USDA Natural Resources
Conservation Service

Ecological site R038XC316AZ
Clayey Slopes 20-24"

Last updated: 5/07/2020
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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 38.3 – Upper Mogollon Transition

Elevations range from 5100-7000 feet and precipitation averages 20 to 27 inches per year. Vegetation includes Gambel oak, Arizona white oak, Emory oak, pinyon, alligator juniper, one seed juniper, Arizona cypress, ponderosa pine, shrubby buckwheat, sacahuista, skunkbush sumac, Wright silktassle, blue grama, sideoats grama, muttongrass, western wheatgrass, and bottlebrush squirreltail. The soil temperature regime is mesic and the soil moisture regime is typic 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

R038XC303AZ	**Clay Loam Upland 20-24" p.z.** Clayloam Upland in LRU 38-3 is likely a slightly more mesic site and tends to be less prone to invasion by manzanita and other shrubs. Clayloam upland tends to have minimal to no oaks on the site.
R038XC317AZ	**Volcanic Hills 20-24"** Volcanic Hills in LRU 38-3 has shallow soil to bedrock and has slightly less herbaceous production and greater amounts of shrub and tree production than the Clayey Slopes site.
R038XB205AZ	**Limestone Hills 16-20" p.z.** Limestone Hills in LRU 38-2 is at the lower elevations of this site. Turbinella oak will increase in abundance and alligator juniper will decrease in abundance in 38-2.

Table 1. Dominant plant species

Tree	(1) *Juniperus deppeana* (2) *Quercus grisea*
Shrub	(1) *Arctostaphylos pungens*
Herbaceous	(1) *Bouteloua curtipendula*

Physiographic features

Goldust soils are on slopes, hills, or escarpments at elevations of 5,000 to 6,500 feet. Slopes are 15 to 50 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Hill (3) Escarpment
Flooding frequency	None
Ponding frequency	None
Elevation	1,524–1,981 m
Slope	15–50%
Aspect	N, E, S

Climatic features

Precipitation in this common resource area averages approximately 20 to 24 inches annually. Precipitation is lower and temperatures are cooler in the eastern part of the MLRA. 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 10 to 18 inches per year and can occur from November through April. May and June are the driest months of the year. Humidity is generally low all year.

Average annual air temperatures range from 50 to 57 degrees F (mesic temperature regime). Daytime temps in the summer are commonly in the mid 80's in the eastern portion of the MLRA and the low to mid 90's in the western portion. Freezing temperatures are common from October through April. The actual precipitation, available moisture and temperature varies, depending on, region, elevation, rain shadow effect and aspect.

Table 3. Representative climatic features

Frost-free period (average)	167 days
Freeze-free period (average)	188 days
Precipitation total (average)	610 mm

