Ecological site R038XA128AZ
Limestone Upland 12-16" p.z.

Last updated: 9/05/2019
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): 038X–Mogollon Transition South

AZ 38.1 – Lower Mogollon Transition

Elevations range from 3,000 to 4,500 feet and precipitation averages 12 to 16 inches per year. Vegetation includes canotia, one-seed juniper, mesquite, catclaw acacia, jojoba, turbinella oak, ratany, shrubby buckwheat, algerita, skunkbush, tobosa, vine mesquite, bottlebrush squirreltail, grama species, curly mesquite, desert needlegrass, and New Mexico feathergrass. The soil temperature regime is thermic and the soil moisture regime is ustic aridic. This MLRA occurs within the Transition Zone Physiographic Province and is characterized by canyons and structural troughs or valleys. Igneous, metamorphic, and sedimentary rock classes occur on rough mountainous terrain in association with less extensive sediment filled valleys exhibiting little integrated drainage.

Ecological site concept

The Limestone Upland ecological site occurs on mesas and hills.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

The Limestone Upland ecological site occurs on mesas and hills.

Table 2. Representative physiographic features

Landforms	(1) Mesa (2) Hill
Elevation	914–1,372 m
Slope	2–60%

Climatic features

Precipitation in this common resource area averages 12 to 16 inches annually. The winter/summer rainfall ratio ranges from about 60/40 percent in the northwest part of the area to 50/50 percent in the southeast part. Summer rains fall July through September; are from high-intensity, convective thunderstorms. This moisture originates primarily from the Gulf of Mexico, but can come from the remnants of Pacific hurricanes in September. Winter

moisture is frontal, originates in the north Pacific, and falls as rain or snow in widespread storms of low intensity and long duration. Snowfall ranges from a trace to 10 inches per year and can occur from November through March. Snow seldom persists for more than a day except on north aspects. May and June are the driest months of the year. Humidity is generally low all year. Average annual air temperatures range from 59 to 70 degrees F (thermic temperature regime). Daytime temperatures in the summer are commonly in the high 90's. Freezing temperatures are common from October through April, usually during the night or early morning hours. The actual precipitation, available moisture, and temperature vary, depending on region, elevation, rain shadow effect, and aspect.

Table 3. Representative climatic features

Frost-free period (average)	230 days
Freeze-free period (average)	285 days
Precipitation total (average)	406 mm

