USDA Natural Resources
Conservation Service

Ecological site R113XY902IL
Natural Till Plain Savanna

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Accessed: 05/21/2024

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.

MLRA notes

Major Land Resource Area (MLRA): 113X–Central Claypan Areas

The eastern Illinois portion of the Central Claypan Areas MLRA is in the Till Plains Section of the Central Lowland Province of the Interior Plains (USDA-NRCS, 2006) and includes the Southern Till Plain Natural Division of the natural divisions of Illinois (Schwegman, 1973; 1997; IDNR, 2018) in south-central Illinois. South-central Illinois is a dissected Illinoisan till plain south of the terminal Wisconsin moraine. This region consists of nearly level to gently sloping, old till plains. Stream valleys are shallow and generally are narrow. Elevation is about 660 feet (200 meters), increasing gradually from south to north. Local relief is generally low on the broad, flat till plains and flood plains and high on the dissected hills bordering rivers or drainage systems. The Kaskaskia, Little Muddy, Little Wabash, Embarras, and Skillet Fork rivers are part of this area. This region is covered with loess, which overlies old glacial drift (Illinoisan till) that has a high content of clay. Fragipans are also present. Pennsylvanian limestone and shale bedrock underlay the glacial till. The dominant soil orders in this region are Alfisol and Mollisol. The soils in the area predominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained to poorly drained, and loamy or clayey. (USDA-NRCS, 2006).

Classification relationships

Major Land Resource Area (MLRA) (USDA-NRCS, 2006):
113 – Central Claypan Areas, Eastern Part

U.S. Forest Service Ecoregions (Cleland et al. 2007):
Domain: Humid Temperate Domain
Division: Hot Continental Division
Province: Eastern Broadleaf Forest (Continental)
Province Code: 222
Section: Central Till Plains, Oak-Hickory Section
Section Code: 222G

Ecological site concept

Note: This MLRA ecological site is poorly documented in the literature. There are no known remaining 113 MLRA reference sites. The following discussion is based on inherent soil properties of this ecological site and probable plant responses (growth and species composition) to high sodium levels associated within its subsoil.

This Natric savanna community type is found in south-central Illinois and occurs on broad, nearly level loess covered Illinoian till plains with Natric horizons that have high levels of sodium in the subsoil, a seasonally perched water table, and a slow rate of water transmission (SSS NRCS OSD 2018).

Natric Till Plain Savannas were controlled by variable sodium levels and sodium depths which influenced species composition and plant growth (Davis, et. al. 2012). The historic reference condition was probably a savanna or a prairie with widely spaced trees. These areas were locally known as “alkaline slicks” (Mohlenbrock 2014). Widely scattered pin oak (Quercus palustris Münchh.)*, post oak (Quercus stellata Wangenh.) and hickories (Carya spp.) were the primary overstory species. The understory contained a highly variable (based on depth to sodium) prairie like ground flora with patchy distribution of sedges, grasses and forbs. (Schwegman, et. al. 1973; Mohlenbrock 2014).

Species overlap with the adjacent ecological sites, such as Wet Upland Prairies and Wet Upland Woodlands, was probably common. Along with pin oak and post oak, other trees that may have been present include American elm (Ulmus americana L.), ash (Fraxinus spp.) and swamp white oak (Quercus bicolor Willd.). The ground layer was likely variable depending on sodium levels and sodium depths. Species such as bluejoint (Calamagrostis canadensis (Michx.) P. Beauv) were likely present as well as big bluestem (Andropogon gerardii Vitman), switchgrass (Panicum virgatum L.), Indiangrass (Sorghastrum nutans (L.) Nash), little bluestem (Schizachyrium scoparium (Michx.) Nash) and Canada wild rye (Elymus canadensis L.). Carolina rose (Rosa carolina L.), possumhaw (Ilex decidua Walter), green hawthorn (Crataegus viridis L.) and sumac (Rhus spp.) formed the shrub layer. Sedges (Carex spp.) were also present in the herbaceous layer along with forbs such as foxglove beardtongue (Penstemon digitalis Nutt. ex Sims), and dotted smartweed (Polygonum punctatum Elliott). Narrowleaf mountain mint (Pycnanthemum tenuifolium Schrad.), an aromatic herbaceous species more commonly associated with dry uplands, was frequently present and reflected the dry conditions seasonally found in this savanna community (Schwegman, J. 1997; NatureServe - Comprehensive Report Association: CEGL002024, 2018; NatureServe - Alliance Detail Report: A3431, 2018; NatureServe - Comprehensive Report Association: CEGL002101, 2018). These sites occasionally ponded water during high rainfall events. Fire also played a role in keeping woody species at bay.

