USDA Natural Resources
Conservation Service

Ecological site R038XB230AZ
Limy Hills 16-20" p.z.

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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): 038X–Mogollon Transition South

AZ 38.2 - Middle Mogollon Transition

Elevations range from 4000 to 5500 feet and precipitation averages 16 to 20 inches per year. Vegetation includes turbinella oak, Wright silktassel, hollyleaf buckthorn, desert buckbrush, one-seed juniper, alligator juniper, pinyon, algerita, sugar sumac, prairie junegrass, blue grama, curly mesquite, bottlebrush squirreltail, muttongrass, cane beardgrass, plains lovegrass and bullgrass. The soil temperature regime ranges from thermic to mesic and the soil moisture regime is aridic ustic. This unit 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.

Associated sites

R038XB203AZ	**Clay Loam Upland 16-20" p.z.** Clayloam Upland 16-20" p.z. ecological site is a non calcareous (limy) soil on slopes less than 15% and dominated by sideoats grama with tobosa grass making up 10-15% of annual production in the reference state. Where it has been subject to continuous heavy herbivory sideoats grama has typically been replaced by blue grama and significant amounts of tobosa remain in the plant community.

R038XB209AZ	**Loamy Upland 16-20" p.z.** Loamy Upland 16-20" p.z. ecological site is a non calcareous (limy) soil on slopes less than 15%, is dominated by sideoats grama in the reference state, and most commonly found dominated by blue grama in MLRA 38 where it has been subject to continuous heavy herbivory.
R038XB202AZ	**Clayey Upland 16-20" p.z.** Clayey Upland 16-20" p.z. ecological site is a non calcareous (limy) soil on slopes less than 15% and dominated by tobosa grass in the reference state and most areas of MLRA 38. Where it has been subject to continuous heavy herbivory significant amounts of tobosa remain and tumble mustard most commonly occupies the interspaces between grass plants.
R038XB215AZ	**Clayey Hills 16-20" p.z.** Clayey Hills 16-20" p.z. ecological site is a non calcareous (limy) soil shallow to basalt or andesite and differentiated by reddish brown soil surfaces and less amounts of black grama.

Similar sites

R038XB205AZ	**Limestone Hills 16-20" p.z.** Limestone Hills 16-20" p.z. ecological site is shallow to limestone bedrock on similar slopes but has a much higher diversity of shrubs.

Table 1. Dominant plant species

Tree	(1) *Juniperus coahuilensis*
Shrub	(1) *Nolina microcarpa*
Herbaceous	(1) *Bouteloua eriopoda* (2) *Bouteloua curtipendula*

Physiographic features

This site occurs in the middle to upper elevations of the Mogollon Transition zone, south of the Mogollon Rim in central Arizona. It occurs on rugged mountain slopes, ridge-tops and mesa sides. The Ecological Site Information System only allows for populating 3 aspects in the format below however the site appears on all aspects and is not restricted to those specified below.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain slope (3) Ridge
Flooding frequency	None
Ponding frequency	None

Elevation	1,219–1,768 m
Slope	15–50%
Aspect	N, S, W

Climatic features

Precipitation in this common resource area averages 16 to 20 inches annually. The winter-summer rainfall ratio ranges from about 60/40% in the western part of the area to 45/55% in the eastern part. Summer rains fall July through September; and 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 5 to 35 inches per year and can occur from November through April. Snow seldom persists for more than a week. May and June are the driest months of the year. Humidity is moderate to low all year. Average annual air temperatures range from 51 to 60 degrees F (thermic temperature regime). Daytime temperatures in the summer are commonly in the low 90's. Freezing temperatures are common from October through April. 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)	180 days
Freeze-free period (average)	240 days
Precipitation total (average)	508 mm

