USDA Natural Resources
Conservation Service

Ecological site R116AY017MO
Dolomite Exposed Cliff

Last updated: 9/24/2020
Accessed: 04/27/2024

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.

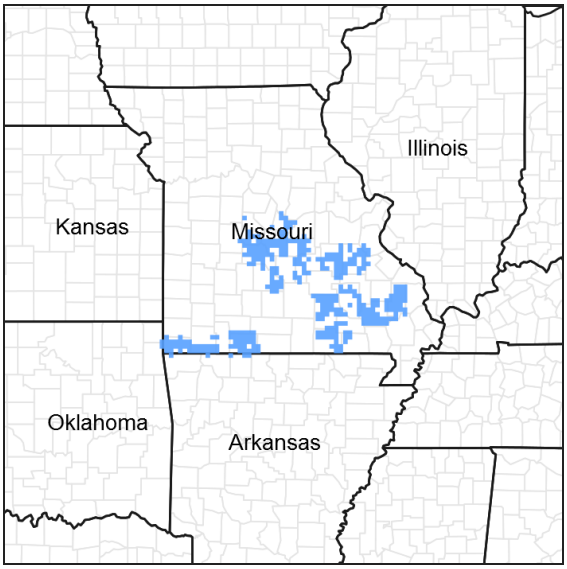


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 116A–Ozark Highland

The Ozark Highland constitutes the Salem Plateau of the Ozark Uplift. Elevation ranges from about 300 feet on the southeast edge of the Ozark escarpment, to about 1,600 feet in the west, adjacent to the Burlington Escarpment of the Springfield Plateau. The underlying bedrock is mainly horizontally bedded Ordovician-aged dolomites and sandstones that dip gently away from the uplift apex in southeast Missouri. Cambrian dolomites are exposed on deeply dissected hillslopes. In some places, Pennsylvanian and Mississipian sediments overlie the plateau. Relief varies, from the gently rolling central plateau areas to deeply dissected hillslopes associated with drainageways such as the Buffalo, Current, Eleven Point and White Rivers.

Classification relationships

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Dry Limestone/Dolomite Cliff.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is most similar to Limestone - Dolostone Midwest Dry Cliff Sparse Vegetation (CEGL002291).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs across the Ozark Highlands Section.

Ecological site concept

NOTE: This is a “provisional” Ecological Site Description (ESD) that is under development. It contains basic ecological information that can be used for conservation planning, application and land management. After additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”.

Dolomite Exposed Cliffs occur along deeply dissected river valleys throughout the Ozark Highland. They occupy southerly and westerly aspects, and are mapped in complex with the Dolomite Protected Cliff ecological site. Soils are very shallow to limestone or dolomite. The reference plant community consists of scattered small trees, shrubs, grasses, forbs, and ferns, occupying cracks and ledges in the cliff face.

Associated sites

F116AY044MO	**Chert Dolomite Upland Woodland** Chert Dolomite Upland Woodlands are adjacent and upslope.
F116AY048MO	**Chert Dolomite Exposed Backslope Woodland** Chert Dolomite Exposed Backslope Woodlands are adjacent.
R116AY020MO	**Shallow Dolomite Upland Glade/Woodland** Shallow Dolomite Upland Glade/Woodlands are adjacent.

Similar sites

R116AY014MO	**Dolomite Protected Cliff** Dolomite Protected Cliffs are mapped in complex with the Dolomite Exposed Cliff ecological sites.

Table 1. Dominant plant species

Tree	(1) *Juniperus virginiana* (2) *Quercus muehlenbergii*
Shrub	(1) *Celastrus scandens*
Herbaceous	(1) *Bouteloua curtipendula* (2) *Pellaea atropurpurea*

Physiographic features

This site is cliffs. It is on exposed aspects (south, southwest, and west), which receive significantly more solar radiation than the protected aspects. The site generates runoff to adjacent, downslope ecological sites, and in places receives runoff from upslope summit and shoulder sites.

The following figure shows a typical landscape position of this ecological site, and landscape relationships with other ecological sites in the uplands. The site is within the area labeled “4”, on cliffs with exposed aspects. They are typically associated with Shallow Dolomite Glade/Woodland ecological sites, included within the area labeled “4”. Chert and Loamy Dolomite Upland Woodland ecological sites often directly upslope and are included within the area labeled “2 and 3”.