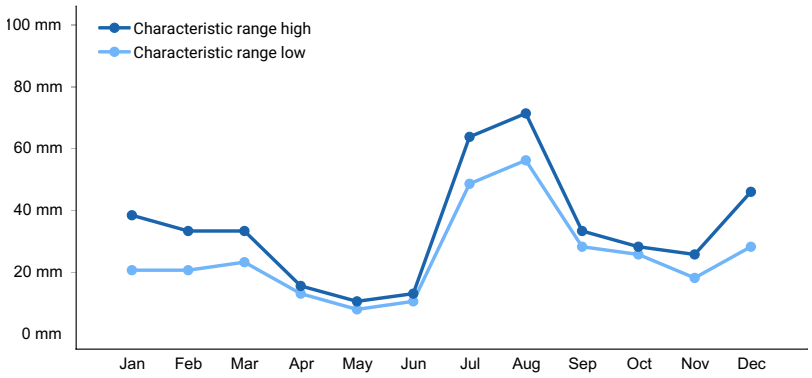


Figure 1. Monthly precipitation range

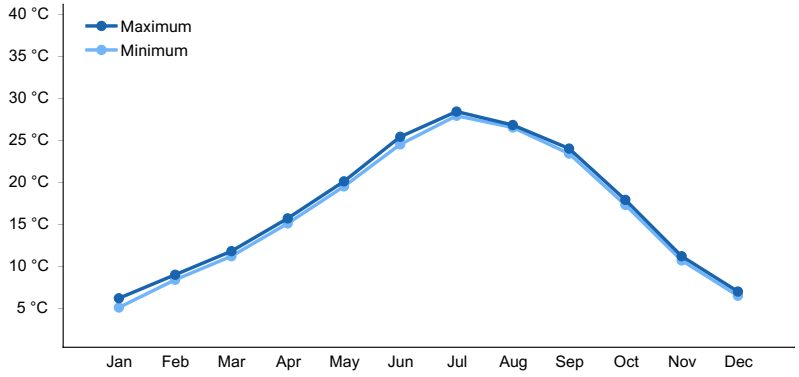


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

Soil features

This series is formed on residuum from limestone. This unit has no regular pattern. Every delineation has at least one of the major components and may have all. Each of the components, however, need not be in every delineation. The percentage varies from one area to another.

Mapped in SSA-639 Black Hills-Sedona Area MU's Pagesprings-428 and 429.

Table 4. Representative soil features

Parent material	(1) Residuum–limestone
Surface texture	(1) Gravelly loam
Family particle size	(1) Loamy

Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	13–28 cm
Available water capacity (0-101.6cm)	0–6.35 cm
Calcium carbonate equivalent (0-101.6cm)	40–60%

Ecological dynamics

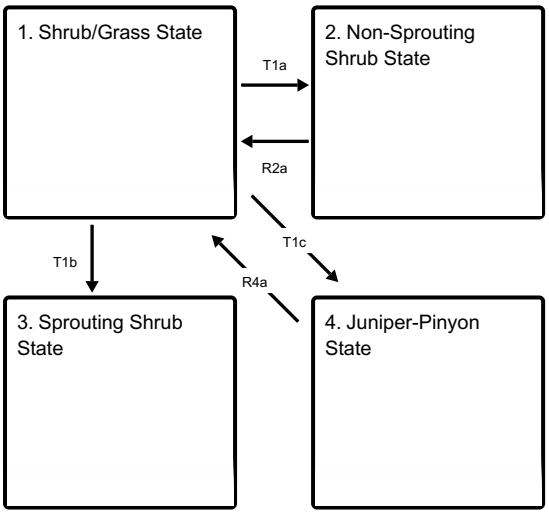
The plant communities found on an ecological site are naturally variable. Composition and production will vary with yearly conditions, location, aspect, and the natural variability of the soils. The Reference Plant Community represents the natural potential plant community found on relict or relatively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

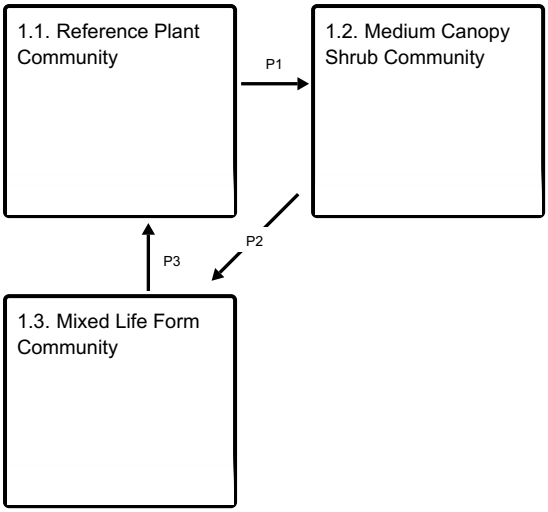
NRCS uses a Similarity Index to compare existing plant communities to the plant communities described here. Similarity Index is determined by comparing the production and composition of a plant community to the production and composition of a plant community described in this site description. To determine 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 shown for the group. Divide the resulting total by the total normal year production shown in the plant community description. If 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

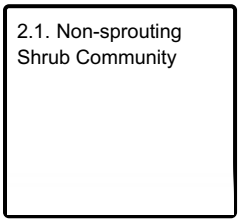
Ecosystem states



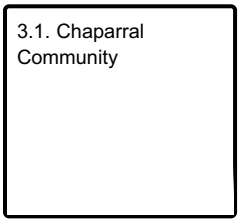
State 1 submodel, plant communities



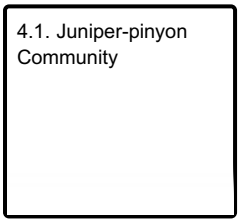
State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities



State 1
Shrub/Grass State

The Shrub/Grass State is the Reference Plant Community. Shrub canopy is 35-45% on all aspects.