Associated sites

F113XY919IL	**Wet Silty Floodplain Forest** Wet Silty Floodplain Forests occur in the floodplain areas below Natric Till Plain Savannas.
F113XY905IL	**Wet Upland Woodland** Similar drainage and landscape position but woody species have a different species dominance due to Fragic soil characteristics and lower sodium subsoil levels.
R113XY904IL	**Upland Prairie** Prairie ecological site has similar ground flora and is often mapped in a complex with Natric Till Plain Savannas but does not have a Natric horizon and is more productive.

Similar sites

R113XY904IL	**Upland Prairie** Prairie ecological site has similar ground flora and is often mapped in a complex with Natric Till Plain Savannas but does not have a Natric horizon and is more productive.

Table 1. Dominant plant species

Tree	(1) *Quercus stellata*
Shrub	(1) *Rosa carolina*
Herbaceous	(1) *Carex* (2) *Panicum virgatum*

Physiographic features

This site is primarily on nearly level, broad till plains (talfs), with slopes 0 to 2 percent (some map units are on side slopes of summits up to 5 percent). The site generates runoff to adjacent, downslope ecological sites. This site does not flood (SSS NRCS OSD, 2018).

Table 2. Representative physiographic features

Hillslope profile	(1) Summit

Slope shape across	(1) Convex
Geomorphic position, flats	(1) Talf
Landforms	(1) Upland > Till plain (2) Upland > Ground moraine (3) Upland > Depression
Runoff class	Low to medium
Flooding frequency	None
Ponding duration	Very brief (4 to 48 hours) to long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	104–415 m
Slope	0–5%
Ponding depth	0–15 cm
Water table depth	15–91 cm
Aspect	Aspect is not a significant factor

Climatic features

The soil temperature regime of MLRA 113 is classified as mesic, where the mean annual soil temperature is between 47 and 59°F. Temperature and precipitation occur along a north-south gradient, where temperature and precipitation increase the further south you travel (USDA-NRCS 2006). The majority of the precipitation occurs as rainfall in the form of convective thunderstorms during the growing season.

Table 3. Representative climatic features

Frost-free period (characteristic range)	155-163 days
Freeze-free period (characteristic range)	187-193 days
Precipitation total (characteristic range)	1,041-1,143 mm
Frost-free period (actual range)	153-168 days
Freeze-free period (actual range)	183-194 days
Precipitation total (actual range)	1,041-1,194 mm
Frost-free period (average)	159 days
Freeze-free period (average)	189 days
Precipitation total (average)	1,092 mm