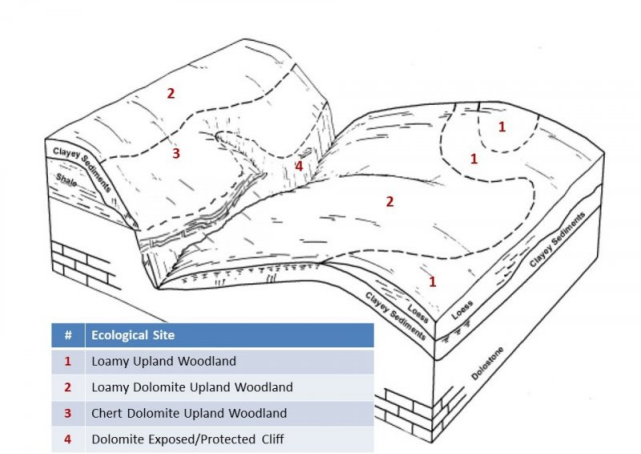


Figure 2. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Cliff
Flooding frequency	None
Slope	15–100%
Water table depth	152 cm
Aspect	W, SE, S, SW

Climatic features

The Ozark Highland has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Ozark Highland experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line crossing the MLRA from northwest to southeast.
The average annual precipitation in almost all of this area is 38 to 45 inches. Snow falls nearly every winter, but the snow cover lasts for only a few days. The average annual temperature is about 53 to 60 degrees F. The lower temperatures occur at the higher elevations in the western part of the MLRA. Mean January minimum temperature follows a stronger north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along a northwest to southeast gradient. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer.

During years when precipitation comes in a fairly normal manner, moisture is stored in the top layers of the soil during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or

microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Deep sinkholes often have a microclimate significantly cooler, moister, and shadier than surrounding surfaces, a phenomenon that may result in a strikingly different ecology. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces may create distinctive environmental niches such as glades and cliffs.

Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest is measurably different from the climate of a more open grassland or savanna areas.

Source: University of Missouri Climate Center - http://climate.missouri.edu/climate.php; Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States Department of Agriculture Handbook 296 - http://soils.usda.gov/survey/geography/mlra/

Table 3. Representative climatic features

Frost-free period (characteristic range)	151-167 days
Freeze-free period (characteristic range)	182-195 days
Precipitation total (characteristic range)	1,143-1,194 mm
Frost-free period (actual range)	145-168 days
Freeze-free period (actual range)	176-196 days
Precipitation total (actual range)	1,118-1,219 mm
Frost-free period (average)	158 days
Freeze-free period (average)	188 days
Precipitation total (average)	1,168 mm

Climate stations used

- (1) CAMDENTON 2 NW [USC00231212], Gravois Mills, MO
- (2) ANDERSON [USC00230164], Anderson, MO
- (3) CLEARWATER DAM [USC00231674], Ellington, MO

Influencing water features

Cliff aspect and local seepages result in a variability of site moisture conditions. North- and east-facing cliffs are typically moister than south- and west-facing cliffs because of reduced wind and reduced direct exposure to the sun. Moisture can be locally present on cliff faces due to local groundwater seepage along the cliff face or surface flow across the cliff face during rain events or snow melt. The site generates runoff to adjacent, downslope ecological sites, and in places receives runoff from upslope summit and shoulder sites.

Soil features

These soils are underlain with dolomite bedrock at less than 20 inches. The soils were formed under prairie vegetation, and have dark, organic-rich surface horizons. Parent material is dolomite residuum. These soils are loamy to clayey and are skeletal, with high amounts of dolomite gravel, channers and flagstones. They are not affected by seasonal wetness. Soil series associated with this site include Gasconade, Knobby, and Moko.

The accompanying picture of the Moko series shows the shallow depth to the fractured dolomite bedrock that characterizes this ecological site. Picture from Baker (1998).

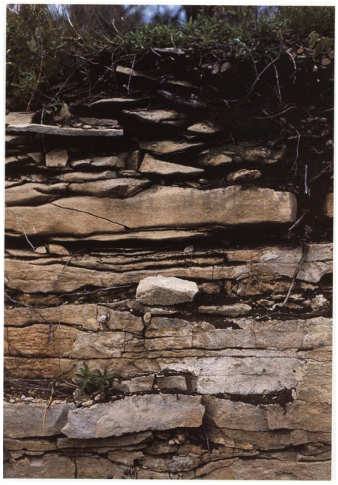


Figure 9. Moko series

Table 4. Representative soil features

Parent material	(1) Residuum–dolomite
Surface texture	(1) Gravelly silty clay loam (2) Very gravelly clay loam (3) Extremely gravelly loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Very slow
Soil depth	10–51 cm
Surface fragment cover <=3"	15–55%
Surface fragment cover >3"	5–60%
Available water capacity (0-101.6cm)	2.54–5.08 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	5–40%
Subsurface fragment volume >3" (Depth not specified)	5–60%

Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

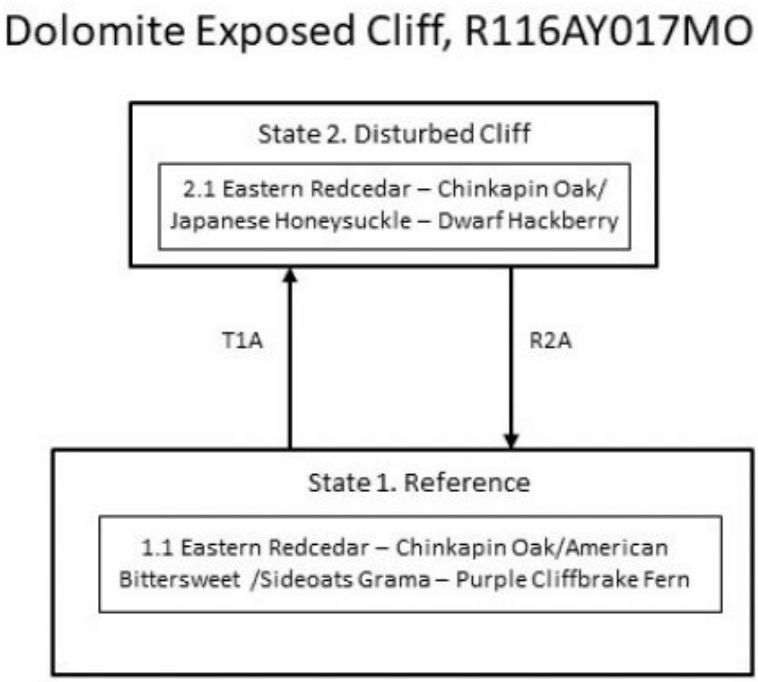
The reference plant community is characterized by vertical rock cliffs and by stress tolerant trees and shrubs, ferns, lichens and mosses. The stunted trees and shrubs and prairie grasses, sedges, forbs, and lichens dominate a variety of microhabitats (e.g. vertical rock faces, crevices, ledges, and solution pockets) making up this diverse ecological site. Exposed cliffs are normally less vegetated than protected cliffs. Herbaceous vegetation ranges up to 35 percent cover, although lichen cover may be greater. Occasional woody species can be found on the site.

Dolomite Exposed Cliffs can be above talus slopes or terraces, and are often below loess or chert forests and woodlands. Exposures of dolomite can be up to 100 feet in height, and often occur in a series of irregular rock ledges. When present, trees are stunted and the herbaceous vegetation is generally sparse.

Soils are generally absent but do occur on cliff edges, ledges, and rock terraces and support higher densities of woody species, forbs and ferns. These sites have large expanses of bare rock, with a variety of plants occupying cracks and minor ledges across the cliff face. Solar radiation on south and west facing aspects coupled with strong air movements keep the cliff face hot and dry. Vegetation structure is influenced by drought stress (cliff edge), wind, extreme heat, and storm damage and damage by falling rocks.

A state-and-transition model diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It may change as knowledge increases.

State and transition model



Code	Event/Activity/Process
T1A	Exotic plant invasion; woody encroachment; rock climbing, rappelling
R2A	Woody removal; site protection and monitoring

Figure 10. State and transition diagram for this ecological site

State 1

Reference

The reference plant community is characterized by rock shelves, vertical rock cliffs and by stress tolerant trees, shrubs, ferns, lichens and mosses. These sites have large expanses of bare rock, with a variety of plants occupying cracks and minor ledges across the cliff face. When present, trees are stunted and the herbaceous vegetation is generally sparse.

Community 1.1
Eastern Redcedar – Chinkapin Oak/American Bittersweet /Sideoats Grama – Purple Cliffbrake Fern

Figure 11. Exposed Cliff at Ha Ha Tonka State Park, Missouri; photo credit MDC.

Forest overstory. The Overstory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

Forest understory. The Understory Species list is based on field surveys and commonly occurring species listed in Nelson (2010).

State 2
Disturbed Cliff

This state has experienced significant exotic plant invasion, such as Japanese honeysuckle. Repeated trampling by rock climbing and rappelling activities destroy the structure and composition of the reference plant communities. In addition, woody encroachment through these disturbances is also occurring.

