Ecological site F108XC501IA
Shallow Limestone Backslope Glade

Last updated: 7/01/2019
Accessed: 05/19/2024

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

The Illinois and Iowa Deep Loess and Drift, West-Central Part (MLRA 108C) encompasses the eastern portion of the Southern Iowa Drift Plain and the Lake Calvin Basin of the Mississippi Alluvial Plain landforms (Prior 1991). It lies entirely in one state (Iowa), containing approximately 9,805 square miles (Figure 1). The elevation ranges from approximately 1,110 feet above sea level (ASL) on the highest ridges to about 505 feet ASL in the lowest valleys. Local elevation difference is mainly 10 to 20 feet. However, some valley floors can range from 80 to 200 feet, while some upland flats and valley floors only range between 3 and 6 feet. The MLRA is underlain by Pre-Illinoian glacial till, deposited more than 500,000 years ago and since undergone extensive erosion and dissection. In the northern half of the area the till thickness ranges from 150 to 350 feet and grades to less than 150 feet thick in the southern half. The till is covered by a mantle of Peoria Loess on the hillslopes and Holocene alluvium in the drainageways. Paleozoic bedrock, comprised of limestone, shale, and mudstones, lies beneath the glacial material (USDA-NRCS 2006).

The vegetation in the MLRA has undergone drastic changes over time. Spruce forests dominated the landscape 30,000 to 21,500 years ago. As the last glacial maximum peaked 21,500 to 16,000 years ago, they were replaced with open tundras and parklands. The end of the Pleistocene Epoch saw a warming climate that initially prompted the return of spruce forests, but as the warming continued, spruce trees were replaced by deciduous trees (Baker et al. 1990). Not until approximately 9,000 years ago did the vegetation transition to prairies as climatic conditions continued to warm and subsequently dry. Between 4,000 and 3,000 years ago, oak savannas began intermingling within the prairie landscape, while the more wooded and forested areas maintained a foothold in sheltered areas. This prairie-forest transition ecosystem formed the dominant landscapes until the arrival of European settlers (Baker et al. 1992).

Classification relationships

USFS Subregions: Central Dissected Till Plains (251C) Section, Central Dissected Till and Loess Plain (251Cc), Mississippi River and Illinois Alluvial Plains (51Cf), Southeast Iowa Rolling Loess Hills (251Ch) Subsections (Cleland et al. 2007)

U.S. EPA Level IV Ecoregion: Rolling Loess Prairies (47f), Upper Mississippi Alluvial Plain (72d) (USEPA 2013)

National Vegetation Classification – Ecological Systems: Central Interior Highlands Calcareous Glade and Barrens (CES202.691); Central Interior Calcareous Cliff and Talus (CES202.690) (NatureServe 2015)

National Vegetation Classification - Plant Associations: Quercus muehlenbergii/Schizachyrium scoparium – Bouteloua curtipendula Wooded Grassland (CEGL005284); Limestone – Dolomite Midwest Moist Cliff Vegetation (CEGL002292); Limestone – Dolomite Midwest Dry Cliff Sparse Vegetation (CEGL002291) (Nature Serve 2015)

Biophysical Settings: Central Interior Highlands Calcareous Glade and Barrens (BpS 4314010) (LANDFIRE 2009)

Iowa Department of Natural Resources: Limestone Glade (INAI 1984)

Ecological site concept

Shallow Limestone Backslope Glades are located within the green areas on the map (Figure 1). They occur on upland backslopes on slopes greater than 15 percent. The soils are Alfisols that are well-drained and shallow (less than 40 cm) formed in silty or loamy sediments over limestone bedrock.

The historic pre-European settlement vegetation on this ecological site was dominated by sparse woody and herbaceous plants tolerant of very dry conditions (INAI 1984; LANDFIRE 2009). Chinquapin oak (Quercus muehlenbergii Engelm.) is the dominant tree, and little bluestem (Schizachyrium scoparium (Michx.) Nash) and sideoats grama (Bouteloua curtipendula (Michx.) Torr.) are the dominant understory grass species. Other grasses present can include Indiangrass (Sorghastrum nutans (L.) Nash) and big bluestem (Andropogon gerardii Vitman). Overall vegetation cover is low and limestone bedrock occasionally occurs at the surface. Fire is the primary disturbance factor maintaining this site, and drought and storm damage are secondary factors (LANDFIRE 2009; NatureServe 2015).