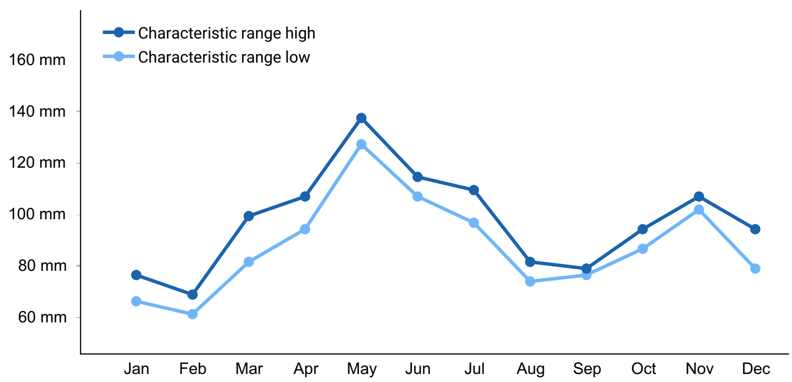


Figure 1. Monthly precipitation range

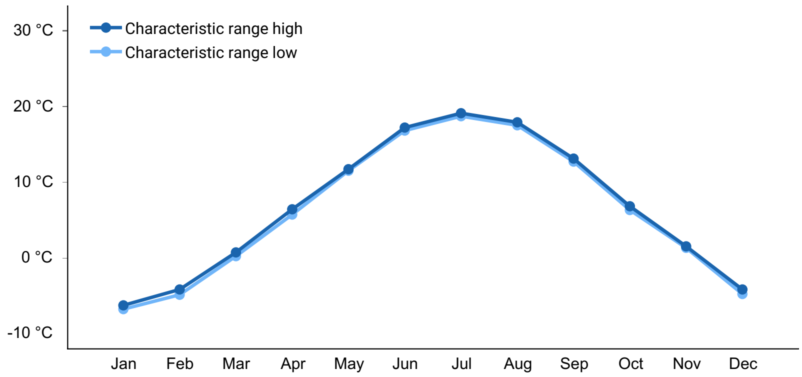


Figure 2. Monthly minimum temperature range

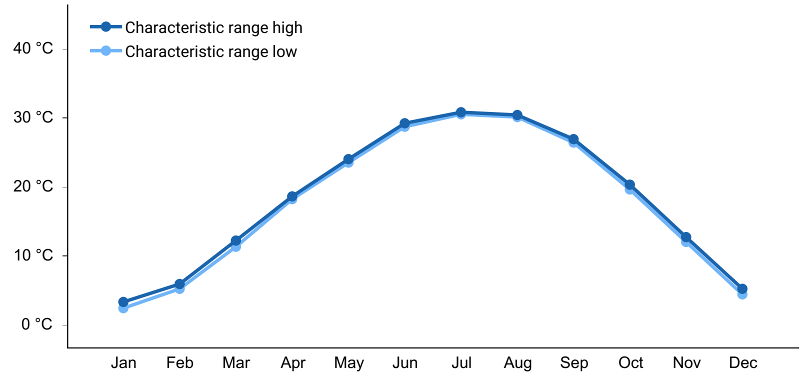


Figure 3. Monthly maximum temperature range

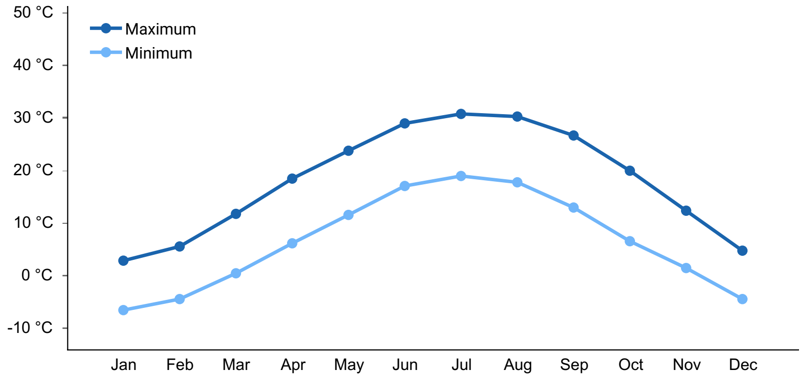


Figure 4. Monthly average minimum and maximum temperature

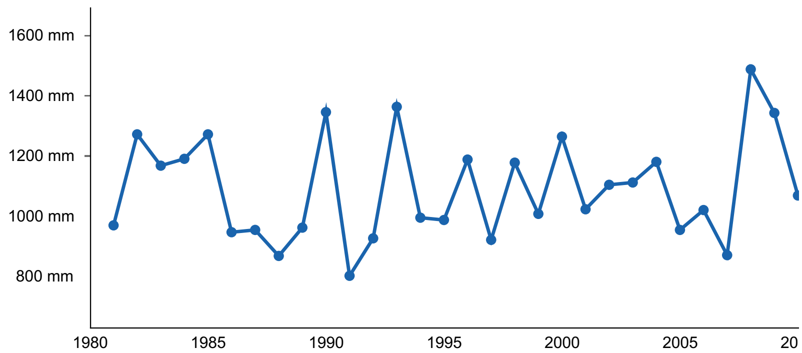


Figure 5. Annual precipitation pattern

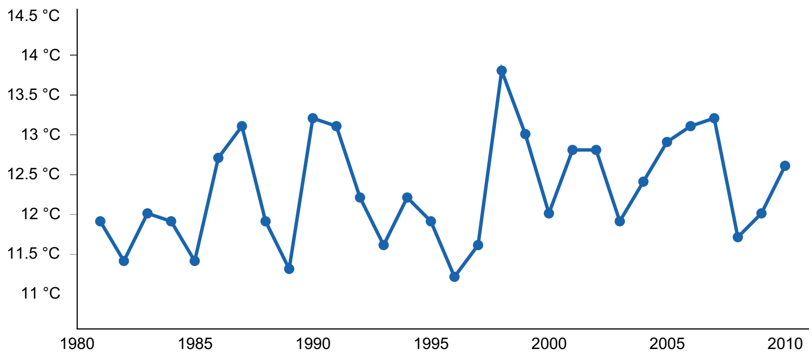


Figure 6. Annual average temperature pattern

Climate stations used

- (1) RAMSEY [USC00117126], Ramsey, IL
- (2) NEWTON [USC00116157], Newton, IL
- (3) OLNEY 2S [USC00116446], Olney, IL
- (4) VANDALIA [USC00118781], Vandalia, IL
- (5) EFFINGHAM 3SW [USW00093816], Effingham, IL

Influencing water features

This ecological site is influenced by a seasonal high water table, as well as slow hydraulic conductivity, which impedes through flow from precipitation. The water table is typically near the surface in early winter through spring, receding in the summer. Some depression areas pond for short periods of time, mostly in the spring. These shallow depression areas were more common prior to the conversion of many areas of this ecological site to cropland. Leveling and surface drainage have reduced or eliminated the shallow depressions. Infiltration is very slow and surface runoff is low to negligible (SSS NRCS WSS, 2018). These areas have a Natric horizon near the surface, with a slow rate of water transmission. (SSS NRCS OSD, 2018).

