZ	**Limy Upland, Deep 3"-7" p.z.** Adjacent uplands, soils are skeletal without desert pavement cover
R040XC330AZ	**Sandy Loam Drainage 3"-7" p.z.** Small drainages often originating on site
R040XC318AZ	**Sandy Wash 3"-7" p.z.** Large drainagaes generally adjacent to or dissecting site

Similar sites

R040XB230AZ	**Desert Pavement 7"-10" p.z.** Elevations 1,200'-2,000'. Less desert varnish, Av soil surface horizon

Figure 1. Desert Pavement, 3"-7" p.z..

Figure 2. Interlocking gravels typical of desert pavement.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Forb, annual*

Physiographic features

This site occurs on fan remnants.

Table 2. Representative physiographic features

Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 3 to 7 inches. Annual rainfall is bimodal, with distinct rainy seasons occurring from December to March (winter) and July to September (summer). Rainfall ratios range from 40:60 (winter:summer). Rainfall intensity differs between rainfall seasons. Winter frontal storms develop in the Pacific Ocean and Gulf of California, producing widespread, low-intensity and long duration precipitation events. Winter precipitation is the more dependable water source for vegetation, and snowfall is very rare. During summer months, atmospheric activity in the Gulf of Mexico produces convective thunderstorms when crossing over the mountains in the afternoon. These storms travel across the plains and valleys, producing precipitation of short duration, usually less than 30 minutes, but of moderate to heavy intensity. However, these thunderstorms often produce little more than gusty winds and light showers. Between these two seasons, little to no effective precipitation can occur for several months at a time. May and June are the driest months, and overall humidity is very low.

Overall, average annual rainfall is variable, but increases in variability from east to west across the region. For long-term precipitation data, the coefficient of variation, the ratio of the standard deviation to the mean expressed as a percentage, increases from 44% at Gila Bend (east) to 65% at Mohawk (west).

Winter temperatures are very mild, with an average of 53°F in January, with recorded extremes of 10°F. Summertime temperatures are hot to very hot, averaging 93°F in July, and with recorded extremes of 125°F. Spring and summer growing seasons are equally important for perennial grass, forb and shrub and tree growth. With above average precipitation, cool and warm season annuals, forbs and grasses can be common in their respective seasons. Perennial forbs may only be visible above ground following rainfall events.

Table 3. Representative climatic features

Frost-free period (characteristic range)	262-365 days
Freeze-free period (characteristic range)	348-365 days
Precipitation total (characteristic range)	102-127 mm
Frost-free period (actual range)	247-365 days
Freeze-free period (actual range)	296-365 days
Precipitation total (actual range)	102-178 mm
Frost-free period (average)	303 days
Freeze-free period (average)	348 days
Precipitation total (average)	127 mm