Associated sites

F108XC513IA	**Till Backslope Forest** Glacial till parent material on backslopes including Bertrand, Douds, Galland, Inton, Lindley, and Russell
F108XC502IA	**Shallow Sandstone Backslope Glade** Silty or loamy sediments over sandstone on backslopes including Boone, Eleva, and Gale
F108XC505IA	**Loess Upland Woodland** Loess parent material on upland summits, shoulders, and upper to mid backslopes including Clinton, Exette, Hayette, Mula, Rozetta, Seaton, and Timula

Similar sites

F108XC502IA	**Shallow Sandstone Backslope Glade** Shallow Sandstone Backslope Glades occur in similar landscape positions but over sandstone bedrock

Table 1. Dominant plant species

Tree	(1) *Quercus muehlenbergii*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Bouteloua curtipendula*

Physiographic features

Shallow Limestone Backslope Glades occur on upland backslopes on slopes greater than 15 percent (Figure 2). They are situated on elevations ranging from approximately 699 to 1299 feet ASL. This site does not experience flooding but rather generates runoff to adjacent, downslope ecological sites.

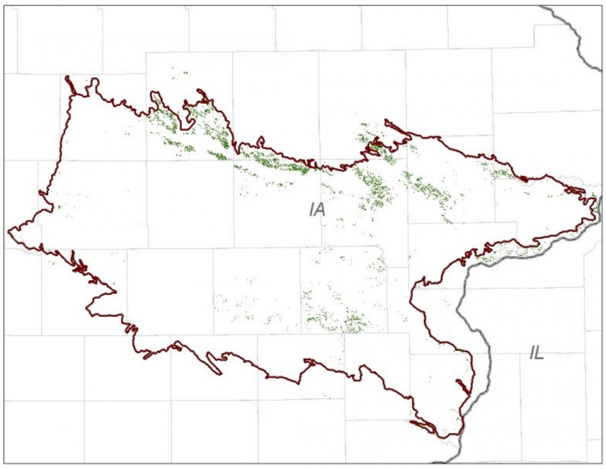


Figure 2. Figure 1. Location of Shallow Limestone Backslope Glade ecological site within MLRA 108C.

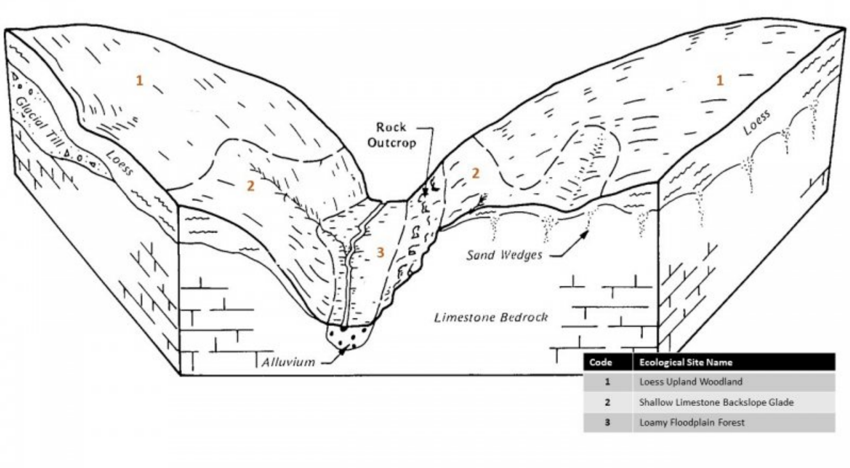


Figure 3. Figure 2. Representative block diagram of Shallow Limestone Backslope Glade and associated ecological sites.