Wetland description

This ecological site may contain wetlands which fit into the MINERAL FLAT class in the hydrogeomorphic (HGM) system (Brinson, 1993). The primary water source is direct precipitation. Vertical water percolation in the soil is impeded by the Natric horizon resulting in significant lateral discharge to adjacent downslope ecological sites. In general, MINERAL FLAT areas provide watershed recharge and runoff that accumulates in downslope reaches as groundwater discharge and surface water accumulation. Wetland hydrology is effectively removed by surface ditches or subsurface tile drainage that directs vertical downward movement in a horizontal direction to the drainage element.

Soil features

These soils are very deep, moderately well, somewhat poorly and poorly drained and seasonally wet. They formed in loess or in loess and the underlying erosional sediments which overlie a strongly weathered paleosol in Illinoian till. These soils contain a significant concentration of exchangeable sodium in the subsoil. A seasonal high water table, near the surface to 3 feet below the surface, is present through the spring, receding in the summer. Soils of this ecological site are in the Alfisol order, further classified as fine-silty, mixed, superactive, mesic Aquic Natrudalfs or fine-silty, mixed, superactive, mesic Typic Natraqualfs (Table 5). Soil series associated with this site include Darmstadt, Huey, and Tamalco (NCSS, 2018; SSS NRCS OSD, 2018).

