USDA Natural Resources Conservation Service

Ecological site R040XB231AZ
Lithic Hills 7"-10" p.z.

Last updated: 10/17/2024
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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): 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) 40-2, Middle Sonoran Desert, is characterized by desert scrub vegetation. A moderate amount of desert pavement is present on fan remnants. Trees are common in washes, bottoms and hillslopes. 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.

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 2 - Middle Sonoran Desert Ecological Site Lithic Hills, 7"-10" 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

Lithic Hills, 7"-10" p.z., occur on steep terrain, with slopes greater than 15%. Soils are calcareous, loamy textured, and very shallow to shallow over hard, unweathered bedrock. Exposed bedrock often covers more than 20% of the surface area. This ecological site was renamed from Limestone Hills, 7"-10" p.z., as parent materials are not limited to limestone.

Associated sites

R040XB216AZ	**Sandy Wash 7"-10" p.z.** Sandy Wash ecological site benefits from run-off originating on Lithic Hills
R040XB208AZ	**Limy Upland, Deep 7"-10" p.z.** Limy Upland Deep ecological site situated on uplands below Lithic Hills
R040XB210AZ	**Limy Upland 7"-10" p.z.** Limy Upland ecological site situated on upland below Lithic Hills

Similar sites

R040XB210AZ	**Limy Upland 7"-10" p.z.**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Encelia farinosa* (2) *Cylindropuntia bigelovii*
Herbaceous	Not specified

Physiographic features

This site occurs on steep hill-slopes and ridge-tops. Rock outcrops can cover more than 20% of the area.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill (3) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	366–610 m
Slope	15–75%
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation ranges from 7 to 10 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) in the southern part, and 60:40 in the central and northern parts. 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 most 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. 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 38% at Florence (east) to 46% at Aguila (west).

Winter temperatures are very mild, with very few days having short periods of freezing temperatures. Summertime temperatures are hot to very hot, with many days in June and July exceeding 105°F. The number of frost-free days ranges from 280 in major river valleys with cold air drainage to between 320 and 350 in upland areas.

Spring and the summer growing seasons are equally important for perennial grass, forb and shrub growth. With above average precipitation, cool and warm season annual forbs and grasses can be common in their respective

seasons. Perennial forage species can remain green throughout the year with sufficient available moisture.

Table 3. Representative climatic features

Frost-free period (average)	291 days
Freeze-free period (average)	344 days
Precipitation total (average)	330 mm