Table 2. Representative physiographic features

Slope shape across	(1) Convex (2) Linear
Slope shape up-down	(1) Convex (2) Linear
Hillslope profile	(1) Backslope
Landforms	(1) Upland
Runoff class	High to very high
Elevation	213–396 m
Slope	14–40%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

The Illinois and Iowa Deep Loess and Drift, West-Central Part falls into the hot humid continental climate (Dfa) Köppen-Geiger climate classification (Peel et al. 2007). In winter, dry, cold air masses periodically shift south from Canada. As these air masses collide with humid air, snowfall and rainfall result. In summer, moist, warm air masses from the Gulf of Mexico migrate north, producing significant frontal or convective rains. Occasionally, hot, dry winds originating from the Desert Southwest will stagnate over the region, creating extended droughty periods in the summer from unusually high temperatures. Air masses from the Pacific Ocean can also spread into the region and dominate producing mild, dry weather in the autumn known as Indian Summers (NCDC 2006).

The soil temperature regime of MLRA 108C is classified as mesic, where the mean annual soil temperature is between 46 and 59°F (USDA-NRCS 2006). Temperature and precipitation occur along a north-south gradient, where temperature and precipitation increase the further south one travels. The average freeze-free period of this ecological site is about 180 days, while the frost-free period is about 159 days (Table 2). The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season. Average annual precipitation is approximately 38 inches, which includes rainfall plus the water equivalent from snowfall (Table 3). The average annual low and high temperatures are 38 and 60°F, respectively.

Climate data and analyses are derived from 30-year averages gathered from four National Oceanic and Atmospheric Administration (NOAA) weather stations contained within the range of this ecological site (Table 4).

Table 3. Representative climatic features

Frost-free period (characteristic range)	134-144 days
Freeze-free period (characteristic range)	164-178 days
Precipitation total (characteristic range)	914-940 mm
Frost-free period (actual range)	133-148 days
Freeze-free period (actual range)	163-183 days
Precipitation total (actual range)	889-940 mm
Frost-free period (average)	139 days
Freeze-free period (average)	172 days
Precipitation total (average)	914 mm

Climate stations used

- (1) IOWA CITY [USC00134101], Iowa City, IA
- (2) WASHINGTON [USC00138688], Washington, IA
- (3) BELLE PLAINE [USC00130600], Belle Plaine, IA
- (4) TOLEDO 3N [USC00138296], Toledo, IA

Influencing water features

Shallow Limestone Backslope Glades are not influenced by wetland or riparian features. Precipitation is the main source of water for this ecological site. Infiltration is very slow (Hydrologic Soil Group D), and surface runoff is high to very high. In the upper layers of limestone, water can be stored and moves easily along fractures, but as the limestone becomes denser and less fractured, water movement can stagnate (Prior et al. 2003). Surface runoff contributes some water to downslope ecological sites (Figure 5).

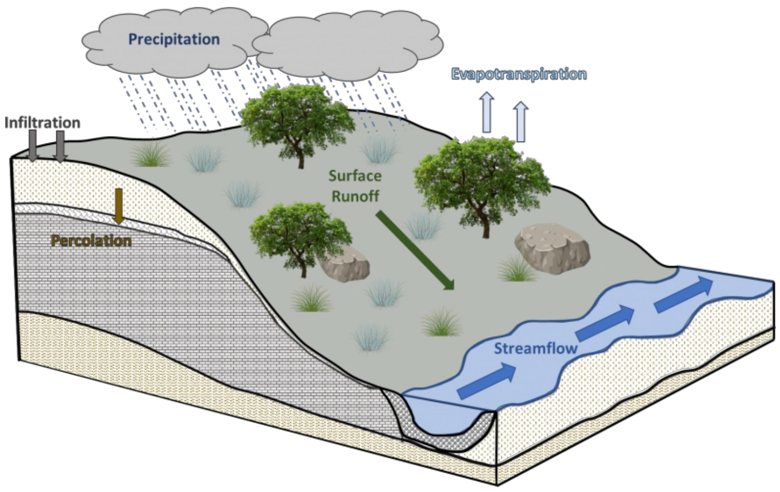


Figure 10. Figure 5. Hydrologic cycling in Shallow Limestone Backslope Glade ecological site.