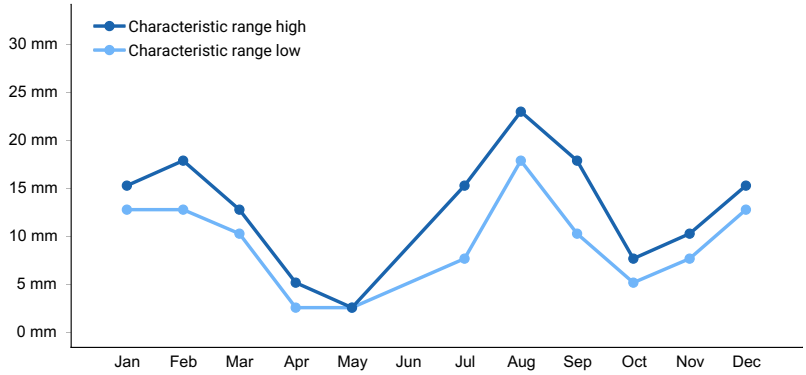


Figure 3. Monthly precipitation range

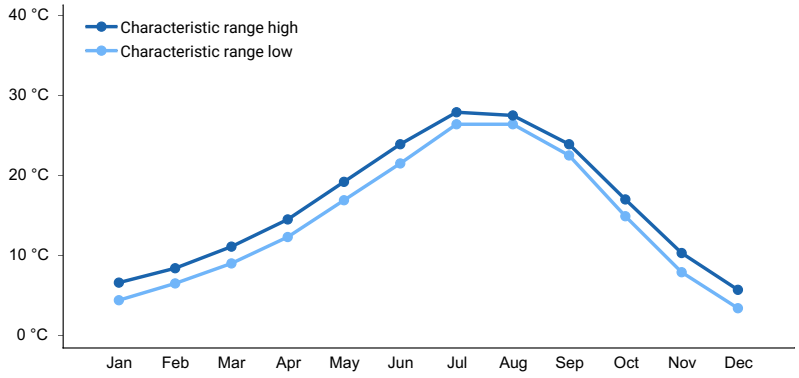


Figure 4. Monthly minimum temperature range

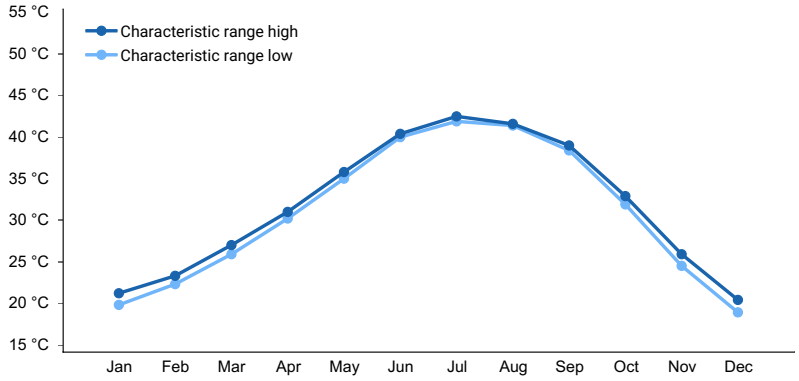


Figure 5. Monthly maximum temperature range

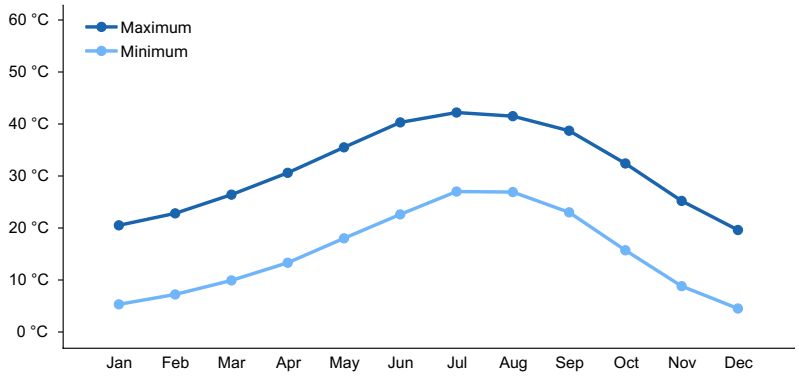


Figure 6. Monthly average minimum and maximum temperature

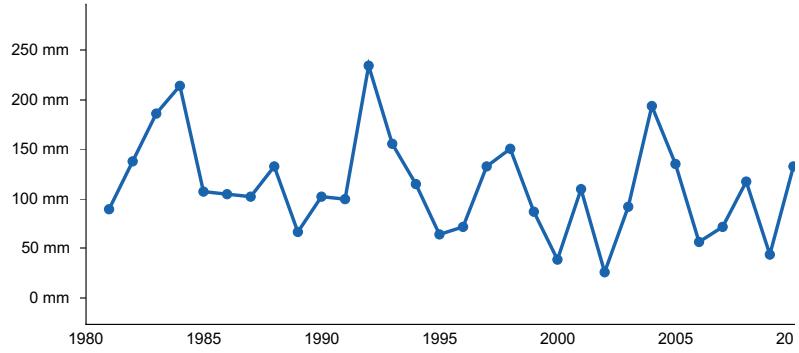


Figure 7. Annual precipitation pattern

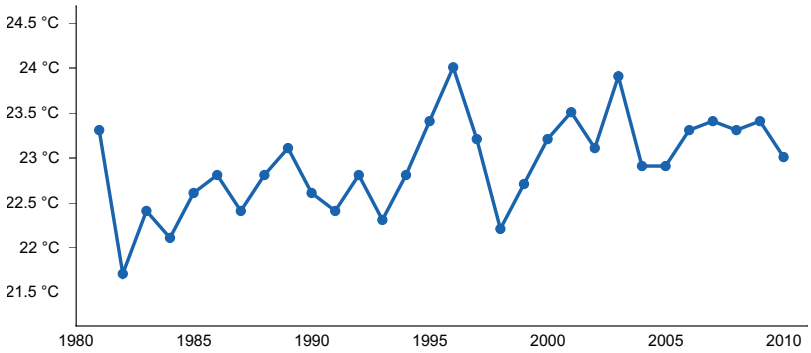


Figure 8. Annual average temperature pattern

Climate stations used

- (1) YUMA PROVING GROUND [USW00003125], Yuma, AZ
- (2) EHRENBERG 2 E [USC00022790], Cibola, AZ
- (3) TACNA 3 NE [USC00028396], Roll, AZ
- (4) GILA BEND [USC00023393], Gila Bend, AZ
- (5) QUARTZSITE [USC00026865], Parker, AZ

Influencing water features

No water features are associated with this ecological site.

Soil features

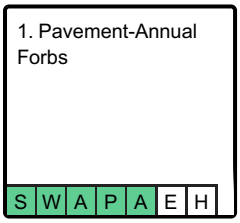
These deep soils form in alluvium of mixed origins. Desert pavement has 97%-99% surface rock fragment cover. Subsurface rock fragment percentage is highly variable. Plant-soil moisture relationships are poor.

Ecological dynamics

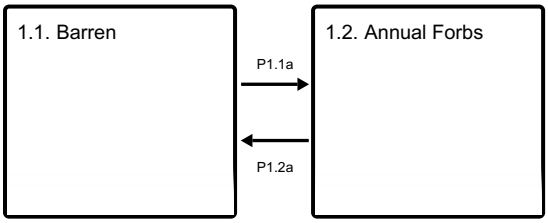
Desert Pavement, 3"-7" p.z., occurs on fan remnants with flat to very gently sloping terrain. Rainfall infiltration is very limited as soil surface is armored with interlocking rock fragments and vesicular pores. Gentle, winter rainfall events allow for relatively more infiltration as compared to summer thunderstorms. Run-off from Desert Pavement provides additional moisture to adjacent Sandy Loam Drainage and Sandy Wash ecological sites. Typically, annual forb community is absent. However, with an unusually wet winter, a variety of annual forbs can flourish for a short time. Aspect is barren land.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 1