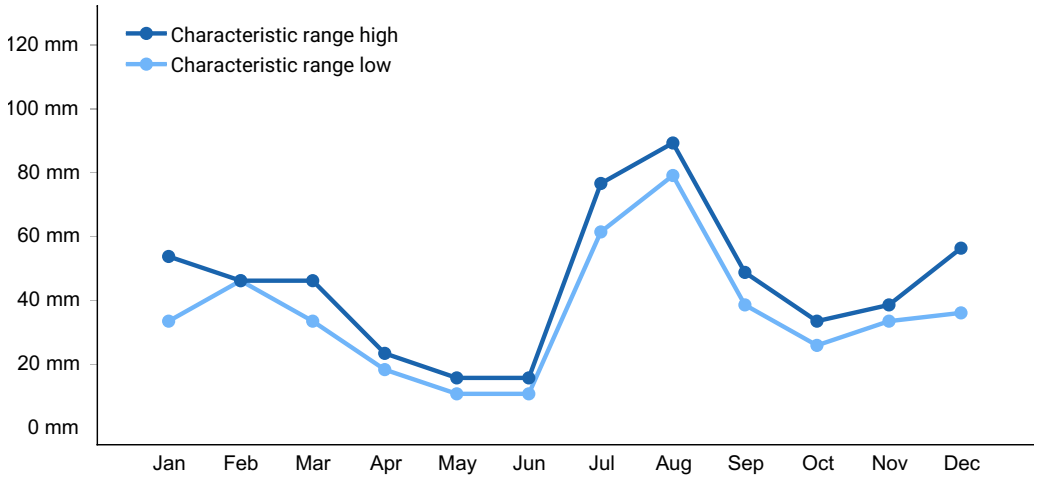


Figure 1. Monthly precipitation range

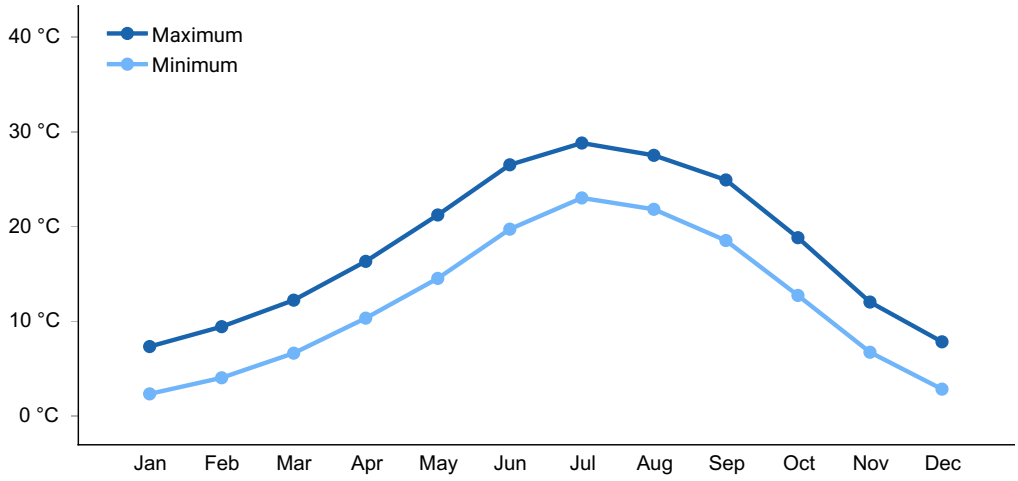


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

There are no water features influencing this site.

Soil features

Soil series mapped under this site include: SSA675 San Carlos IR area MU 22 Hathaway family.

Table 4. Representative soil features

Parent material	(1) Alluvium–calcareous conglomerate (2) Residuum–calcareous sandstone
Surface texture	(1) Gravelly loam (2) Very gravelly sandy loam (3) Extremely gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Soil depth	51–89 cm
Surface fragment cover <=3"	20–55%
Surface fragment cover >3"	0–25%
Available water capacity (0-101.6cm)	4.83–7.37 cm
Calcium carbonate equivalent (0-101.6cm)	10–30%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm

Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	10–30%
Subsurface fragment volume >3" (Depth not specified)	0–30%