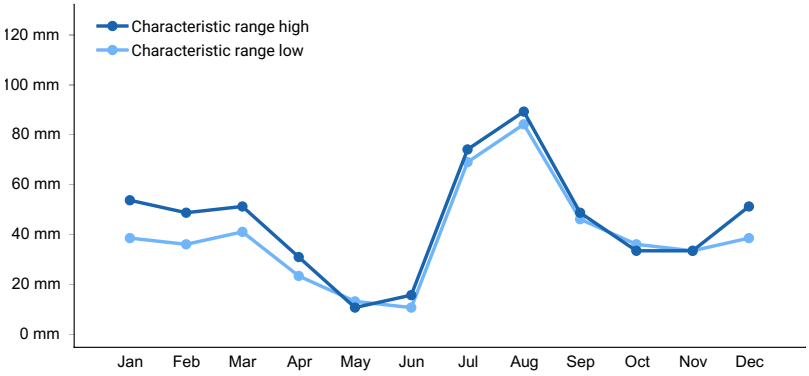


Figure 1. Monthly precipitation range

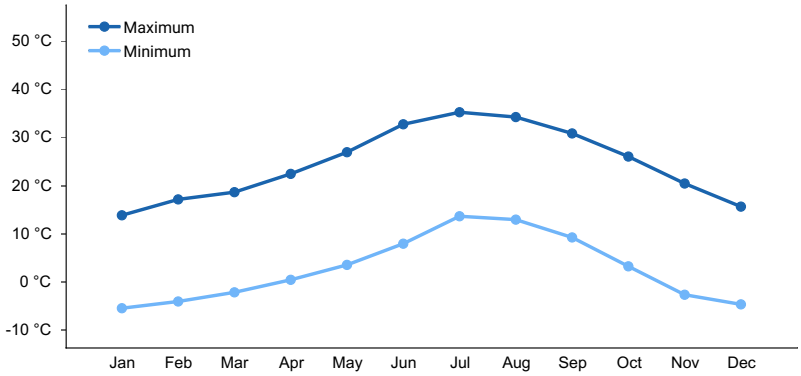


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

Soil features

The Goldust series consists of very deep, well drained, slowly permeable soils that formed in mixed alluvium and colluvium derived dominantly from sedimentary and igneous rocks.

Soils mapped on this site include: from SSA-675 San Carlos IR Area - MU Goldust-39.

Table 4. Representative soil features

Parent material	(1) Alluvium–quartzite (2) Colluvium–diabase
Surface texture	(1) Extremely cobbly clay loam (2) Very cobbly loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Moderately slow to slow
Soil depth	102–152 cm
Surface fragment cover <=3"	10–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	9.4–15.75 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	25–45%
Subsurface fragment volume >3" (Depth not specified)	10–15%

Ecological dynamics

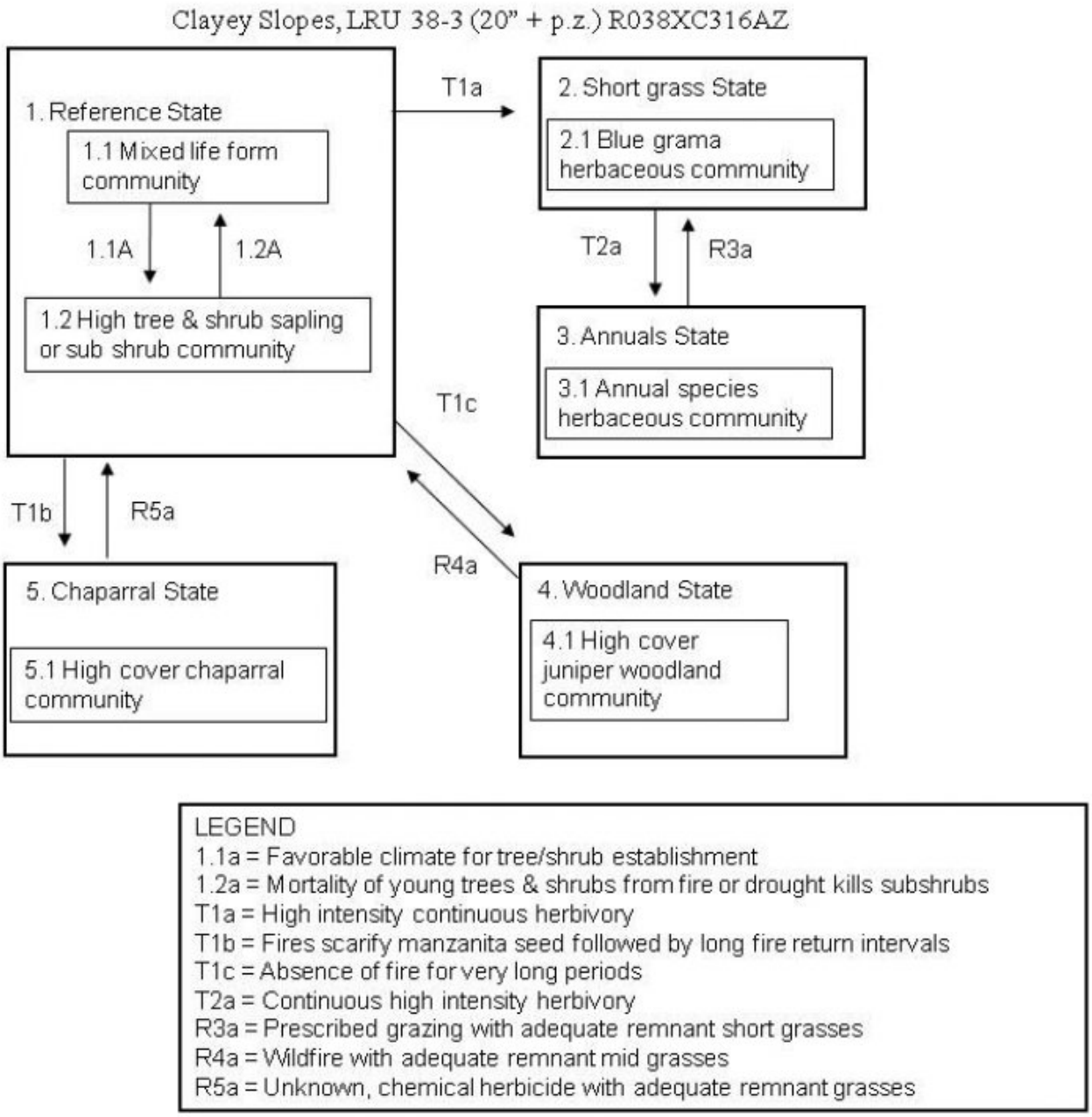
The Reference Plant Community is a mixed savanna with trees approximately twice that of shrubs and lesser amounts of succulents and forbs. Alligator juniper is the primary juniper species. Oneseed or redberry juniper can