Community 1.1
Reference Plant Community

The Shrub/Grass State is the Reference Plant Community. It is a diverse mixture of perennial grasses, suffrutescent forbs, shrubs, succulents and scattered trees. A flora of native annual forbs and grasses, of both the winter and summer seasons, exist in the plant community. Periodic, naturally occurring, wildfires were important in maintaining the Reference Plant Community. North slopes have a mixture of grass and evergreen chaparral shrubs like turbinella oak, mountain mahogany, and redberry buckthorn. Southern exposures will have a higher percentage of desert shrubs and succulents in the plant community. Shrub canopy is 35-45% on all aspects.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	224	448	673
Shrub/Vine	336	482	527
Tree	45	67	112
Forb	34	78	101
Total	**639**	**1075**	**1413**

Table 6. Ground cover

Tree foliar cover	0-1%
Shrub/vine/liana foliar cover	2-4%
Grass/grasslike foliar cover	3-6%
Forb foliar cover	0-1%
Non-vascular plants	0%
Biological crusts	0-2%
Litter	30-50%
Surface fragments >0.25" and <=3"	15-30%
Surface fragments >3"	20-25%
Bedrock	0%
Water	0%
Bare ground	3-7%

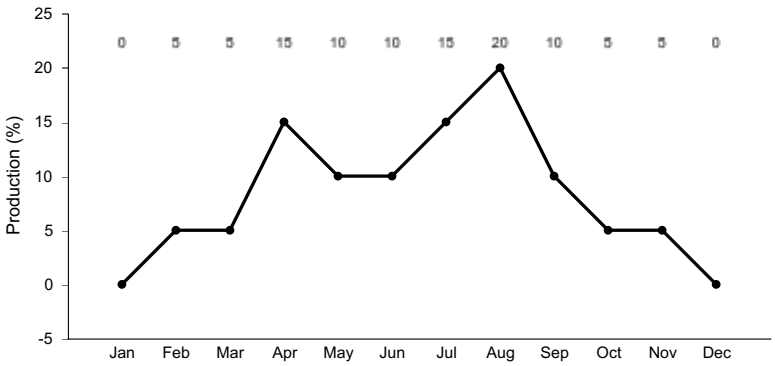


Figure 4. Plant community growth curve (percent production by month). AZ3812, 38.2 16-20" p.z. all sites. Growth begins in the spring and continues into the summer and fall..

Community 1.2
Medium Canopy Shrub Community

Shrubs increase in canopy and density to approximately 45-60% canopy in the absence of fire. Herbaceous species are present in sufficient quantity and are evenly distributed to promote fire intensities sufficient to reduce abundance of shrub species.

Community 1.3
Mixed Life Form Community

Juniper or pinyon germinate and are present at densities of 5-10 per acre and are still small in size. One seed or redberry juniper are the juniper species. Tree canopy is approximately 5-10%. Herbaceous production is approximately 700 lbs/ac and fires are effective at killing fire sensitive juniper and pinyon.

Pathway P1
Community 1.1 to 1.2

Increased shrub canopy due to passage of time without fire

Pathway P2
Community 1.2 to 1.3

Fire

Pathway P3
Community 1.3 to 1.1

Time

State 2
Non-Sprouting Shrub State

Non-sprouting shrubs have increased to 60-80% canopy.

Community 2.1
Non-sprouting Shrub Community

Non sprouting shrubs have increased to 60-80% canopy. Cooler aspects are dominated by sotol and minor amounts of turbinella oak. Warmer aspects are dominated by prickly pear, ocotillo, agave, cat claw acacia, and minor amounts of wait a bit. Herbaceous species are less than 100 lbs/ac and are not well distributed on the site.

State 3
Sprouting Shrub State

Sprouting shrubs have increased to 60-80% canopy.