Soil features

Soils of Shallow Limestone Backslope Glades are in the Alfisols order, further classified as Lithic Hapludalfs with very slow infiltration and high to very high runoff potential. The soil series associated with this site includes Dubuque, Dunbarton, Nordness (Figure 6). The parent material is silty or loamy sediments over limestone bedrock, and the soils are well-drained and shallow (less than 40 cm). Soil pH classes are moderately acid to neutral (Table 5).

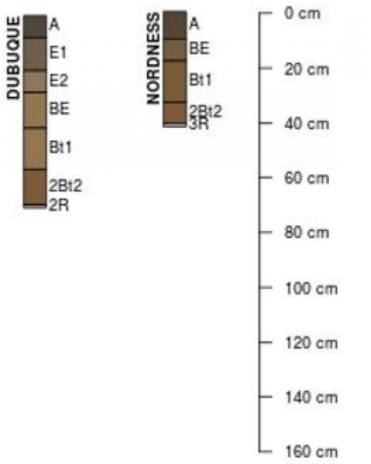


Figure 11. Figure 6. Profile sketches of soil series associated with Shallow Limestone Backslope Glade.

Table 4. Representative soil features

Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow
Depth to restrictive layer	36–41 cm
Soil depth	36–41 cm

Ecological dynamics

The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The MLRA lies within the transition zone between the eastern deciduous forests and the tallgrass prairies. The heterogeneous topography of the area results in variable microclimates and fuel matrices that in turn are able to support prairies, savannas, woodlands, and forests. Shallow Limestone Backslope Glades form an aspect of this vegetative continuum. This ecological site occurs on upland backslopes on well-drained, shallow to bedrock soils. Species characteristic of this ecological site consist of sparse woody and herbaceous vegetation adapted to dry, root-restrictive conditions.

Fire is the dominant ecosystem driver for maintaining the vegetation of Shallow Limestone Backslope Glades. Fire intensity typically comprised mixed, surface, and replacement fires occurring approximately every 5 to 20 years (LANDFIRE 2009). Ignition sources included summertime lightning strikes from convective storms and possibly, to a more limited extent, human-driven ignitions.

Drought, wind, and ice damage have also played a role in shaping this ecological site (LANDFIRE 2009). The periodic episodes of reduced soil moisture in conjunction with the well-drained, shallow soils have favored the proliferation of plant species tolerant of such conditions. Drought can slow the growth of plants and result in dieback of certain species. Damage to trees from storms can vary from minor, patchy effects of individual trees to stand effects that temporarily affect community structure and species richness and diversity (Irland 2000; Peterson 2000). When coupled with fire, periods of drought and seasonal storms can eliminate or greatly reduce the occurrence of woody vegetation, substantially altering the extent of shrubs and trees (Pyne et al. 1996).

Today, Shallow Limestone Backslope Glades are limited in their extent, having been reduced as a result of eastern redcedar (Juniperus virginianus L.) encroachment from long-term fire suppression. The state-and-transition model that follows provides a detailed description of each state, community phase, pathway, and transition. This model is based on available experimental research, field observations, literature reviews, professional consensus, and interpretations.

STATE 1 – REFERENCE STATE

The reference plant community is categorized as an open woodland community, dominated by scrubby woody and herbaceous vegetation. The two community phases within the reference state are dependent on a combination of surface, mixed, and replacement fires. Low intensity surface fires are the dominant fire regime, comprising approximately 60 percent of all fires and occurring every five years. Mixed and replacement fires comprise the remaining 40 percent, occurring approximately every 15 and 19 years, respectively (LANDFIRE 2009). Fire intensity and return intervals alter species composition, cover, and extent. Episodic droughts and storm damage have more localized impacts in the reference phases, but do contribute to overall species composition, diversity, cover, and productivity.

Community Phase 1.1 Chinquapin Oak/Little Bluestem – Sideoats Grama – Sites in this reference community phase consist of an open canopied woodland, with chinquapin oak as the dominant tree. Bur oak (*Quercus macrocarpa* Michx.) and northern pin oak (*Quercus ellipsoidalis* E.J. Hill) may also be present. Tree growth is highly influenced by the restrictive edaphic conditions and thus are generally stunted and relatively isolated in clusters (Tirmenstein 1991). Tree size class is typically medium (9 to 21-inch DBH) and heights are less than 30 feet tall (LANDFIRE 2009). The understory is also sparse with a relatively simple species composition. Little bluestem and sideoats grama are the dominant species, but big bluestem and Indiangrass can also occur. Areas of exposed limestone bedrock can occur across the site.