be the dominant juniper on warmer aspects at the lower elevations near the Land Resource Unit boundary.

All exposures are a mixed tree and shrub savanna community. The plant community includes a flora of native annual grasses and forbs. Periodic wildfires occurred at moderate intervals (10 to 15 years) and helped maintain a balance between herbaceous plants and trees and shrubs. In the absence of fire for longer periods, shrubby species and trees can become dominant. The interactions of drought, fire and continuous livestock grazing can, over time, result in the loss of palatable perennial grasses and half shrubs.

In some areas, young (< 8-10" DRC) alligator juniper trees have experienced mortality at the lower elevations and/or warmer aspects of the site. These trees likely established in a wetter period at the lower elevational range of the species and have died in the recent drought.

State and transition model



State 1
Reference State

Grass, shrubs, and trees are all represented in the plant community.

Community 1.1
Mixed life form community

Midgrasses are the dominant herbaceous species. Mature alligator juniper and grey oak trees > 18-48" Diameter at Root Collar (DRC) are present at 10-20 per acre. Manzanita is the dominant shrub with 1-5% canopy. Mexican cliffrose is abundant in some locations and has experienced high mortality on warm aspects. Warm aspects can be dominated by one seed or redberry juniper. Fire return intervals were likely similar to the adjacent alligator juniper savanna and ponderosa pine forest communities. This site has a predisposition to invasion by juniper, oak, and manzanita in the absence of fire for long periods. Despite manzanita being dependent on fire for germination (Pase and Brown, 1982), fires were likely frequent enough to maintain a savanna aspect and low levels of manzanita on this site. Pase and Granfelt (1977) suggest frequent burning before manzanita becomes sexually mature as a strategy to maintain low amounts of the species in the dense chaparral communities in Land Resource Unit (LRU) 38-2 at the elevations below this site. However, they acknowledge in the absence of fine fuels in the true chaparral communities it is difficult or impossible for the communities to support frequent fire due to the slow rate the woody species accumulate litter, dead stems, and other woody fuels needed to carry fire. Unlike the true chaparral communities at elevations below this ecological site the maintenance of low amounts of manzanita is possible on this site given the sites greater perennial grass production potential and the ability this herbaceous production confers to supporting frequent fires.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	785	1233	1793
Tree	448	673	785
Shrub/Vine	258	280	303
Forb	11	56	112
Total	**1502**	**2242**	**2993**