Pavement-Annual Forbs

Expansive barren areas with interlocking rock fragments covering the soil surface. Patina-darkened fragment surfaces (desert varnish) give the site a dark appearance. The dark color results in excessive daytime surface heating, especially during the summer. Occasionally, an isolated shrub may occur on a disturbed area. These isolated plants are inconsequential to overall site dynamics and are considered as micro-inclusions of Limy Upland, Deep, ecological site.

Community 1.1
Barren

Figure 9. Desert Pavement, Barren community phase

Figure 10. Vesicular horizon (Av Horizon) below interlocking gravel cover

Figure 11. Vesicular pores within surface soil ped.

Site is barren. Individual dead-standing spiny stems of spineflowers (Chorizanthe spp.) can be encountered at any time of year.

Table 4. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	–	6	17
Shrub/Vine	–	–	2
Tree	–	–	–
Grass/Grasslike	–	–	–
Total	**–**	**6**	**19**

Table 5. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	97-99%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	1-3%

Table 6. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	0-1%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	0-1%	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

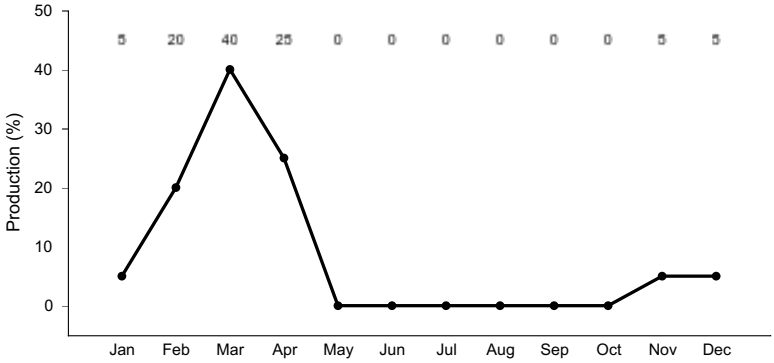


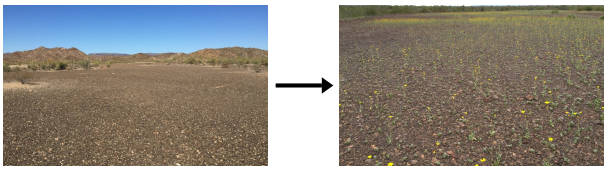
Figure 13. Plant community growth curve (percent production by month). AZ4041, 40.3 3-7" p.z. all sites. Most growth occurs in the winter to early spring, plants are dormant May through October..