Pathway 1.1A – Reduced fire return interval

Community Phase 1.2 Chinquapin Oak/Eastern Redcedar/Little Bluestem – Sideoats Grama – This reference community phase can occur when the average fire return intervals are extended such as from drought. In the absence of regular fire, eastern redcedar can begin to develop within the shrub layer, overtopping the herbaceous component. Tree size class remains stunted due to the severe edaphic conditions, but shrubs can reach heights nearly 10 feet tall (LANDFIRE 2009). The return of fire will set back the development of eastern redcedar, returning the community to phase 1.1.

Pathway 1.2A – Increased fire return interval

Transition 1A – Fire suppression in excess of 70 years will transition the site to the fire-suppressed state (2).

STATE 2 – FIRE-SUPPRESSED STATE

Long-term fire suppression can transition the reference plant community into a closed canopy state dominated by eastern redcedar (Briggs et al. 2002; Anderson 2003). Eastern redcedar is a species native to the eastern half of North America with a range spanning from Ontario east to Nova Scotia, south across the Great Plains into eastern Texas, and east to the Atlantic coast (Lawson 1990; Lee 1996). It is a long-lived (450+ years), slow-growing, fire-intolerant dioecious conifer historically found in areas that were protected from fire (e.g., bluffs, rocky hillsides, sandstone cliffs, granite outcrops, etc.) (Ferguson et al. 1968; Anderson 2003). Today, however, decades of fire suppression have allowed this species to spread, and it can now be found occupying sites with highly variable aspects, topography, soils, and formerly stable plant communities (Anderson 2003).

Community Phase 2.1 Chinquapin Oak – Eastern Redcedar/Sideoats Grama – This community phase represents the early stages of eastern redcedar invasion and maturity. In the prolonged absence of fire, eastern redcedar can become highly competitive, co-dominating with the hardwoods. Native grasses can persist in the understory, however sideoats grama is the only species known to increase its cover under some overstory shading (Gehring and Bragg 1992).

Pathway 2.1A – Woody species succession as fire suppression continues.