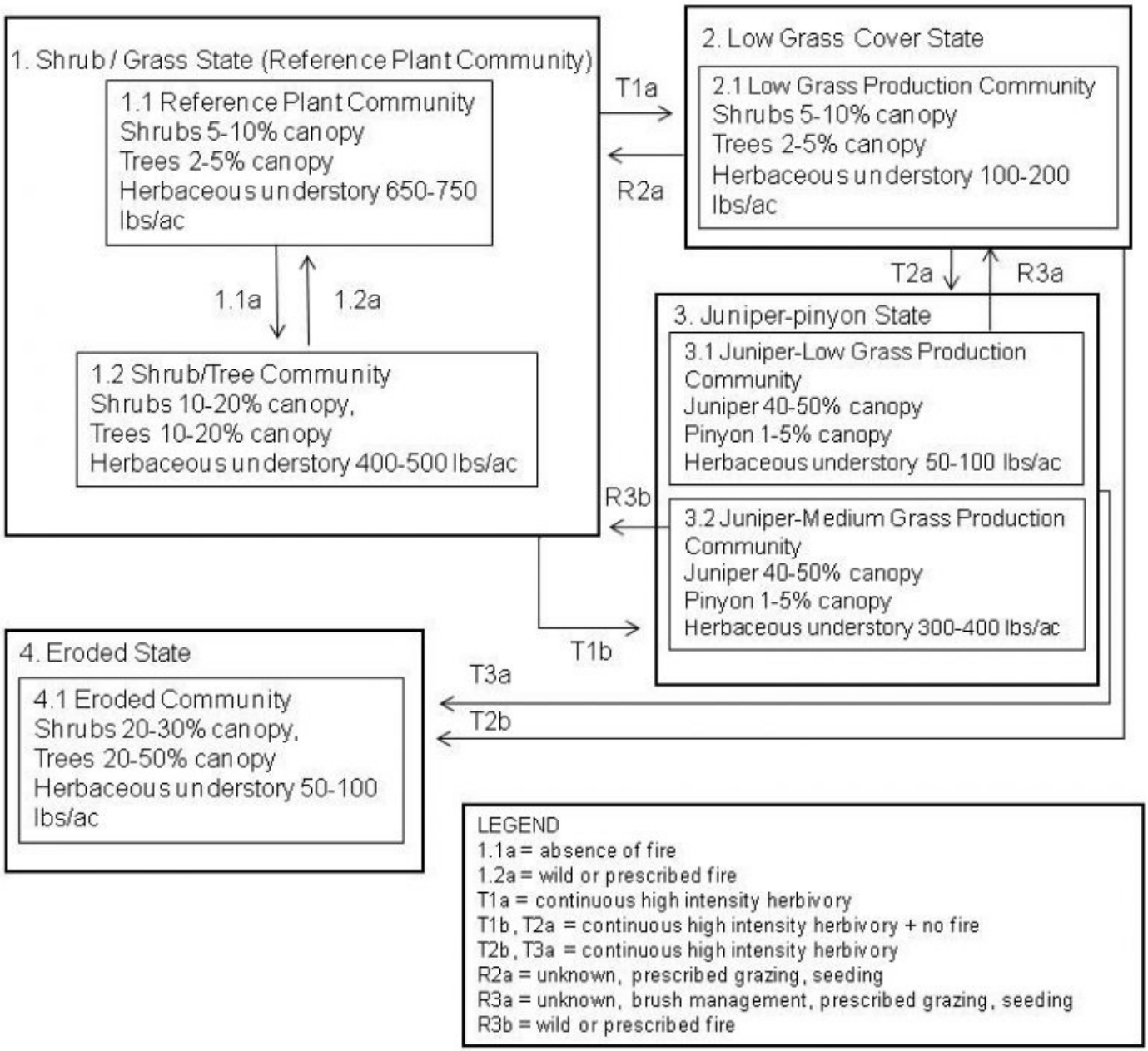
Ecological dynamics

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 grazing, 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



State 1
Shrub/ Grass State

Two dominant communities cycle in this state with fire or absence of fire being the main driver between communities. One seed or red berry juniper is the dominant tree; Bear grass, mint bush lippia, and Stansbury cliffrose are the dominant shrubs; black grama and sideoats grama are the dominant grass species. Wildfire is a natural component in this plant community. Black grama populations have variable responses to fire. It has poor seed viability and regenerates primarily by vegetative stolons. The US Forest Service Fire Effects Information System summarizes research on black grama by Allen (1996, 1998), Cable (1965), Gosz (1996), and Humprey (1950), acknowledging the susceptibility of black grama to fire but also the good post fire recovery if the stand is healthy before fire and there is adequate precipitation the 2 years following fire. Black grama populations

have persisted where they have experienced periodic fire in the northern part of White Sands Missile Range where herbivory is very light (Dave Anderson, personal communication 1998). Minimal to moderate herbivory maintaining high plant vigor is likely highly important in black grama's response to fire. Fire return intervals have not been studied in detail on this ecological site but are likely similar or possibly slightly longer to that suggested by Robinett (2005) on adjacent Volcanic derived soils that support a mixed grass/shrub-tree plant community with return intervals ranging from 10-15 years. This assumption is based on a slightly longer recovery due to vegetative reproduction but the nearly continuous perennial grass herbaceous understory that can develop in a 15-20 year period that is very conducive to fire spread.