Community 2.1
Eastern Redcedar – Chinkapin Oak/ Japanese Honeysuckle – Dwarf Hackberry

Transition T1A

State 1 to 2

Exotic plant invasion; woody encroachment; rock climbing, rappelling

Restoration pathway R2A
State 2 to 1

Woody removal; site protection and monitoring

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
chinquapin oak	QUMU	*Quercus muehlenbergii*	Native	–	–	–	–
blue ash	FRQU	*Fraxinus quadrangulata*	Native	–	–	–	–
white ash	FRAM2	*Fraxinus americana*	Native	–	–	–	–
eastern redcedar	JUVI	*Juniperus virginiana*	Native	–	–	–	–
common hackberry	CEOC	*Celtis occidentalis*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	–
sideoats grama	BOCU	*Bouteloua curtipendula*	Native	–	–
bristleleaf sedge	CAEB2	*Carex eburnea*	Native	–	–
Forb/Herb					
chickenthief	MEOL	*Mentzelia oligosperma*	Native	–	–
Missouri orange coneflower	RUMI	*Rudbeckia missouriensis*	Native	–	–
orange coneflower	RUFUU	*Rudbeckia fulgida var. umbrosa*	Native	–	–
diamondflowers	STNIN	*Stenaria nigricans var. nigricans*	Native	–	–
zigzag goldenrod	SOFL2	*Solidago flexicaulis*	Native	–	–
red columbine	AQCA	*Aquilegia canadensis*	Native	–	–
wrinkleleaf goldenrod	SORU2	*Solidago rugosa*	Native	–	–
Fern/fern ally					
Tennessee bladderfern	CYTE3	*Cystopteris tennesseensis*	Native	–	–
slender lipfern	CHFE	*Cheilanthes feei*	Native	–	–
purple cliffbrake	PEAT2	*Pellaea atropurpurea*	Native	–	–
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	–
wild hydrangea	HYAR	*Hydrangea arborescens*	Native	–	–
dwarf hackberry	CEPU10	*Celtis pumila*	Native	–	–
Vine/Liana					
American bittersweet	CESC	*Celastrus scandens*	Native	–	–
Nonvascular					
rim lichen	LEMU60	*Lecanora muralis*	Native	–	–
false Russell's fishscale lichen	PSPS3	*Psora pseudorussellii*	Native	–	–

Animal community

Wildlife*

Only a few animals are highly associated with cliff natural communities due to their unique structural conditions.

Bird species associated with this ecological site's reference state condition: Turkey Vulture, Eastern Phoebe, American Kestrel, Northern Rough-winged Swallow, Cliff Swallow, and Barn Swallow.

South-facing cliffs that are more xeric may have overwintering Northern Fence Lizards (Sceloporus undulatus hyacinthinus), Five-lined Skinks (Eumeces faciatus), Rough Green snakes (Opheodrys aestivus aestivus) or Timber Rattlesnakes (Crotalus horridus).

Small mammals likely associated with this ecological site's reference state condition: Eastern Woodrat (Neotoma floridana) and Peromyscus species.

As with most natural communities, many invertebrate groups are represented on cliff natural communities including snails, spiders, insects, centipedes, millipedes and protistan microbe communities. Funnel-web and aerial web spiders are two groups well represented on cliff natural communities.

*This section prepared by Mike Leahy, Natural Areas Coordinator, Missouri Department of Conservation, 2013.

References for this section: Fitzgerald and Pashley 2000a; Heitzman and Heitzman 1996; Jacobs 2001; Johnson 2000; Pitts and McGuire 2000; Schwartz and others 2001.

Other information

Forestry
Management: This ecological site is not recommended for traditional timber production activity.

Inventory data references

Potential Reference Sites: Dolomite Exposed Cliff

Plot HACRCA_KS04 - Moko soil
Located in Hart Creek CA, Boone County, MO
Latitude: 38.708023
Longitude: -92.330661

Plot HUZZCA06 - Knobby soil
Located in Huzzah CA, Crawford County, MO
Latitude: 38.03831
Longitude: -91.22064967

Other references

Fitzgerald, J.A. and D.N. Pashley. 2000a. Partners in Flight bird conservation plan for the Ozark/Ouachitas. American Bird Conservancy.

Heitzman, J.R. and J.E. Heitzman. 1996. Butterflies and moths of Missouri. 2nd ed. Missouri Department of Conservation, Jefferson City.

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Schwartz, C.W., E.R. Schwartz and J.J. Conley. 2001. The wild mammals of Missouri. University of Missouri Press, Columbia and Missouri Department of Conservation, Jefferson City.

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Contributors

Fred Young
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Approval

Nels Barrett, 9/24/2020

Acknowledgments

Missouri Department of Conservation and Missouri Department of Natural Resources personnel provided significant and helpful field and technical support in the development of this ecological site.

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	04/27/2024
Approved by	Nels Barrett
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**