Table 4. Representative soil features

Parent material	(1) Loess (2) Pedisediment (3) Drift
Surface texture	(1) Silt loam

Family particle size	(1) Fine-silty
Drainage class	Poorly drained to moderately well drained
Permeability class	Very slow
Soil depth	183 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	5.08–15.24 cm
Calcium carbonate equivalent (Depth not specified)	0–30%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–40
Soil reaction (1:1 water) (Depth not specified)	4.5–9
Subsurface fragment volume <=3" (Depth not specified)	0–3%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

MLRA 113 has areas (Natric Till Plain Savannas) where the subsoil contains high sodium levels (alkaline slicks) (Mohlenbrock 2014). The sodium landscape pattern is often variable, so soils are frequently mapped in complexes with other non-Natric soils (NCSS, 2018). This landscape pattern is visually apparent when soils get dry. Water is less available in high sodium areas, so when weather turns dry, drought symptoms appear first in the high sodium areas. Even in saturated soils, with extremely high levels of sodium, the pull of sodium is so strong, plants can become water starved (Munns, 1993).

Species composition in a Natric Till Plain Savanna is regulated by the concentration and depth of sodium, depth to water table, soil physical properties and associations with nearby ecological sites. Soils are very slowly permeable due to a high sodium levels. This results in a shallow, perched water table during the winter and spring, and dry conditions during the summer and fall, thereby restricting rooting depth (NCSS, 2018; SSS NRCS OSD, 2018). During the summer and periods of drought, soils in this community can become quite dry. The salt in the soil solution (the “osmotic stress) also reduces leaf growth and to a lesser extent root growth, and decreases stomatal conductance and thereby photosynthesis (Munns, 1993). These actions have direct implications on plant growth and community composition for the site (Davis, et. al. 2012).
The primary physical processes associated with high sodium concentrations are soil dispersion and clay platelet and aggregate swelling. The forces that bind clay particles together are disrupted when too many large sodium ions come between them. When this separation occurs, the clay particles expand, causing swelling and soil dispersion. Soil dispersion causes clay particles to plug soil pores, resulting in reduced soil permeability. The three main problems caused by sodium-induced dispersion are reduced infiltration, reduced hydraulic conductivity, and surface crusting. Soil dispersion hardens soil and blocks water infiltration, making it difficult for plants to establish and grow. The major implications associated with decreased infiltration due to sodium-induced dispersion include reduced plant available water and increased runoff and soil erosion. (Davis, et. al. 2012; Pearson 2003)
Soil dispersion not only reduces the amount of water entering the soil, but also affects hydraulic conductivity of soil. For instance, soils with well-defined structure will contain a large number of macropores, cracks, and fissures which allow for relatively rapid flow of water through the soil. When sodium-induced soil dispersion causes loss of soil structure, the hydraulic conductivity is reduced. If water cannot pass through the soil, then the upper layer can become swollen and water logged. This results in anaerobic soils which can further reduce or prevent plant growth and decrease organic matter decomposition rates. (Franzen et. al. 2010; Pearson 2003)

Fire also played a major role in the maintenance of this Natric Till Plain Savanna. Ignition sources included summertime lightning strikes from convective storms and bimodal, human ignitions during the spring and fall seasons. Native Americans regularly set fires to improve sight lines for hunting, driving large game, improving grazing and browsing habitat, agricultural clearing, and enhancing vital ethnobotanical plants (Barrett 1980). Woody species can become more abundant in the absence of fire. These periodic fires removed the litter, and stimulated the growth and flowering of the grasses and forbs. During fire free intervals, woody understory species increased and the herbaceous understory diminished. The return of fire would open up the prairies again and stimulate the abundant ground flora species. (Anderson, 1975; Brugam et.al., 2016; White, 1978).

