USDA Natural Resources Conservation Service

Ecological site R108XD797IA
Limestone Backslope Glade

Last updated: 10/17/2024
Accessed: 05/13/2025

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.

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): 108X–Illinois and Iowa Deep Loess and Drift

The Illinois and Iowa Deep Loess and Drift, Western Part MLRA covers parts of both Iowa and Missouri and is known locally as part of the Southern Iowa Drift Plain. A silty loess deposit of varying thickness (5 to 20 feet) covers a series of glacial advances known collectively as pre-Illinoisan till. This till, deposited more than half a million years ago, was subjected to multiple instances of extreme erosion as well as periods of subdued erosion and intense weathering. The loess is thickest in the western part of the MLRA and generally thins eastward. In some areas, the loess has been removed and the older weathered till, called a “paleosol,” entirely exposed. These highly weathered soils, or paleosols, have a high content of clay, which slows the downward movement of water through the profile and causes water to move laterally instead of vertically. Wet areas, or “side-hill seeps,” commonly form where these paleosols become exposed along hillsides (Prior, 1991).

The dominant soil orders in this MLRA are Mollisols and Alfisols and, to a lesser extent, Entisols and Inceptisols. Most of the soils are Udolls or Udalfs. Aquolls are on the flatter interfluves. The soils in the area dominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, well drained to poorly drained, and silty, loamy, or clayey. These soils on uplands include somewhat poorly drained, nearly level Argiudolls (Macksburg series); moderately well drained, gently sloping to strongly sloping Argiudolls (Sharpsburg series); poorly drained, nearly level Argiaquolls (Winterset series); and well drained strongly, sloping to steep Hapludalfs (Gara, Lindley, Ladoga, and Armstrong series) (USDA-NRCS, 2006).
The western part of the Illinois and Iowa Deep Loess and Drift is a segment of three other MLRAs within the Central Feed Grains and Livestock Region. The other areas are: the West-Central part (108C), the East-Central part (108B) and the Eastern part (108A).

Classification relationships

Major Land Resource Area (MLRA): Illinois and Iowa Deep Loess and Drift, Western Part (108D)

USFS Subregions: Central Dissected Till Plains Section (251C); Loess Hills (251Cb) and Central Dissected Till and Loess Plain (251Cc) Subsections (Cleland et al, 2007)

Relationship to Other Established Classifications:

NatureServe Classification: Ecological System: North-Central Interior Dry-Mesic Oak Forest and Woodland (4116); Ecological Association: Central Limestone Glade (NatureServe, 2013)

Landfire Biophysical Setting: Central Tallgrass Prairie (4314210) (Landfire, 2009)

Ecological site concept

Limestone Backslope Glades are within the red areas on the map (Figure 1). These sites formed in thin loess and limestone residuum parent material and can be found on hillslopes on uplands. Typically these sites are located upslope from till savanna ecological sites. Soils are typically Alfisols characterized by shallow, dark colored surfaces high in organic matter and have rooting restrictions from 20 to 40 inches. Plant communities consist of mostly trees and grasses with few forbs.

Associated sites

R108XD833IA	**Till Backslope Savanna** Till Backslope Savanna. Fine-loamy soils, including Gara and Shelby.
R108XD845IA	**Shale Upland Savanna** Shale Upland Savanna.Fine textured soils including the Bauer and Clanton series.
R108XD835IA	**Shale Backslope Savanna** Shale Backslope Savanna.Fine textured soil including the Bauer and Clanton series.

Similar sites

R108XD798IA	**Shallow Limestone Backslope Glade** Shallow Limestone Backslope Glade.Loamy soils, including Nordness and Sogn series

Table 1. Dominant plant species

Tree	(1) *Quercus muehlenbergii*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Sorghastrum nutans*

Physiographic features

Limestone Backslope Glades are of small extent, and can be found on hillslopes in uplands in the north central part of MLRA 108D. These sites are within a dissected till plain landscape. Slopes are generally between 9 and 14 percent. These sites typically occur above similar shallow limestone backslope glades.