Table 6. Soil surface cover

Tree basal cover	1-2%
Shrub/vine/liana basal cover	1-2%
Grass/grasslike basal cover	6-10%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-70%
Surface fragments >0.25" and <=3"	10-20%
Surface fragments >3"	10-15%

Bedrock	0%
Water	0%
Bare ground	2-5%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	5-10%	–
>0.15 <= 0.3	–	–	–	1-2%
>0.3 <= 0.6	–	–	15-25%	–
>0.6 <= 1.4	–	–	5-15%	–
>1.4 <= 4	–	2-5%	–	–
>4 <= 12	10-15%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

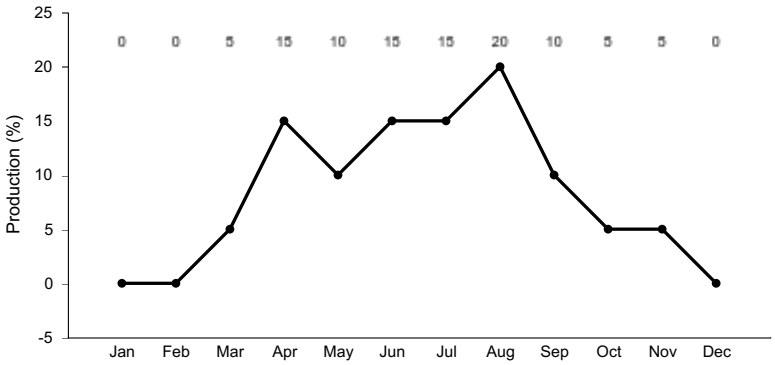


Figure 4. Plant community growth curve (percent production by month). AZ3813, 38.3 20-24"p.z. all sites. Growth begins in the spring and continues into the summer and fall..

State 2
Short grass State

Blue grama is the dominant herbaceous plant in the plant community.

Community 2.1
Blue grama herbaceous community

Continuous heavy herbivory reduces the vigor and subsequently the dominance of sideoats grama. Blue grama or hairy grama and curly mesquite on warmer slopes become the dominant grass. Trees and shrubs are represented as in the Reference Plant Community. Herbivory can be from cattle or elk or unmanaged grazing by horses.

State 3
Annuals State

Basal area of short grasses is significantly reduced and annuals become dominant.

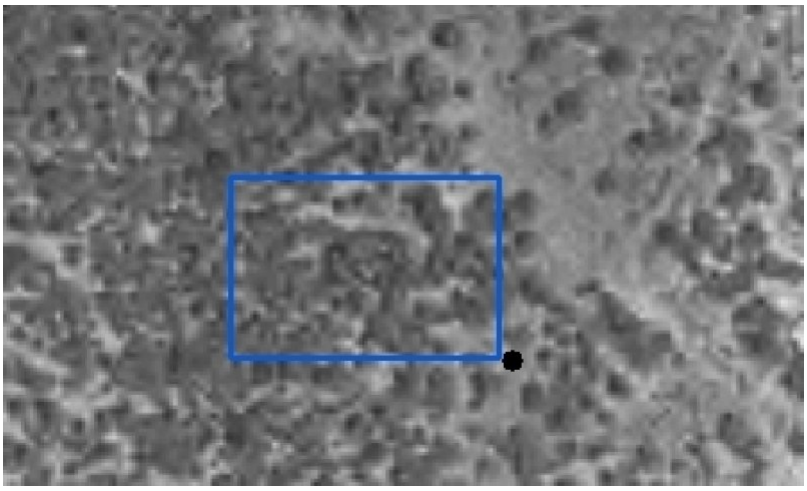
Community 3.1
Annual species herbaceous community

Short grass vigor and abundance is decreased in the presence of continuous herbivory and annuals become the dominant herbaceous species. Trees and shrubs are represented as in the Reference Plant Community. Herbivory can be from cattle or elk or unmanaged grazing by horses.

State 4
Woodland State

Tree regeneration increases in size and trees dominate the site.