Community 3.1
Chaparral Community

Turbinella oak has increased to 60-80% canopy in the absence of fire for extended periods of time. Herbaceous species are less than 100 lbs/ac and are not well distributed on the site. A restoration pathway is unlikely from this state given the ability of turbinella oak to withstand substantial fire intensities (Pase 1965) and this species prolific root sprouting ability.

State 4
Juniper-Pinyon State

Juniper and/or Pinyon have increased to 40-50% canopy in the absence of fire for very long periods of time.

Community 4.1
Juniper-pinyon Community

Juniper and/or pinyon have increased to 40-50% canopy in the absence of fire for very long periods of time. The dominant juniper is one seed or redberry juniper. Herbaceous species are vigorous and evenly distributed in the interspaces of trees in areas where turbinella oak has not increased in the interspaces. These herbaceous species contribute to recovery of the site without the need for substantial inputs in the form of range planting. Turbinella oak has increased to 20-30% canopy in some areas where pinyon has increased to 40-50% canopy. Herbaceous species are less than 100 lbs/ac and not well distributed on the site. It is unknown if this community can return to the reference plant community. This would only be likely with range planting applied after wildfire.

Transition T1a

State 1 to 2

Non-sprouting shrubs such as sotol and prickly pear germinate. In the absence of fire for prolonged periods they will grow to maturity and eventually dominate the site.

Transition T1b
State 1 to 3

Sprouting shrubs, primarily turbinella oak that is the dominant shrub on other sites in this Land Resource Unit (16-20" precipitation zone), germinate. In the absence of fire for prolonged periods will grow to maturity and eventually dominate the site.

Transition T1c
State 1 to 4

Trees germinate and in the absence of fire for prolonged periods grow to maturity. High densities of perennial grasses can still occupy the interspaces of trees with tree canopy as high as 45-55%. Trees are of sufficient size that most practitioners are unlikely to apply prescribed fire.

Restoration pathway R2a
State 2 to 1

It is unknown if this restoration is possible. Chemical brush management is likely the only alternative to reduce shrub species given the rocky nature of these soils. Range planting would be necessary to restore the herbaceous community if brush management is effective. Range planting would have greater success in this Land Resource Unit due to the higher rainfall this site receives.

Restoration pathway R4a
State 4 to 1

Extreme wildfire is likely the only restoration pathway. Trees have reached such a large size that very high temperatures and wind speeds are needed to allow fires to burn through canopies and top kill non sprouting juniper or pinyon. Very costly mechanical brush management where soils have lower amount of cobbles or boulders and gentler slopes is possible followed by burning of tree skeletons. Perennial grass canopy in the interspaces of trees is > 50% in some areas with existing plants likely providing an adequate seed source for restoration following brush management or fires. Range planting should likely only be considered where perennial grass canopy in the interspaces of trees is less than 25%; however this threshold needs additional investigation.

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	**Dominant Warm Season Grasses**			90–488	
	sideoats grama	BOCU	*Bouteloua curtipendula*	56–224	–
	blue threeawn	ARPUN	*Aristida purpurea var. nealleyi*	6–112	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	17–95	–
	black grama	BOER4	*Bouteloua eriopoda*	11–56	–
2	**Cool Season Grasses**			0–50	
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	0–11	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–11	–