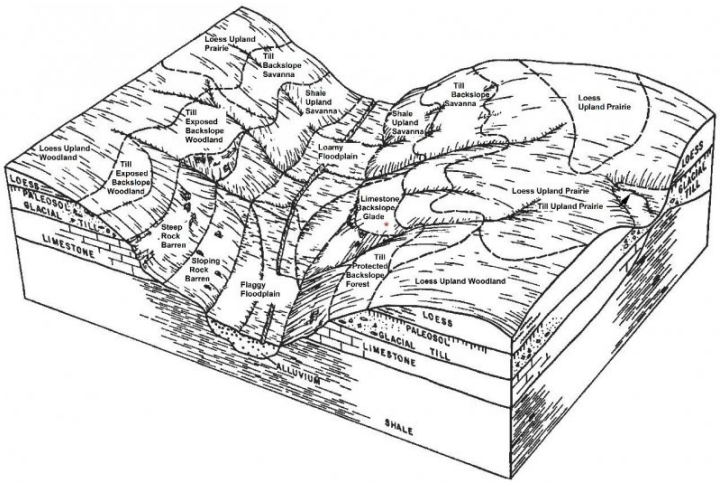


Figure 2. Block diagrams representing typical soil-landform sequences in Loess over Limestone. Red asterisk identifies soil component correlated to Limestone Backslope Glade.

Table 2. Representative physiographic features

Landforms	(1) Upland slope
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	213–610 m
Slope	9–14%
Water table depth	0 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The soil temperature regime of MLRA 108D is classified as “mesic” where the mean annual soil temperature is between 46 and 59°F (Soil Survey Staff, 2014). The average freeze-free period of this ecological site is about 166 days, while the frost-free period is about 144 days. Average annual precipitation is 31 inches, which includes rainfall plus the water equivalent from snowfall. The average annual low and high temperatures are 38 and 60°F, respectively.

Table 3. Representative climatic features

Frost-free period (characteristic range)	133-145 days
Freeze-free period (characteristic range)	155-175 days
Precipitation total (characteristic range)	889-940 mm
Frost-free period (actual range)	129-150 days
Freeze-free period (actual range)	148-176 days
Precipitation total (actual range)	889-965 mm
Frost-free period (average)	140 days
Freeze-free period (average)	165 days
Precipitation total (average)	914 mm

Climate stations used

- (1) WINTERSET 1N [USC00139132], Winterset, IA
- (2) GUTHRIE CTR [USC00133509], Guthrie Center, IA
- (3) GREENFIELD [USC00133438], Greenfield, IA
- (4) KNOXVILLE [USC00134502], Knoxville, IA
- (5) MARYVILLE 2E [USC00235340], Maryville, MO

Influencing water features

This ecological site is not influenced by wetland or riparian water features. The soil is well-drained. Permeability is moderately slow to rapid. The site contains soils in hydrologic group D (Hydrologic Soil Group, 2016). The land capability class is 3e (Land Capability Classification, 2016). The water source is direct precipitation and upslope till savanna contributing sites. Depth of endosaturation is greater than 5 feet.

Soil features

These soils have a major rooting restriction between 20 and 40 inches. The soils were formed under glade vegetation, and have thin surface horizons. Parent material is loess and limestone residuum. The soils have silt loam surface horizons (Table 5). Subsoils are silt loam, silty clay loam or clay. Dunbarton is the only soil series associated with this site.

Table 4. Representative soil features

Parent material	(1) Residuum
Surface texture	(1) Silt loam (2) Silty clay loam (3) Clay
Drainage class	Well drained
Permeability class	Moderate to very rapid
Soil depth	51–102 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	5.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–8%
Subsurface fragment volume >3" (Depth not specified)	0–6%