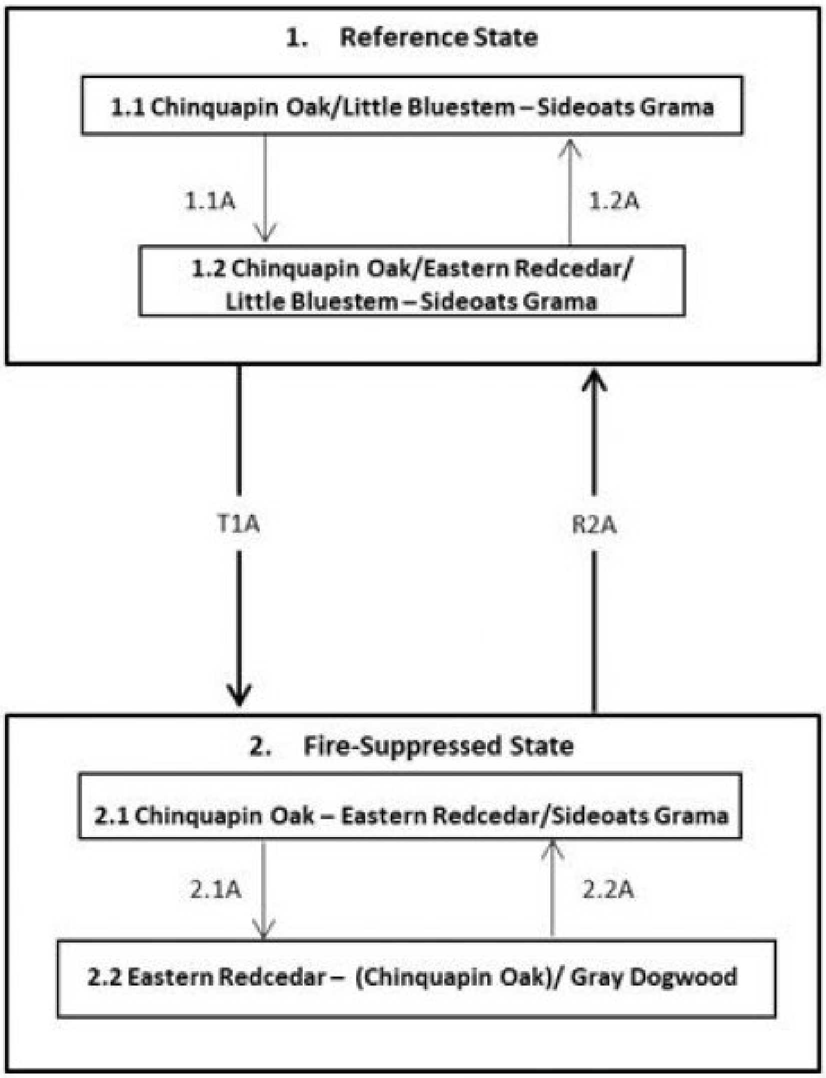
Community Phase 2.2 Eastern Redcedar – (Chinquapin Oak)/Gray Dogwood – Sites falling into this community phase have an established eastern redcedar tree canopy following numerous years of fire suppression. Eastern redcedar is the dominant tree, and chinquapin oak either becomes a minor component or non-existent as it is intolerant of shade (Tirmenstein 1991). In the prolonged absence of fire, the shrub layer can become well-developed with species such as gray dogwood (*Cornus racemosa* Lam.) (NatureServe 2015). As the canopy closes, light availability is greatly reduced to the ground layer allowing only the most shade-tolerant species to persist. The continued absence of fire will allow this community to expand its range.

Pathway 2.2A – Single disturbance event.

Restoration 2A – Selective removal of eastern redcedars and re-establish natural fire regime will transition the site to the reference state (1).

State and transition model

F108CY501IA SHALLOW LIMESTONE BACKSLOPE GLADE



Code	Process
T1A	Fire suppression (+70 years)
1.1A	Reduced fire return interval
1.2A	Increased fire return interval
R2A	Restore natural fire regime
2.1A	Woody species succession as fire suppression continues
2.2A	Single disturbance event

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

Anderson, M.D. 2003. Juniperus virginiana. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available at:

https://www.feis-crs.org/feis/. (Accessed 12 February 2018).

Baker, R.G., C.A. Chumbley, P.M. Witinok, and H.K. Kim. 1990. Holocene vegetational changes in eastern Iowa. Journal of the Iowa Academy of Science 97: 167-177.

Baker, R.G., L.J. Maher, C.A. Chumbley, and K.L. Van Zant. 1992. Patterns of Holocene environmental changes in the midwestern United States. Quaternary Research 37: 379-389.

Briggs, J.M., A.K. Knapp, and B.L. Brock. 2002. Expansion of woody plants in tallgrass prairie: a fifteen-year study of fire and grazing-interactions. The American Midland Naturalist 147: 287-294.

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 Coterminous United States. USDA Forest Service, General Technical Report WO-76. Washington, DC. 92 pps.

Ferguson, E.R., E.R. Lawson, W.R. Maple, and C. Mesavage. 1968. Managing Eastern Redcedar. Research paper SO-37. U.S. Department of Agriculture, Forest Service, Southern Forest Experimental Station, New Orleans, LA. 14 pps.

Iowa Natural Areas Inventory [INAI]. 1984. An Inventory of Significant Natural Areas in Iowa: Two Year Progress Report of the Iowa natural Areas Inventory. Iowa Natural Areas Inventory, Iowa Department of Natural Resources, Des Moines, IA.

Irland, L.C. 2000. Ice storms and forest impacts. The Science of the Total Environment 262:231-242.

LANDFIRE. 2009. Biophysical Setting 4314010 Central Interior Highlands Calcareous Glade and Barrens. In: LANDFIRE National Vegetation Dynamics Models. USDA Forest Service and US Department of Interior. Washington, DC.