	needle and thread	HECO26	*Hesperostipa comata*	0–6	–
3	**Miscellaneous grasses**			6–168	
	bullgrass	MUEM	*Muhlenbergia emersleyi*	0–39	–
	Arizona threeawn	ARAR6	*Aristida arizonica*	0–17	–
	curly-mesquite	HIBE	*Hilaria belangeri*	6–17	–
	tanglehead	HECO10	*Heteropogon contortus*	0–11	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	1–11	–
	longtongue muhly	MULO	*Muhlenbergia longiligula*	0–11	–
	slim tridens	TRMU	*Tridens muticus*	0–11	–
	slim tridens	TRMUE	*Tridens muticus var. elongatus*	0–11	–
	green sprangletop	LEDU	*Leptochloa dubia*	1–11	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–6	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–6	–
	plains lovegrass	ERIN	*Eragrostis intermedia*	0–6	–
	hairy woollygrass	ERPI5	*Erioneuron pilosum*	0–6	–
	Arizona brome	BRAR4	*Bromus arizonicus*	0–1	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–1	–
	Hall's panicgrass	PAHA	*Panicum hallii*	0–1	–
	common wolfstail	LYPH	*Lycurus phleoides*	0–1	–
4	**Annual grasses**			0–39	
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–11	–
	witchgrass	PACA6	*Panicum capillare*	0–6	–
	Mexican panicgrass	PAHI5	*Panicum hirticaule*	0–6	–
	mucronate sprangeltop	LEPAB	*Leptochloa panicea ssp. brachiata*	0–6	–
	little barley	HOPU	*Hordeum pusillum*	0–2	–
	delicate muhly	MUFR	*Muhlenbergia fragilis*	0–1	–
Forb					
5	**Perennial Forbs**			11–140	
	variableleaf bushbean	MAGI2	*Macroptilium gibbosifolium*	0–45	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	6–22	–
	brownfoot	ACWR5	*Acourtia wrightii*	0–17	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–11	–
	perennial rockcress	ARPE2	*Arabis perennans*	1–11	–
	cliffbrake	PELLA	*Pellaea*	1–11	–
	trailing windmills	ALIN	*Allionia incarnata*	1–6	–
	wishbone-bush	MILAV	*Mirabilis laevis var. villosa*	0–2	–
	Colorado four o'clock	MIMU	*Mirabilis multiflora*	0–1	–
	brownplume wirelettuce	STPA4	*Stephanomeria pauciflora*	0–1	–
	jewels of Opar	TAPA2	*Talinum paniculatum*	0–1	–
	aster	ASTER	*Aster*	0–1	–
	mariposa lily	CALOC	*Calochortus*	0–1	–
	Indian paintbrush	CASTI2	*Castilleja*	0–1	–
	bastard toadflax	COUM	*Comandra umbellata*	0–1	–

	bluedicks	DICA14	*Dichelostemma capitatum*	0–1	–
	fleabane	ERIGE2	*Erigeron*	0–1	–
	desert trumpet	ERIN4	*Eriogonum inflatum*	0–1	–
	wild dwarf morning-glory	EVAR	*Evolvulus arizonicus*	0–1	–
	silver dwarf morning-glory	EVSE	*Evolvulus sericeus*	0–1	–
	dwarf Indian mallow	ABPA3	*Abutilon parvulum*	0–1	–
	southwestern mock vervain	GLGO	*Glandularia gooddingii*	0–1	–
	tufted globe amaranth	GOCA	*Gomphrena caespitosa*	0–1	–
	Gordon's bladderpod	LEGO	*Lesquerella gordonii*	0–1	–
	Chihuahuan flax	LIVE2	*Linum vernale*	0–1	–
6	**Annual Forbs**			0–56	
	spurge	EUPHO	*Euphorbia*	1–17	–
	longleaf false goldeneye	HELOA2	*Heliomeris longifolia var. annua*	0–11	–
	phacelia	PHACE	*Phacelia*	0–11	–
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	0–11	–
	desert Indianwheat	PLOV	*Plantago ovata*	0–6	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–6	–
	purslane	PORTU	*Portulaca*	0–1	–
	Thurber's pepperweed	LETH2	*Lepidium thurberi*	0–1	–
	Arizona lupine	LUAR4	*Lupinus arizonicus*	0–1	–
	pitseed goosefoot	CHBE4	*Chenopodium berlandieri*	0–1	–
	cryptantha	CRYPT	*Cryptantha*	0–1	–
	dodder	CUSCU	*Cuscuta*	0–1	–
	American wild carrot	DAPU3	*Daucus pusillus*	0–1	–
	flatcrown buckwheat	ERDE6	*Eriogonum deflexum*	0–1	–
	New Mexico copperleaf	ACNE	*Acalypha neomexicana*	0–1	–
Shrub/Vine					
7	**Evergreen shrubs**			11–163	
	Sonoran scrub oak	QUTU2	*Quercus turbinella*	11–106	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–17	–
	Palmer oak	QUPA10	*Quercus palmeri*	0–11	–
	redberry buckthorn	RHCR	*Rhamnus crocea*	0–9	–
	Mexican cliffrose	PUME	*Purshia mexicana*	0–6	–
	desert ceanothus	CEGR	*Ceanothus greggii*	0–6	–
	California buckthorn	FRCAU	*Frangula californica ssp. ursina*	0–2	–
	ashy silktassel	GAFL2	*Garrya flavescens*	0–2	–
	Wright's silktassel	GAWR3	*Garrya wrightii*	0–2	–
	red barberry	MAHA4	*Mahonia haematocarpa*	0–1	–
	Apache plume	FAPA	*Fallugia paradoxa*	0–1	–
8	**Large shrubs**			6–56	
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	6–28	–
	mariola	PAIN2	*Parthenium incanum*	0–11	–