Ecological dynamics

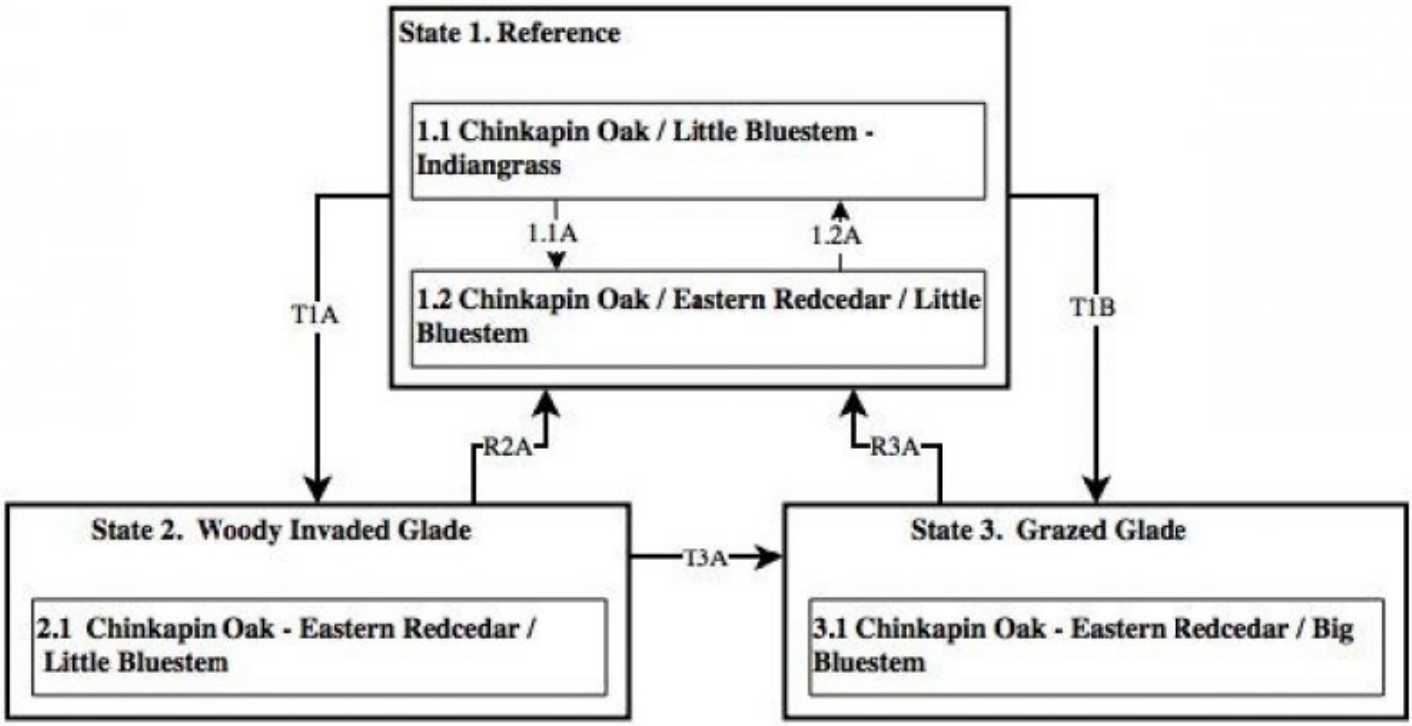
Reference plant community is categorized as a limestone glade and includes trees, grasses, forbs, and shrubs. Species composition typically includes *Quercus muehlenbergii*, *Juniperus virginiana*, *Schizachyrium scoparium*, *Sorghastrum nutans*, and *Andropogon gerardii*.

Fire, wind, storm, and drought, are all disturbances influencing the dynamics at this site. These sites likely burned every 5 years. Fires removed the litter and stimulated the growth and flowering of the grasses and forbs. They also further limited the growth and dominance of trees, especially eastern redcedar. Fire tolerant chinkapin oak and post oak occupied islands and edges where the deeper range of the soil component occurred, creating a complex mosaic of open glade and low-density woodland. During fire-free intervals, woody species increased, but not to densities on over-grazed glades. Disturbances from these animals removed thatch, litter, and reduced the proliferation of small trees and shrubs.

These sites are not productive. In the absence of fire, woody species, especially eastern redcedar, quickly occupy the site. This is especially true after grazing has reduced grass cover and exposed more surface to the dispersal of cedar seeds by birds. Once established, cedars can quickly fill in a glade/woodland system, especially if grazing has diminished the vigor of the diverse flora. Many glades have been heavily grazed and suffer substantial redcedar invasion. Removal of the redcedar and the application of prescribed fire have proven to be an effect way to management these systems (Mutel, 2008).

State and transition model

R108DY797IA Limestone Backslope Glade



Code	Process
1.1A	Fire-free interval (10 to 20 years)
1.2A	Fire interval (3-10 years)
T1A	Fire suppression (>20 years)
T1B	Uncontrolled grazing; fire suppression
T3A	Uncontrolled grazing
R2A	Cedar removal; prescribed fire
R3A	Grazing exclusion; prescribed fire; woody removal

Figure 9. STM

State 1
Reference

This state is a shallow limestone glade. As such, this has a reference plant community which includes trees, grasses and forbs. Species composition includes *Quercus muehlenbergii*, *Juniperus virginiana*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Andropogon gerardii*, *Helianthus divaricatus*, Cercis Canadensis, and Quercus stellate. Canopy cover is between 5 and 15 percent. If disturbance frequency becomes more often, between 3 and 10 years, the phase will shift back to chinkapin oak / Little bluestem phase.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass

Community 1.1
chinkapin oak / little bluestem - indiangrass

Sparsely wooded glade with native grasses.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- Indiangrass (*Sorghastrum nutans*), grass

Community 1.2
Chinkapin oak/ eastern redcedar/ little bluestem

This community is exhibiting an increase in eastern redcedar due to longer fire intervals.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redcedar (*Juniperus virginiana*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

Pathway P1.1A
Community 1.1 to 1.2

Fire-free intervals of 10 to 20 years will cause a shift to a 1.2.

Pathway P1.2A
Community 1.2 to 1.1

Fire Interval 3-10 years.

State 2
Woody Invaded Glade

This state is chinkapin oak – eastern redcedar / little bluestem phase and the reference state will transition to this state phase due to fire suppression of greater than 20 years. A restoration path is also possible to the reference state by removal of cedars and prescribed fire. If phase 2.1 is grazed uncontrollably, the phase becomes chinkapin oak – eastern redcedar / big bluestem (Woodland Health, 2004).

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- little bluestem (*Schizachyrium scoparium*), grass

Community 2.1
Woody Invaded Glade

This community has a higher amount of eastern redcedar due to longer fire intervals.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redcedar (*Juniperus virginiana*), shrub
- little bluestem (*Schizachyrium scoparium*), grass

State 3

Grazed Glade

This state is chinkapin oak – eastern redcedar / big bluestem phase. A transition to this state can occur from the reference state with uncontrolled grazing and fire suppression. This state has a possibility for restoration to the reference state which requires the exclusion of grazing, prescribed fire, and woody removal.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redcedar (*Juniperus virginiana*), shrub
- big bluestem (*Andropogon gerardii*), grass

Community 3.1
Chinkapin oak - eastern redcedar / big bluestem

This community is influenced by grazing.

Dominant plant species

- chinquapin oak (*Quercus muehlenbergii*), tree
- eastern redcedar (*Juniperus virginiana*), tree
- big bluestem (*Andropogon gerardii*), grass

Transition T1A
State 1 to 2

Fire suppression of over 20 years.

Transition T1B
State 1 to 3

Uncontrolled grazing; fire suppression.

Restoration pathway R2A
State 2 to 1

cedar removal; prescribed fire

Transition T2A
State 2 to 3

Uncontrolled grazing.

Restoration pathway R3A
State 3 to 1

grazing exclusion; prescribed fire; woody removal.

Additional community tables

Inventory data references

No field plots were available for this site. A review of the scientific literature and professional experience were used to approximate the plant communities for this provisional ecological site. Information for the state-and-transition model was obtained from the same sources. All community phases are considered provisional based on these plots and the sources identified in ecological site description.

Other references

Cleland, D.T., J.A. Freeouf, J.E. Keys, G.J. Nowacki, C. Carpenter, and W.H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC.

Landfire. 2009. Biophysical Setting 4314210 Central Tallgrass Prairie. In: Landfire National Vegetation Dynamics Models. USDA For. Serv. and U.S. Department of Interior. Washington, DC.

Mutel, Cornelia F. 2008. The Emerald Horizon: The History of Nature in Iowa. University of Iowa Press.

NatureServe. 2013. Associations and alliances of Iowa. St. Paul, Minnesota.

Prior, Jean Cutler. 1991. Landforms of Iowa. University of Iowa Press. Iowa City, Iowa.
Soil Survey Staff. 2014. Keys to Soil Taxonomy, 12th ed. USDA-Natural Resources Conservation Service, Washington, DC.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. USDA Handbook 296.

United States Department of Agriculture, Natural Resources Conservation Service. Hydrologic Soil Group. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054223#39 accessed August 29, 2016.

United States Department of Agriculture, Natural Resources Conservation Service. Land Capability Classification. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054226#02 accessed August 29, 2016.

Woodland Health: Stewardship Options for Iowa Woodland Owners. 2004. Iowa Natural Heritage Foundation. Des Moines, Iowa.

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Approval

Suzanne Mayne-Kinney, 10/17/2024

Acknowledgments

This ESD was originally approved prior to April 2021.

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	05/13/2025
Approved by	Suzanne Mayne-Kinney

Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

Other:

Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**