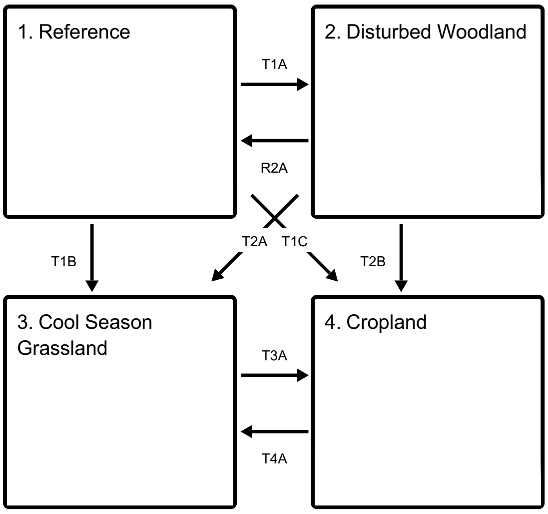
In addition to high sodium levels and fire, Natric Till Plain Savannas were also subjected to disturbances from grazing by native large herbivores, such as bison (Bos bison), prairie elk (Cervus elaphus), and white-tailed deer (Odocoileus virginianus). (Anderson, 1982). This activity may have served a more limited role, compared to fire, in impacting community composition and structure but still likely contributed to woody species reduction.

Today, most Natric Till Plain Savannas have been drained and converted to agricultural production. A return to the historic plant community may not be possible following extensive land modification, but long-term conservation or prairie reconstruction efforts can help to restore some biotic diversity and ecological function.

A provisional state and transition diagram is depicted in Figure 2. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios may not be included. It may change as knowledge increases.

State and transition model

Ecosystem states



T1A - Fire suppression > 30 years; woody invasion; domestic uncontrolled grazing

T1B - Woody removal; vegetative seeding; grassland management

T1C - Tillage; conservation cropping system; water management

R2A - Access control; prescribed fire; vegetative seeding; savanna management

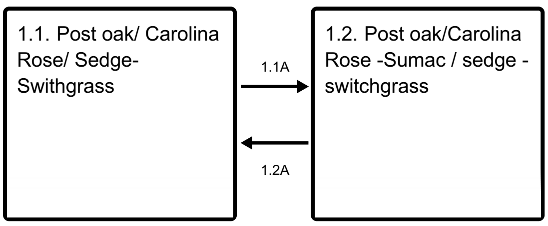
T2A - Woody removal; tillage; vegetative seeding; grassland management

T2B - Woody removal; tillage; conservation cropping system; water management

T3A - Tillage; conservation cropping system; water management

T4A - Vegetative seeding ; grassland management

State 1 submodel, plant communities



1.1A - Fire interval greater than 10 years

1.2A - Fire interval 3-5 years

State 1
Reference

This state is a savanna community dominated by big bluestem, switchgrass, sedges and forbs, with an overstory of scattered oaks and hickories. This state occurs on level to gently sloping soils that have high sodium levels and a seasonal high water table during the spring months in most years. Some ponding may also occur. These conditions influence the species composition and site productivity. Two phases can occur that will transition back and forth depending on fire and wetness frequencies. This state is extremely rare (maybe completely expatriated). Nearly all sites have been converted to cool season grassland and cropland. Some altered sites have transitioned to woodland.

Dominant plant species

- post oak (*Quercus stellata*), tree
- Carolina rose (*Rosa carolina*), shrub
- sedge (*Carex*), grass
- switchgrass (*Panicum virgatum*), grass

Community 1.1
Post oak/ Carolina Rose/ Sedge-Swithgrass

Dominant plant species

- post oak (*Quercus stellata*), tree
- Carolina rose (*Rosa carolina*), shrub
- sedge (*Carex*), grass
- switchgrass (*Panicum virgatum*), grass

Community 1.2
Post oak/Carolina Rose -Sumac / sedge -switchgrass

The overstory in this phase is dominated by post oak with scattered blackjack oak and hickories. This brushy woodland community typically has a three-tiered structure. It is characterized by a thick understory of oak and hickory saplings, and shrubs. The herbaceous layer is reduced but still dominated by little bluestem. Fire-free intervals likely ranged from 5 to 20 years.