	skunkbush sumac	RHTR	*Rhus trilobata*	0–7	–
	Wright's beebrush	ALWR	*Aloysia wrightii*	0–6	–
	stretchberry	FOPUP	*Forestiera pubescens var. pubescens*	0–2	–
	rockspirea	HODU	*Holodiscus dumosus*	0–1	–
	pale desert-thorn	LYPA	*Lycium pallidum*	0–1	–
	Coulter's brickellbush	BRCO	*Brickellia coulteri*	0–1	–
	Torrey's jointfir	EPTO	*Ephedra torreyana*	0–1	–
9	**Half shrubs**			62–213	
	fairyduster	CAER	*Calliandra eriophylla*	28–112	–
	featherplume	DAFO	*Dalea formosa*	34–45	–
	littleleaf ratany	KRER	*Krameria erecta*	0–28	–
	bastardsage	ERWR	*Eriogonum wrightii*	1–22	–
	rough menodora	MESC	*Menodora scabra*	0–6	–
	yerba de pasmo	BAPT	*Baccharis pteronioides*	0–2	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–1	–
10	**Succulents**			90–426	
	common sotol	DAWH2	*Dasylirion wheeleri*	56–135	–
	sacahuista	NOMI	*Nolina microcarpa*	0–135	–
	Schott's century plant	AGSC3	*Agave schottii*	11–67	–
	banana yucca	YUBA	*Yucca baccata*	22–56	–
	cactus apple	OPEN3	*Opuntia engelmannii*	1–11	–
	ocotillo	FOSP2	*Fouquieria splendens*	0–11	–
	tulip pricklypear	OPPH	*Opuntia phaeacantha*	0–6	–
	Arizona hedgehog cactus	ECCOA	*Echinocereus coccineus var. arizonicus*	0–1	–
	Engelmann's hedgehog cactus	ECEN	*Echinocereus engelmannii*	0–1	–
	candy barrelcactus	FEWI	*Ferocactus wislizeni*	0–1	–
	crucifixion thorn	CAHO3	*Canotia holacantha*	0–1	–
	Christmas cactus	CYLE8	*Cylindropuntia leptocaulis*	0–1	–
	walkingstick cactus	CYSP8	*Cylindropuntia spinosior*	0–1	–
	Whipple cholla	CYWH	*Cylindropuntia whipplei*	0–1	–
	goldenflower century plant	AGCH2	*Agave chrysantha*	0–1	–
	Parry's agave	AGPA4	*Agave parryi*	0–1	–
11	**Increaser half-shrubs**			6–22	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–22	–
	turpentine bush	ERLA12	*Ericameria laricifolia*	0–1	–
Tree					
12	**Trees**			11–135	
	redberry juniper	JUCO11	*Juniperus coahuilensis*	11–56	–
	oneseed juniper	JUMO	*Juniperus monosperma*	11–56	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	0–56	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–28	–
	alligator juniper	JUDE2	*Juniperus deppeana*	0–22	–

Contributors

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Approval

Scott Woodall, 9/05/2019

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	
Approved by	
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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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

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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:**