Community 4.1
High cover juniper woodland community



Mature alligator juniper and grey oak trees > 18-48" Diameter at Root Collar (DRC) are present at 10-20 per acre and pinyon pine > 12-16" DBH are present at 1-5 per acre. Juniper and oak have germinated and reached 10-15 feet in height and mostly < 12" DRC in the absence of fire and occupy a majority of the interspaces of very old parent trees. Perennial grass densities in the tree interspaces can occur at densities of 10-15 plants per square yard and provide an adequate seed source if extreme wild fires burn the area or brush management is applied on less sloping areas. These grass densities have been observed on areas that have had minimal herbivory where tree and shrub canopy is 70-80%. Warm aspects can be dominated by one seed or redberry juniper. Warm aspects can be dominated by oneseed or redberry juniper instead of alligator juniper. In some areas, young (< 8-10" DRC) alligator juniper trees have experienced mortality at the lower elevations and/or warmer aspects of the site. These trees likely established in a wetter period at the lower elevational range of the species and have died in the recent drought.

State 5
Chaparral State

Manzanita increases in abundance and dominates the interspaces between trees.

Community 5.1
High cover chaparral community

Chaparral species, primarily manzanita, have geminated and in the absence of fire for very long periods have grown to very large size and occupy the interspaces of trees. Nearly all herbaceous vegetation has been lost from the site.

Transition 1a
State 1 to 2

High intensity continuous herbivory by livestock or wildlife reduces the vigor and abundance of sideoats grama and increases the abundance of short grasses like blue grama on cool aspects or hairy grama and curly mesquite on warm aspects. Horses being more apt to use steeper slopes can have equally detrimental effects.

Transition 1c
State 1 to 4

Absence of fires for very long periods allows tree regeneration to grow to maturity and increase in size on the site.

Transition 1b
State 1 to 5

Exact mechanism is uncertain. However, fire intervals are likely greater than the historic 7-10 years of adjacent ponderosa pine forests, which the herbaceous species of the Reference Plant Community are capable of supporting. Fire intervals are likely of sufficient length that existing manzanita plants become sexually mature and able to produce seed as suggested by Pase and Granfelt (1977) which is scarified in future fires.

Transition 2a
State 2 to 3

Continuous high intensity herbivory reduces the vigor and basal area of short grasses and opens the community up to increased abundance of annual species like goldeneye.

Restoration pathway 3a
State 3 to 2

Unknown. Prescribed grazing of remnant plants with range planting to increase the abundance of desirable species. Aerial application of seed is the only practical method of seeding.

Restoration pathway 4a
State 4 to 1

Extreme wildfire with adequate remnant midgrass plants in the interspaces of trees.

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	**Mid grasses**			673–1009	
	sideoats grama	BOCU	*Bouteloua curtipendula*	673–1009	–
	green sprangletop	LEDU	*Leptochloa dubia*	6–11	–
	Texas bluestem	SCCI2	*Schizachyrium cirratum*	0–11	–
2	**Short grasses**			22–336	
	curly-mesquite	HIBE	*Hilaria belangeri*	11–224	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	11–112	–
3	**Cool season grasses**			11–56	
	squirreltail	ELEL5	*Elymus elymoides*	6–28	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	6–28	–
	muttongrass	POFE	*Poa fendleriana*	6–28	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	0–11	–
4	**Miscellaneous grasses**			6–45	
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–22	–
	spidergrass	ARTE3	*Aristida ternipes*	0–22	–