Lawson, E.R. 1990. Juniperus virginiana L. eastern redcedar. In: R.M. Burns and B.H. Honkala, technical coordinators. Silvics of North America, Volume I: Conifers. Agricultural Handbook 654. Washington, DC: U.S. Department of Agriculture, Forest Service.

Lee, S.A. 1996. Propagation of Juniperus for conservation plantings in the Great Plains. M.S. Thesis. University of Nebraska, Lincoln, NE. 91 pps.

National Climate Data Center [NCDC]. 2006. Climate of Iowa. Central Region Headquarters, Climate Services Branch, National Climatic Data Center, Asheville, NC.

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1 NatureServe, Arlington, VA. Available at http://explorer.natureserve.org. (Accessed 13 February 2017).

Peel, M.C., B.L. Finlayson, and T.A. McMahon. 2007. Updated world map of the Köppen-Geiger climate classification. Hydrology and Earth System Sciences 11: 1633-1644.

Peterson, C.J. 2000. Catastrophic wind damage to North American forests and the potential impact of climate change. The Science of the Total Environment 262: 287-311.

Prior, J.C. 1991. Landforms of Iowa. University of Iowa Press for the Iowa Department of Natural Resources, Iowa City, IA. 153 pps.

Prior, J.C., J.L. Boekhoff, M.R. Howes, R.D. Libra, and P.E. VanDorpe. 2003. Iowa's Groundwater Basics. Iowa Department of Natural Resources, Iowa Geological Survey Educational Series 6. 92 pps.

Pyne, S.J., P.L. Andrews, and R.D. Laven. 1996. Introduction to Wildland Fire, Second Edition. John Wiley and Sons, Inc. New York, New York. 808 pps.

Tirmenstein, D.A. 1991. Quercus muehlenbergii. In: Fire Effects Information System [Online}. U.S. Department of

Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available at https://www.crs.org/feis. (Accessed 27 February 2018).

United States Department of Agriculture – Natural Resource Conservation Service (USDA-NRCS). 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. 682 pps.

U.S. Environmental Protection Agency [EPA]. 2013. Level III and Level IV Ecoregions of the Continental United States. Corvallis, OR, U.S. EPA, National Health and Environmental Effects Research Laboratory, map scale 1: 3,000,000. Available at http://www.epa.gov/eco-research/level-iii-andiv-ecoregions-continental-united-states. (Accessed 1 March 2017).

Contributors

Lisa Kluesner
Ryan Dermody

Approval

lisa kluesner, 7/01/2019

Acknowledgments

This project could not have been completed without the dedication and commitment from a variety of partners and staff (Table 6). Team members supported the project by serving on the technical team, assisting with the development of state and community phases of the state-and-transition model, providing peer review and technical editing, and conducting quality control and quality assurance reviews.

Organization Name Title Location
Drake University:
Dr. Tom Rosburg Professor of Ecology and Botany Des Moines, IA

Iowa Department of Natural Resources:
Kevin Andersen Private Lands Biologist Fairfield, IA
John Pearson Ecologist Des Moines, IA

LANDFIRE (The Nature Conservancy):
Randy Swaty Ecologist Evanston, IL

Natural Resources Conservation Service:
Rick Bednarek Iowa State Soil Scientist Des Moines, IA
Leland Camp Soil Scientist Waverly, IA
Stacey Clark Regional Ecological Site Specialist St. Paul, MN
Ryan Dermody Soil Survey Leader Waverly, IA
Tonie Endres Senior Regional Soil Scientist Indianapolis, IN
John Hammerly Soil Data Quality Specialist Indianapolis, IN
Lisa Kluesner Ecological Site Specialist Waverly, IA
Sean Kluesner Earth Team Volunteer Waverly, IA
Jeff Matthias State Grassland Specialist Des Moines, IA
Kevin Norwood Soil Survey Regional Director Indianapolis, IN
Doug Oelmann Soil Scientist Des Moines, IA
James Phillips GIS Specialist Des Moines, IA
Jason Steele Area Resource Soil Scientist Fairfield, IA
Doug Wallace Ecologist ACES Program Columbia, MO

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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:**