Community 1.1
Reference Plant Community

This plant community has a shrub/tree savanna appearance. Herbaceous understory species production ranges from 650-750 lbs per acre, tree canopy is 2-5%, and shrub canopy is 5-10%. Note the very old 2' DRC juniper that has been killed by fire in the representative photo of this community. There are approximately 5-10 of these old trees per acre in the reference plant community. These very large trees are also observed in the juniper invaded state in addition to recent smaller diameter trees. The presence of these large trees suggests that this plant community was historically a savanna and not pure grassland.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	729	897
Shrub/Vine	78	112	168
Forb	11	62	168
Tree	56	67	101
Total	**593**	**970**	**1334**

Table 6. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	4-8%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0%
Litter	30-50%
Surface fragments >0.25" and <=3"	20-30%
Surface fragments >3"	10-15%
Bedrock	0%
Water	0%
Bare ground	15-30%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	2-5%	–
>0.15 <= 0.3	–	–	30-35%	2-5%
>0.3 <= 0.6	–	–	15-20%	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	5-10%	–	–
>4 <= 12	10-15%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

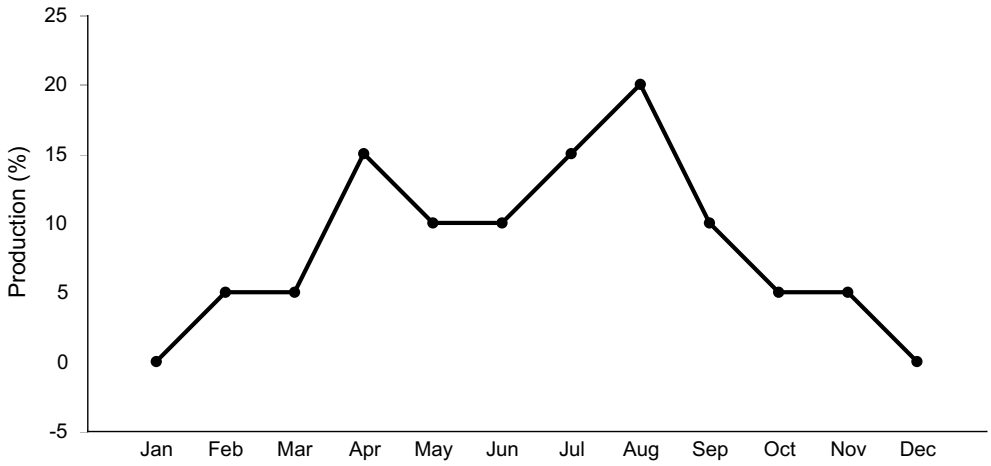


Figure 4. Plant community growth curve (percent production by month). AZ3812, 38.2 16-20" p.z. all sites. Growth begins in the spring and continues into the summer and fall..

Community 1.2
Shrub/Tree Community

Trees and Shrubs have increased in this community but perennial grass production is still adequate and continuity high enough to carry fires between trees and shrubs. Herbaceous production is approximately 400-500 lbs/ac and 2 year old biomass within the canopy of perennial grass plants is nearly 300 lbs/ac, for total herbaceous biomass of 700-800 lbs per acre. This approaches the minimum herbaceous fuel load of 800 lbs/ac that the Clifton Ranger District Fire Management Program uses to carry fire when burning the alligator juniper plant communities found in the Land Resource Unit at elevations above this plant community.

State 2
Low Grass Cover State

Herbaceous production is reduced to approximately 100-200 lbs/ac. Tree canopy is

approximately 2-5% and shrub canopy is approximately 5-10%, levels similar to the reference plant community.

Community 2.1
Low Grass Production Community

This plant community is observed in areas at close distances to livestock water where there has been continuous heavy livestock herbivory. Rill erosion may or may not be present on the site however the site is very susceptible to rill formation at this stage.