	Hall's panicgrass	PAHA	*Panicum hallii*	6–22	–
	longtongue muhly	MULO	*Muhlenbergia longiligula*	1–2	–
5	**Annual grasses**			11–56	
	Eastwood fescue	VUMIC	*Vulpia microstachys var. ciliata*	1–28	–
	Pacific fescue	VUMIP	*Vulpia microstachys var. pauciflora*	1–28	–
	sixweeks threeawn	ARAD	*Aristida adscensionis*	1–6	–
	prairie threeawn	AROL	*Aristida oligantha*	1–6	–
	witchgrass	PACA6	*Panicum capillare*	1–6	–
	Mexican panicgrass	PAHI5	*Panicum hirticaule*	1–6	–
	Arizona brome	BRAR4	*Bromus arizonicus*	0–1	–
	tufted lovegrass	ERPE	*Eragrostis pectinacea*	0–1	–
Forb					
6	**Perennial forbs**			1–11	
	weakleaf bur ragweed	AMCO3	*Ambrosia confertiflora*	1–6	–
	Cooley's bundleflower	DECO2	*Desmanthus cooleyi*	1–6	–
	Lewis flax	LILE3	*Linum lewisii*	1–2	–
	New Mexico groundsel	PANE7	*Packera neomexicana*	0–1	–
	Oak Creek ragwort	PAQU8	*Packera quercetorum*	0–1	–
	Flagstaff ragwort	SEAC2	*Senecio actinella*	0–1	–
	bluedicks	DICA14	*Dichelostemma capitatum*	0–1	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–1	–
7	**Annual forbs**			0–45	
	longleaf false goldeneye	HELO6	*Heliomeris longifolia*	6–34	–
	desert Indianwheat	PLOV	*Plantago ovata*	0–11	–
	American wild carrot	DAPU3	*Daucus pusillus*	0–2	–
	New Mexico thistle	CINE	*Cirsium neomexicanum*	0–1	–
Shrub/Vine					
8	**Evergreen shrubs**			56–202	
	pointleaf manzanita	ARPU5	*Arctostaphylos pungens*	56–196	–
	Sonoran scrub oak	QUTU2	*Quercus turbinella*	0–6	–
9	**Miscellaneous shrubs**			0–11	
	catclaw mimosa	MIACB	*Mimosa aculeaticarpa var. biuncifera*	0–11	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–2	–
10	**Sub shrubs**			6–34	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–34	–
	prairie acacia	ACAN	*Acacia angustissima*	0–11	–
	bastardsage	ERWR	*Eriogonum wrightii*	1–11	–
11	**Succulents**			17–78	
	sacahuista	NOMI	*Nolina microcarpa*	6–34	–
	goldenflower century plant	AGCH2	*Agave chrysantha*	6–28	–
	Parry's agave	AGPA4	*Agave parryi*	6–11	–
	cactus apple	OPEN3	*Opuntia engelmannii*	0–6	–

	walkingstick cactus	CYSP8	*Cylindropuntia spinosior*	0–1	–
	pinkflower hedgehog cactus	ECFE	*Echinocereus fendleri*	0–1	–
Tree					
12	**Trees**			224–673	
	twoneedle pinyon	PIED	*Pinus edulis*	56–280	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	56–280	–
	gray oak	QUGR3	*Quercus grisea*	112–280	–
	redberry juniper	JUCO11	*Juniperus coahuilensis*	0–112	–
	alligator juniper	JUDE2	*Juniperus deppeana*	56–112	–
	oneseed juniper	JUMO	*Juniperus monosperma*	0–112	–

Animal community

This site is a significant habitat for whitetail deer. Elk and mule deer utilize this site to a fair degree given the diversity of forage.

This site has limited use by livestock in summer unless water is less than 1/2 mile away. There are limited areas of very cobbly surfaces that receive little livestock use. This site is susceptible to erosion in areas with very high livestock or wildlife utilization like bed grounds, trails, and areas adjacent to water. Horses make significant use of this site and can severely deteriorate areas if left unmanaged.

Hydrological functions

Site is not conducive to rill formation. High cover of grass, trees, and shrubs with woody species being scattered and herbaceous species are abundant to the perimeter of woody species. Grass plants are less than 1 foot apart in the interspaces of woody species and provide a highly sinuous flow path for overland flow.

Rill formation can begin to occur at 2-5 rills per acre when tree cover has increased to 70-80% and perennial grass plants are still present at 10-15 plants per square yard. Rills are 8-12 inches wide and 3-4 inches deep and tend to be armored with gravels that have remained in the rills.