Community 1.2
Annual Forbs

Figure 14. Desert Pavement, Annual Forbs community phase.

Annual forbs occasionally flourish in early spring following unusually wet winters. Maximum production years recur about every 10 years. Standing dead annuals quickly dry out and are wind disseminated. Dead stems of spineflower (Chorizanthe spp.) can be found almost at any time.

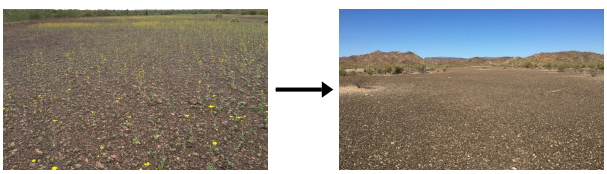
Pathway P1.1a
Community 1.1 to 1.2



Barren **Annual Forbs**

Winter precipitation.

Pathway P1.2a
Community 1.2 to 1.1



Annual Forbs **Barren**

Desert climate.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Annual Grasses**			0–6	
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–1	–
	needle grama	BOAR	*Bouteloua aristidoides*	0–1	–
	sixweeks grama	BOBA2	*Bouteloua barbata*	0–1	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	0–1	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–1	–
Forb					
2	**Perennial Forb**			0–1	
	desert marigold	BAMU	*Baileya multiradiata*	0–1	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–1	–
	buckwheat	ERIOG	*Eriogonum*	0–1	–
	desert Indianwheat	PLOV	*Plantago ovata*	0–1	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–1	–
3	**Annual Forb**			0–17	
	common fiddleneck	AMMEI2	*Amsinckia menziesii var. intermedia*	0–1	–
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–1	–
	desert marigold	BAMU	*Baileya multiradiata*	0–1	–
	suncup	CAMIS	*Camissonia*	0–1	–
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–1	–
	devil's spineflower	CHRI	*Chorizanthe rigida*	0–1	–
	Esteve's pincushion	CHST	*Chaenactis stevioides*	0–1	–
	cryptantha	CRYPT	*Cryptantha*	0–1	–
	hairy prairie clover	DAMO	*Dalea mollis*	0–1	–
	western tansymustard	DEPI	*Descurainia pinnata*	0–1	–
	desert woollystar	ERER2	*Eriastrum eremicum*	0–1	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–1	–
	spurge	EUPHO	*Euphorbia*	0–1	–
	Gordon's bladderpod	LEGO	*Lesquerella gordonii*	0–1	–
	Coulter's lupine	LUSP2	*Lupinus sparsiflorus*	0–1	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	0–1	–
	glandular threadplant	NEGL	*Nemacladus glanduliferus*	0–1	–
	phacelia	PHACE	*Phacelia*	0–1	–
	sleepy silene	SIAN2	*Silene antirrhina*	0–1	–
Shrub/Vine					
4	**Dominant Shrubs**			0–2	
	creosote bush	LATR2	*Larrea tridentata*	0–17	0–1
	branched pencil cholla	CYRA9	*Cylindropuntia ramosissima*	0–2	0
	burrobush	AMDU2	*Ambrosia dumosa*	0–1	0–1
	brittlebush	ENFA	*Encelia farinosa*	0–1	0–1

Other references

Griffith, G.E., Omernik, J.M., Johnson, C.B., and Turner, D.S. 2014. Ecoregions of Arizona (poster): U.S. Geological Survey Open-File Report 2014-1141, with map, scale 1:1,325,000, https://dx.doi.org/10.3133/ofr20141141. ISSN 2331-1258 (online)

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

McAuliffe, J.R. 2019. Soil horizon development and the tempo and modes of vegetation change during the Holocene in a Sonoran Desert basin, USA. The Holocene 29(8):1263-1272.

Approval

Kendra Moseley, 3/04/2025

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	05/12/2025
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:

---

17. **Perennial plant reproductive capability:**