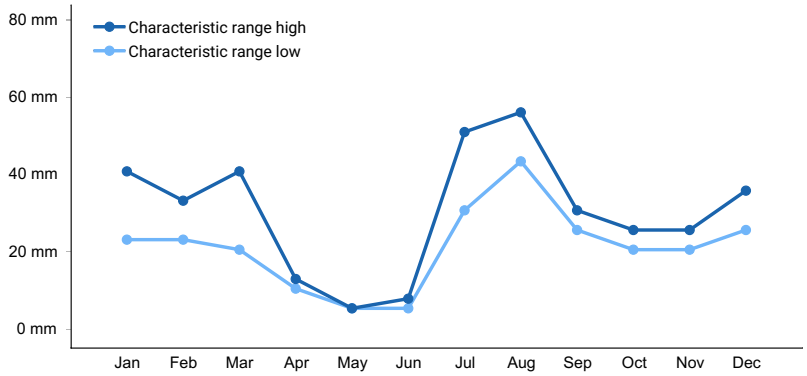

Figure 1. Monthly precipitation range

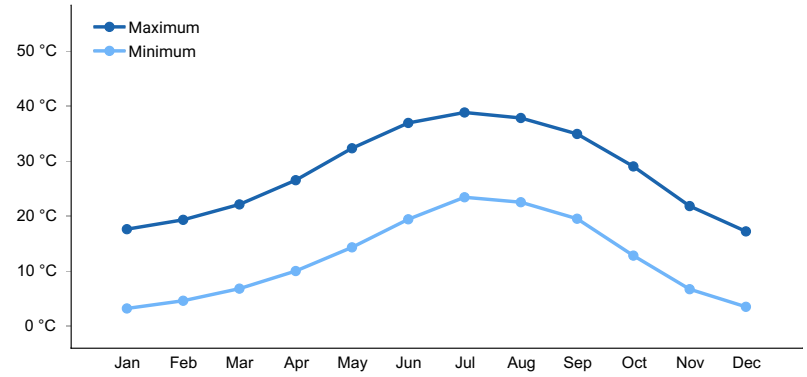

Figure 2. Monthly average minimum and maximum temperature

Influencing water features

Soil features

These shallow and very shallow soils form over bedrock. Parent material varies from sedimentary to igneous sources. Soils are calcareous throughout, and are very gravelly to cobbly. Plant-soil moisture relationships are poor, though the large rock outcrops concentrate precipitation to areas with soil.

Table 4. Representative soil features

Surface texture	(1) Very gravelly sandy loam (2) Gravelly sandy loam (3) Gravelly loam
Family particle size	(1) Loamy
Drainage class	Somewhat excessively drained
Permeability class	Rapid to moderately rapid
Soil depth	13–51 cm
Surface fragment cover <=3"	30–60%
Surface fragment cover >3"	5–20%

Available water capacity (0-101.6cm)	1.27–5.08 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–2
Soil reaction (1:1 water) (0-101.6cm)	7.9–8.4
Subsurface fragment volume <=3" (Depth not specified)	35–65%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The potential plant community is a diverse mixture of desert trees, shrubs, cacti, half-shrubs and shrub-like perennial forbs. Drought conditions frequently occur. The sparse plant community and exposed bedrock effectively eliminate the occurrence of fire. The shallow, course-textured soils dry very quickly, greatly limiting the occurrence of shallow-rooted perennials. Rainfall infiltrates cracks in the bedrock, and plants become deeply rooted within these cracks. Shrubland is the only ecological state for this site. Plant-soil moisture relationships are poor. The aspect is open shrubland.

State and transition model

40-2AZ Lithic Hills 7-10" p.z. (R040XB231AZ)

1. Shrubland State

1.1 Shrub-Cactus Community
Cholla/ocotillo/brittlebush dominated with miscellaneous shrubs, scattered saguaro and palo verde. Annual forbs and grasses flourish after rainfall.

State 1
Shrubland

Community 1.1
Shrub-Cactus

The potential plant community is a diverse mixture of desert trees, shrubs, cacti, and perennial grasses and forbs. The large amount of rock outcrop on this site tends to concentrate precipitation onto adjacent soil areas. Brittlebush predominates on north-facing slopes while teddybear cholla predominates on south-facing slopes. Plant populations of range from 110 to 150 individuals per acre for brittlebush, 200 to 250 for teddybear cholla, 50 to 100 for

creosotebush, 35 to 50 for ocotillo, and 1 to 10 for saguaro. Cryptogam cover on bare ground ranges from low to moderate. Plant-soil moisture relationships are poor. The aspect is shrubland.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	112	252	387
Forb	11	13	28
Grass/Grasslike	–	2	11
Total	**123**	**267**	**426**

Table 6. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	1-3%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0-15%
Litter	0-20%
Surface fragments >0.25" and <=3"	30-60%
Surface fragments >3"	5-25%
Bedrock	20-60%
Water	0%
Bare ground	5-25%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-2%	0-10%	1-10%
>0.15 <= 0.3	–	0-2%	1-5%	1-10%
>0.3 <= 0.6	–	1-5%	0-1%	0-2%
>0.6 <= 1.4	0-1%	1-5%	0-1%	0-1%
>1.4 <= 4	5-10%	–	–	–
>4 <= 12	0-1%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Miscellaneous perennial grasses**			0–6	
	slim tridens	TRMU	*Tridens muticus*	0–2	–
	Parish's threeawn	ARPUP5	*Aristida purpurea var. parishii*	0–2	–