State 3
Juniper-Pinyon State

Juniper has increased in the absence of fire to 40-50% canopy. Pinyon is less prevalent with 1-5% canopy. Two major communities occur in this state that have different amounts of herbaceous production.

Community 3.1
Juniper Low Grass Production Community

Juniper has increased in the absence of fire to 40-50% canopy. Pinyon is less prevalent with 1-5% canopy. Herbaceous production is approximately 50-100 lbs/ac.

Community 3.2
Juniper Medium Grass Production Community

Juniper has increased in the absence of fire to 40-50% canopy. Pinyon is less prevalent with 1-5% canopy. Herbaceous production is approximately 300-400 lbs/ac.

State 4
Eroded State

Rill erosion has progressed into gully erosion.

Community 4.1
Eroded Community

This community can occur at a couple of locations on the landscape. The community is observed at close distances to water where continuous heavy livestock herbivory has reduced herbaceous plant vigor and production which has predisposed the site to severe rill erosion that has progressed into gully erosion. The community can also occur naturally on the landscape in tributaries to steep canyons such as Bonita Creek in Graham County.

This occurs where tributaries into a canyon system are trying to reach the base level of the canyon and steep topography exceeds natural soil stability.

Transition T1a
State 1 to 2

Continuous high intensity herbivory, generally at close distances to water, reduces the vigor of perennial grass species. Plant densities are usually less than 1 plant per square yard.

Transition T1b
State 1 to 3

Juniper plants germinate and grow to maturity in the absence of fire. The dominant perennial grass plants maintain themselves at densities of 4-7 plants per square yard despite the presence of high juniper canopy cover.

Restoration pathway R2a
State 2 to 1

The ability to achieve this restoration pathway is uncertain. The application of prescribed grazing and seeding of sideoats grama is the only likely restoration. This is due to black grama’s poor seed viability and the long time periods it would take for vegetative recovery of the site by this species.

Transition T2a
State 2 to 3

Juniper plants germinate and grow to maturity in the absence of fire. Rill erosion has not become severe on the site and perennial grass plants maintain themselves at low densities in the presence of high juniper canopy cover.

Transition T2b
State 2 to 4

Continuous heavy livestock herbivory further deduces the vigor of the dominant grass species and high intensity rains result in severe rill formation or existing rills developing into gullies.

Restoration pathway R3b
State 3 to 1

The ability to achieve this restoration pathway is uncertain. Herbaceous plants are present in relatively high amounts (4-7 per square yard) that make re-colonization of the site more

favorable. Prescribed fire should only be applied after an average to above average summer monsoon season followed by average to above average winter/spring precipitation. The average to above average winter moisture is highly critical to ensure root systems of black grama are well hydrated and have the best possible chance of surviving fire.

Restoration pathway R3a
State 3 to 2

The ability to achieve this restoration pathway is uncertain. The application of prescribed grazing and seeding of sideoats grama is the only likely restoration for the herbaceous component of the community. This is due to black grama's poor seed viability and the long time periods it would take for vegetative recovery of the site by this species. Brush management by hand sawing of juniper species is the only practical alternative for reducing juniper dominance. These soils are highly susceptible to erosion even when disturbed by light equipment. Shearing with bobcat type loaders should not be attempted even on lower slope areas.

Transition T3a
State 3 to 4

Continuous heavy livestock herbivory further deduces the vigor of the dominant grass species and high intensity rains result in severe rill formation or existing rills developing into gullies.

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	**Dominant Perennial Grasses**			359–639	
	black grama	BOER4	*Bouteloua eriopoda*	224–448	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	56–112	–
	blue threeawn	ARPUN	*Aristida purpurea var. nealleyi*	11–56	–
2	**Cool Season Grasses**			19–112	
	New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	11–73	–
	needle and thread	HECO26	*Hesperostipa comata*	6–28	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–6	–
	squirreltail	ELEL5	*Elymus elymoides*	2–6	–