Surface soils are likely lost with prolonged high tree and shrub cover. Gravel and cobble covers tend to be high in these areas and trees and shrubs are likely relatively effective at intercepting high amounts of rainfall and providing protection of the site at this stage. This high interception is suggested by Hydrologic Model TR-55 for high juniper cover.

Recreational uses

Hunting, horseback riding, backpacking, rock hounding, photography.

Wood products

Limited harvest of fuel-wood, fence posts and stays from juniper, pinyon, and oak species. These activities are restricted to the tops of slopes where access roads have been installed on ridges or where roads have been installed across gentler sloping areas.

Other products

Western Apache use approximately 700 species of plants in the region. This site provides an important source of plants and animals for traditional uses in the reference state. As the site degrades to woodland the number of species of plants and animals used for traditional purposes declines significantly.

Type locality

Location 1: Gila County, AZ	
General legal description	Upper slopes south of and surrounding Seneca Lake.
Location 2: Sierra County, NM	
Township/Range/Section	T14S R7W S6
General legal description	Sierra County, New Mexico; about 6 miles north and 5 miles west of the Ladder Ranch Headquarters; 1,760 feet south and 240 feet west of the northeast corner, sec. 6, T. 14 S., R. 7 W.

Other references

Pase, Charles P. and David E. Brown. 1982. Interior chaparral. In: Brown, David E., ed. Biotic communities of the American Southwest--United States and Mexico. Desert Plants. 4(1-4): 95-99.

Pase, C. P. And G. E. Granfelt. 1977. The use of fire on Arizona rangelands. Arizona Interagency Range Committee Publication No. 4, 15p. Fort Collins, CO: USDA Forest Service. Rocky Mtn. Forest & Range Experiment Station.

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	05/30/2011
Approved by	Scott Woodall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Site is not conducive to rill formation. High cover of grass, trees, and shrubs with woody species being scattered and herbaceous species are abundant to the perimeter of woody species. Grass plants are less than 1 foot apart in the interspaces of woody species and provide a highly sinuous flow path for overland flow.

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2. **Presence of water flow patterns:** Water flow paths are very hard to observe on the site due to high herbaceous litter and density of herbaceous species. Perennial grass plants are less than 1 foot apart in the interspaces of woody species and provide a highly sinuous flow path for overland flow.

3. **Number and height of erosional pedestals or terracettes:** None present on the site. Herbaceous production is dominated by very dense bunchgrasses that are not conducive to pedestalling or terracette formation. There are approximately 10-15 perennial bunch grass plants per square yard in the interspaces between woody species.

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

5. **Number of gullies and erosion associated with gullies:** Geologic erosional gullies are present on the site but have healed and have sloping banks that are well vegetated.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None present on the site. Plant community is shrub and tree dotted savanna with very dense perennial bunch grass plants and 10-20% gravel cover in the interspaces that is not conducive to wind erosion.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter is transported less than 2 feet before being intercepted by high density perennial bunch grass plants. Woody litter stays in place near parent plants.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability values range from 5-6 across most of the site.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Weak to moderate fine to medium granular structure 2 to 3 inches thick. Color is 7.5YR 5/2 dry and 7.5YR 3/2 moist. Organic matter is 1-3%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial bunch grass plants are the most extensive in terms of canopy cover on the site and at 10-15 plants per square yard in interspaces of trees are highly effective at promoting infiltration and reducing the energy of water that leaves the site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None present on the site. Argillic horizon at 2-3 inches deep may be mistaken for a compaction layer. High gravel and cobble in subsurface are usually easily detected.

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 bunch grass > trees > short grasses

Sub-dominant: evergreen shrubs > succulents = miscellaneous grass = cool season grass = annual grass = annual forbs > perennial forbs

Other:

Additional:

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

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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):** 1340 lbs/ac in below average year, 2000 lbs/ac in average year, 2670 lbs/ac in above average year.

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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:** Alligator juniper is the most common species on cooler aspects, one seed or redberry juniper on warmer aspects. Manzanita and oaks are second most common species. Annual goldeneye can become problematic where trees and shrubs have not increased and continuous herbivory from livestock or wildlife have reduced vigor of short grasses.

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