	Wright's threeawn	ARPUW	*Aristida purpurea var. wrightii*	0–2	–
	spidergrass	ARTE3	*Aristida ternipes*	0–2	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	0–2	–
	Arizona cottontop	DICA8	*Digitaria californica*	0–2	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–2	–
	Havard's threeawn	ARHA3	*Aristida havardii*	0–2	–
2	**Annual grasses**			0–50	
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–11	–
	Rothrock's grama	BORO2	*Bouteloua rothrockii*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–11	–
	prairie threeawn	AROL	*Aristida oligantha*	0–6	–
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–3	–
	Arizona signalgrass	URAR	*Urochloa arizonica*	0–2	–
	desert lovegrass	ERPEM	*Eragrostis pectinacea var. miserrima*	0–2	–
	Arizona brome	BRAR4	*Bromus arizonicus*	0–1	–
	needle grama	BOAR	*Bouteloua aristidoides*	0–1	–
	sixweeks grama	BOBA2	*Bouteloua barbata*	0–1	–
Forb					
3	**Dominant perennial forbs**			11–56	
	California fagonbush	FALA	*Fagonia laevis*	1–6	–
	slender poreleaf	POGR5	*Porophyllum gracile*	1–6	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	1–6	–
	trailing windmills	ALIN	*Allionia incarnata*	0–6	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	1–6	–
	slender janusia	JAGR	*Janusia gracilis*	0–6	–
	Coues' cassia	SECO10	*Senna covesii*	0–3	–
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–2	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	0–1	–
	scarlet spiderling	BOCO	*Boerhavia coccinea*	0–1	–
	Parry's beardtongue	PEPA24	*Penstemon parryi*	0–1	–
	rosemallow	HIBIS2	*Hibiscus*	0–1	–
	paleface	HIDE	*Hibiscus denudatus*	0–1	–
	narrowleaf silverbush	ARLA12	*Argythamnia lanceolata*	0–1	–
	glandleaf milkwort	POMA7	*Polygala macradenia*	0–1	–
	desert marigold	BAMU	*Baileya multiradiata*	0–1	–
	leatherweed	CRPOP	*Croton pottsii var. pottsii*	0–1	–
	dense ayenia	AYMI	*Ayenia microphylla*	0–1	–
	New Mexico silverbush	ARNE2	*Argythamnia neomexicana*	0–1	–
	weakleaf bur ragweed	AMCO3	*Ambrosia confertiflora*	0–1	–
4	**Annual forbs and minor perennials**			1–73	
	phacelia	PHACE	*Phacelia*	0–17	–
	desert Indianwheat	PLOV	*Plantago ovata*	0–11	–
	lyreleaf jewelflower	STCA5	*Streptanthus carinatus*	0–11	–