3	**Miscellaneous Perennial Grasses**			11–112	
	purple threeawn	ARPU9	*Aristida purpurea*	2–17	–
	spidergrass	ARTE3	*Aristida ternipes*	6–17	–
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	6–17	–
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	0–17	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–11	–
	curly-mesquite	HIBE	*Hilaria belangeri*	6–11	–
	low woollygrass	DAPU7	*Dasyochloa pulchella*	2–6	–
4	**Annual Grasses**			0–112	
	sixweeks threeawn	ARAD	*Aristida adscensionis*	0–28	–
	witchgrass	PACA6	*Panicum capillare*	0–28	–
	small fescue	VUMI	*Vulpia microstachys*	0–11	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–11	–
	prairie threeawn	AROL	*Aristida oligantha*	0–11	–
	needle grama	BOAR	*Bouteloua aristidoides*	0–11	–
	mucronate sprangeltop	LEPAB	*Leptochloa panicea ssp. brachiata*	0–6	–
	Mexican sprangletop	LEFUU	*Leptochloa fusca ssp. uninervia*	0–1	–
6	**Annual Forbs**			0–157	
	lambsquarters	CHAL7	*Chenopodium album*	6–28	–
	California poppy	ESCAM	*Eschscholzia californica ssp. mexicana*	6–28	–
	longleaf false goldeneye	HELOA2	*Heliomeris longifolia var. annua*	6–17	–
	Coulter's lupine	LUSP2	*Lupinus sparsiflorus*	2–17	–
	western tansymustard	DEPI	*Descurainia pinnata*	6–11	–
	miniature woollystar	ERDI2	*Eriastrum diffusum*	0–11	–
	bristly fiddleneck	AMTE3	*Amsinckia tessellata*	2–11	–
	spreading fleabane	ERDI4	*Erigeron divergens*	0–6	–
	Gordon's bladderpod	LEGO	*Lesquerella gordonii*	0–6	–
	shaggyfruit pepperweed	LELA	*Lepidium lasiocarpum*	1–6	–
	desert Indianwheat	PLOV	*Plantago ovata*	1–6	–
	Coulter's spiderling	BOCO2	*Boerhavia coulteri*	2–6	–

	spreading fanpetals	SIAB	*Sida abutifolia*	0–1	–
	green carpetweed	MOVE	*Mollugo verticillata*	0–1	–
	Arizona popcornflower	PLAR	*Plagiobothrys arizonicus*	0–1	–
	Arizona lupine	LUAR4	*Lupinus arizonicus*	0–1	–
	miniature lupine	LUBI	*Lupinus bicolor*	0–1	–
	milkvetch	ASTRA	*Astragalus*	0–1	–
Forb					
5	**Perennial Forbs**			11–56	
	trailing windmills	ALIN	*Allionia incarnata*	11–22	–
	desert globemallow	SPAM2	*Sphaeralcea ambigua*	1–6	–
	weakleaf bur ragweed	AMCO3	*Ambrosia confertiflora*	1–6	–
	plains blackfoot	MELE2	*Melampodium leucanthum*	1–2	–
	brownfoot	ACWR5	*Acourtia wrightii*	0–1	–
	largeflower onion	ALMA4	*Allium macropetalum*	0–1	–
	tuber anemone	ANTU	*Anemone tuberosa*	0–1	–
	perennial rockcress	ARPE2	*Arabis perennans*	0–1	–
	scarlet spiderling	BOCO	*Boerhavia coccinea*	0–1	–
	sego lily	CANU3	*Calochortus nuttallii*	0–1	–
	Cooley's bundleflower	DECO2	*Desmanthus cooleyi*	0–1	–
	desert larkspur	DEPA	*Delphinium parishii*	0–1	–
	bluedicks	DICA14	*Dichelostemma capitatum*	0–1	–
	spurge	EUPHO	*Euphorbia*	0–1	–
Shrub/Vine					
7	**Dominant Shrubs**			45–90	
	common sotol	DAWH2	*Dasylirion wheeleri*	22–45	–
	sacahuista	NOMI	*Nolina microcarpa*	22–45	–
8	**Miscellaneous shrubs**			11–39	
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	6–11	–
	Sonoran scrub oak	QUTU2	*Quercus turbinella*	6–11	–
	skunkbush sumac	RHTR	*Rhus trilobata*	1–6	–