Dominant plant species

- post oak (*Quercus stellata*), tree
- Carolina rose (*Rosa carolina*), shrub
- oak (*Quercus*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- wildrye (*Elymus*), grass

Pathway 1.1A
Community 1.1 to 1.2

Fire interval greater than 10 years

Pathway 1.2A
Community 1.2 to 1.1

Fire interval 3-5 years

State 2
Disturbed Woodland

These existing alternative areas have experienced fire exclusion for decades along with periodic uncontrolled domestic livestock grazing. In the absence of fire, ongoing recruitment of trees into the canopy develops a closed canopy, shading out the herbaceous ground flora. Oak, hickory and midstory species increase. Herbaceous cover and diversity greatly diminishes, leaf litter builds up, and more shade-tolerant species persist.

Dominant plant species

- pin oak (*Quercus palustris*), tree
- swamp white oak (*Quercus bicolor*), tree
- red maple (*Acer rubrum*), tree
- American elm (*Ulmus americana*), tree
- goldenrod (*Solidago*), other herbaceous

State 3
Cool Season Grassland

Conversion of other states to non-native cool season species such as tall fescue (*Schedonorus arundinaceus* (Schreb.) Dumort., nom. cons.) and white clover (*Trifolium repens* L.) has occurred in the MLRA. A return to the reference state may be impossible, requiring a very long term series of management options.

Dominant plant species

- tall fescue (*Schedonorus arundinaceus*), grass
- creeping bentgrass (*Agrostis stolonifera*), grass
- white clover (*Trifolium repens*), other herbaceous

State 4
Cropland

This is the dominant state that exists currently with intensive cropping of corn (*Zea mays* L.), soybeans (*Glycine max* (L.) Merr.), and common wheat (*Triticum aestivum* L.) occurring. When weather turns dry, drought symptoms on crops often appear (Figure 3). Some conversion to cool season hay land occurs for a limited period of time before transitioning back to cropland.

Dominant plant species

- corn (*Zea mays*), grass
- common wheat (*Triticum aestivum*), grass
- soybean (*Glycine max*), other herbaceous

Transition T1A
State 1 to 2

Fire suppression > 30 years; woody invasion; domestic uncontrolled grazing

Transition T1B
State 1 to 3

Woody removal; vegetative seeding; grassland management

Transition T1C
State 1 to 4

Tillage; conservation cropping system; water management

Restoration pathway R2A
State 2 to 1

Access control; prescribed fire; vegetative seeding; savanna management

Transition T2A
State 2 to 3

Woody removal; tillage; vegetative seeding; grassland management

Transition T2B
State 2 to 4

Woody removal; tillage; conservation cropping system; water management

Transition T3A
State 3 to 4

Tillage; conservation cropping system; water management

Transition T4A
State 4 to 3

Vegetative seeding ; grassland management

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 and ecological dynamics 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 the sources identified in ecological site description.

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Other references

Relationship to other established ecological classifications:
Biophysical Setting (LANDFIRE, 2018); the reference community of this ecological site is most similar to: Central Wet-Mesic Tallgrass Prairie.

National Vegetation Classification System (NatureServe, 2018): the reference community of this ecological site is most similar to the following NVC Association: Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus Wet Meadow; CEGL002024.

Illinois Natural Areas Survey (INAS) (White, 1978); the reference community of this ecological site is most similar to: INAS Community Class – Prairie; Natural community – Wet-Mesic Prairie

Contributors

Douglas Wallace
Ralph Tucker
Zach Weber

Approval

Suzanne Mayne-Kinney, 5/17/2024

Acknowledgments

Contact information for primary authors: Ralph Tucker (ralph.tucker@mo.usda.gov), Soil Scientist, United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS), Union, MO; Zach Weber (zach.weber@il.usda.gov), Soil Scientist, USDA-NRCS, Olney, IL; Douglas Wallace (doug.wallace@mo.usda.gov), Ecologist, USDA-NRCS, 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	05/21/2024
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:**

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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:**

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

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

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

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

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

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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):**

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:**