	[illegible]	[illegible]	[illegible]	[illegible]	
	western tansymustard	DEPI	*Descurainia pinnata*	0–11	–
	cryptantha	CRYPT	*Cryptantha*	0–11	–
	California poppy	ESCAM	*Eschscholzia californica ssp. mexicana*	0–11	–
	Gordon's bladderpod	LEGO	*Lesquerella gordonii*	0–11	–
	Coulter's lupine	LUSP2	*Lupinus sparsiflorus*	0–11	–
	exserted Indian paintbrush	CAEXE	*Castilleja exserta ssp. exserta*	0–11	–
	shaggyfruit pepperweed	LELA	*Lepidium lasiocarpum*	0–6	–
	hairy prairie clover	DAMO	*Dalea mollis*	0–6	–
	Texas stork's bill	ERTE13	*Erodium texanum*	0–6	–
	chia	SACO6	*Salvia columbariae*	0–2	–
	wishbone-bush	MILAV	*Mirabilis laevis var. villosa*	0–2	–
	Florida pellitory	PAFL3	*Parietaria floridana*	0–1	–
	whitestem blazingstar	MEAL6	*Mentzelia albicaulis*	0–1	–
	foothill deervetch	LOHU2	*Lotus humistratus*	0–1	–
	Mexican fireplant	EUHE4	*Euphorbia heterophylla*	0–1	–
	Parish's larkspur	DEPAP3	*Delphinium parishii ssp. parishii*	0–1	–
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	0–1	–
	sleepy silene	SIAN2	*Silene antirrhina*	0–1	–
	slimjim bean	PHFI3	*Phaseolus filiformis*	0–1	–
	Arizona popcornflower	PLAR	*Plagiobothrys arizonicus*	0–1	–
	woolly tidestromia	TILA2	*Tidestromia lanuginosa*	0–1	–
	pricklyleaf dogweed	THAC	*Thymophylla acerosa*	0–1	–
	sand fringepod	THCU	*Thysanocarpus curvipes*	0–1	–
	desert mariposa lily	CAKE	*Calochortus kennedyi*	0–1	–
	whitemargin sandmat	CHAL11	*Chamaesyce albomarginata*	0–1	–
	brittle spineflower	CHBR	*Chorizanthe brevicornu*	0–1	–
	hyssopleaf sandmat	CHHY3	*Chamaesyce hyssopifolia*	0–1	–
	Palmer's Indian mallow	ABPA	*Abutilon palmeri*	0–1	–
	brownfoot	ACWR5	*Acourtia wrightii*	0–1	–
	San Felipe dogweed	ADPO	*Adenophyllum porophylloides*	0–1	–
	tuber anemone	ANTU	*Anemone tuberosa*	0–1	–
	rockcress	ARABI2	*Arabis*	0–1	–
	aster	ASTER	*Aster*	0–1	–
	Coulter's spiderling	BOCO2	*Boerhavia coulteri*	0–1	–
	hoary bowlesia	BOIN3	*Bowlesia incana*	0–1	–
	Arizona wrightwort	CAAR7	*Carlowrightia arizonica*	0–1	–
Shrub/Vine					
5	**Dominant low shrubs**			45–163	
	white ratany	KRGR	*Krameria grayi*	6–28	–
	brittlebush	ENFA	*Encelia farinosa*	17–28	–
	burrobush	AMDU2	*Ambrosia dumosa*	6–17	–
	whitestem paperflower	PSCO2	*Psilostrophe cooperi*	1–11	–

	littleleaf ratany	KRER	*Krameria erecta*	1–11	–
	pelotazo	ABIN	*Abutilon incanum*	0–11	–
	triangle bur ragweed	AMDE4	*Ambrosia deltoidea*	0–11	–
	woody crinklemat	TICAC	*Tiquilia canescens var. canescens*	0–11	–
	desert zinnia	ZIAC	*Zinnia acerosa*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–2	–
	American threefold	TRCA8	*Trixis californica*	0–2	–
6	**Dominant large shrubs**			45–112	
	ocotillo	FOSP2	*Fouquieria splendens*	17–56	–
	creosote bush	LATR2	*Larrea tridentata*	11–28	–
	whitethorn acacia	ACCO2	*Acacia constricta*	0–11	–
	yellow paloverde	PAMI5	*Parkinsonia microphylla*	2–11	–
7	**Miscellaneous shrubs**			6–28	
	Nevada jointfir	EPNE	*Ephedra nevadensis*	0–2	–
	Warnock's snakewood	COWA	*Condalia warnockii*	0–2	–
	lotebush	ZIOB	*Ziziphus obtusifolia*	0–1	–
	javelina bush	COER5	*Condalia ericoides*	0–1	–
	knifeleaf condalia	COSP3	*Condalia spathulata*	0–1	–
	desert lavender	HYEM	*Hyptis emoryi*	0–1	–
	water jacket	LYAN	*Lycium andersonii*	0–1	–
	Arizona desert-thorn	LYEX	*Lycium exsertum*	0–1	–
	algerita	MATR3	*Mahonia trifoliolata*	0–1	–
8	**Cactus**			17–84	

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.

Approval

Kendra Moseley, 10/17/2024

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	11/14/2024
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:

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

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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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:**

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17. **Perennial plant reproductive capability:**