	Stansbury cliffrose	PUST	*Purshia stansburiana*	1–6	–
	Wright's beebrush	ALWR	*Aloysia wrightii*	2–6	–
9	**Half shrub**			6–11	
	featherplume	DAFO	*Dalea formosa*	3–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	2–6	–
10	**Succulents**			28–45	
	banana yucca	YUBA	*Yucca baccata*	22–34	–
	cactus apple	OPEN3	*Opuntia engelmannii*	6–11	–
	walkingstick cactus	CYSP8	*Cylindropuntia spinosior*	0–1	–
	Engelmann's hedgehog cactus	ECEN	*Echinocereus engelmannii*	0–1	–
Tree					
11	**Trees**			39–73	
	redberry juniper	JUCO11	*Juniperus coahuilensis*	22–34	–
	oneseed juniper	JUMO	*Juniperus monosperma*	22–34	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	11–22	–
	honey mesquite	PRGL2	*Prosopis glandulosa*	6–17	–

Animal community

The plant community on this site is suitable for grazing by all classes of livestock at any season. High soil pH can limit the availability of some essential plant nutrients reducing forage quality especially compared to adjacent non-limy sites. Steep slopes limit grazing distribution on this site. Fencing large areas of this site separately from non-limy hills and uplands will allow effective management of the forage resource it produces.

This site is very dry and water development is critical to improving use of the site. Canyons at the bottom of this site tend to be deep sandy alluvium and dry even in winter due to the extreme porosity of this material.

This site provides fair habitat for both whitetail and mule deer. It does not produce large amounts of palatable evergreen browse species like associated volcanic soils.

Hydrological functions

These soils are very coarse textured and are poor producers of runoff.

Recreational uses

Hunting, hiking, horseback riding, photography, camping and picnicking

Wood products

Very limited fuel-wood for campfires and branding fires.

Other products

There is limited harvest of fibers from beargrass, banana yucca and skunkbush sumac.

Inventory data references

200 frames dry weight rank/comparative yield for herbaceous species at reference location. 2/10 acre belt transect for woody species in proximity to herbaceous sampling.

Type locality

Location 1: Graham County, AZ	
General legal description	Bonita Creek watershed of San Carlos Apache Reservation

Other references

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for Major Land Resource Area 38-Mogollon Transition, Land Resource Unit 38-2.

Contributors

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Approval

Scott Woodall, 5/07/2020

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.

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Contact for lead author	USDA NRCS Tucson Area Office
Date	07/21/2011
Approved by	Scott Woodall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** No rills present on the site. Black grama and sideoats grama plants have densities of 5-10 plants per square yard, higher densities for younger plants.

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2. **Presence of water flow patterns:** Water flow paths are difficult to observe and highly sinuous. Water flows less than 1 foot before being intercepted by an adjacent plant with high litter cover between plants.

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3. **Number and height of erosional pedestals or terracettes:** No pedestals or terracettes present on the site. High density of black or sideoats grama provides very high protection of site and not conducive to terracette formation despite black grama's clonal nature that would normally contribute to terracette formation on sites with lower perennial grass densities.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 15-30%

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5. **Number of gullies and erosion associated with gullies:** None present on the site. When the site is neat deep canyon systems gullies are to be expected however these are generally of geologic age and not highly active with sloping versus vertical sides of the gullies.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None present on the site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter generally travels less than 1-1.5 foot before encountering adjacent plant bases. Woody litter stays in place.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Expect soil stability values of 4-6 across most of the site.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface is approximately 2" thick, fine to medium granular, and color is 7.5YR 4/2 dry and 7.5YR 3/2 moist.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Very high densities of perennial grasses are well distributed on the site and contribute to high infiltration. Densities of perennial grass plants range from 4-7 per square yard; higher densities for smaller/younger plants.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None present on the site. High amounts of gravel or cobble make use of penetrometer impractical. Soils typically do not have an argillic horizon that could be mistaken for a compaction layer.

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: Perennial grass

    Sub-dominant: trees > shrubs = succulents

    Other: perennial forbs = annual forb = annual grass in normal year, In El Nino Years annual forbs and grasses > trees

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** 10-15% canopy mortality of trees and shrubs, < 5% mortality of dominant perennial grasses

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):** 530 lbs/ac in below average rainfall year, 865 lbs/ac in normal year, 1190 lbs/ac in above average year.

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: Non-native annual grasses like red brome and cheatgrass can invade and dominate areas of the site with very low perennial grass cover. Juniper is the most common woody species to increase however prickly pear can also increase on the site

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17. **Perennial plant reproductive capability:** Not affected despite several drought years in the region.
