USDA Natural Resources Conservation Service

Ecological site F109XY007MO
Till Upland Woodland

Accessed: 05/03/2024

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.

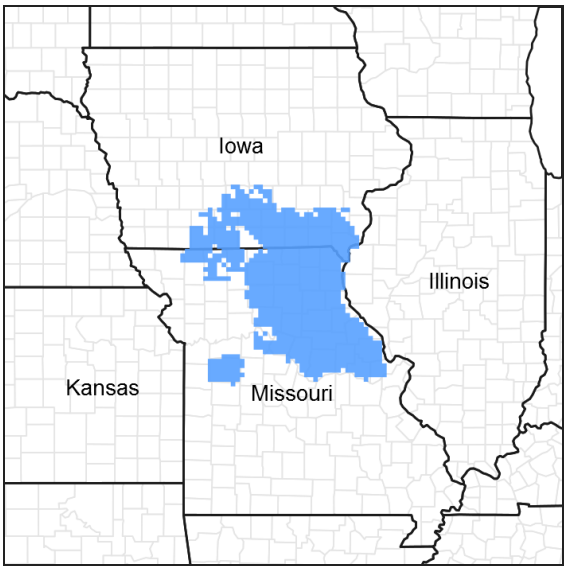


Figure 1. Mapped extent

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): 109X–Iowa and Missouri Heavy Till Plain

The Iowa and Missouri Heavy Till Plain (area outlined in red on the map) is an area of rolling hills interspersed with interfluve divides and alluvial valleys. Elevation ranges from about 660 feet along the lower reaches of rivers, to about 980 feet on stable interfluve summits in southern Iowa. Relief is about 80 to 160 feet between major streams and adjacent interfluve summits. Most of the till plain drains south to the Missouri River via the Grand and Chariton River systems, but the northeastern portion drains southeast to the Mississippi River. Loess caps the pre-Illinoisan aged till on interfluves, whereas the till is exposed on side slopes. Mississippian aged limestone and Pennsylvanian aged sandstone and shale crop out on lower slopes in some areas.

Classification relationships

Terrestrial Natural Community Type in Missouri (Nelson, 2010):
The reference state for this ecological site is most similar to a Dry-Mesic Loess/Glacial Till Woodland.

Missouri Department of Conservation Forest and Woodland Communities (Missouri Department of Conservation, 2006):
The reference state for this ecological site is most similar to a White Oak Loess/Glacial Till Woodland.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):

The reference state for this ecological site is most similar to a Quercus alba - (Carya ovata)/ Carex pensylvanica Glaciated Woodland (CEGL002134).

Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002):
This ecological site occurs in many Land Type Associations, primarily within the following Subsections:
Chariton River Hills
Claypan Till Plains
Mississippi River Hills
Wyaconda River Dissected Till Plains

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. As additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”.

Till Upland Woodlands are within the green areas on the map. They occur primarily in the eastern portion of the Till Plain. These sites are typically associated with loess woodland sites, which are upslope on summits, and till backslope woodland and forest sites downslope. In prairie transition areas, loess prairie ecological sites are upslope on summits. Soils are very deep, with dense till subsoils that are mainly clay loam. The reference plant community is woodland with an overstory dominated by white oak and black oak, and a ground flora of native grasses and forbs.

Associated sites

F109XY003MO	**Loess Upland Woodland** Loess Upland Woodlands are upslope, on summits.
F109XY009MO	**Till Protected Backslope Forest** Till Protected Backslope Woodlands are downslope, on steep backslopes with northern to eastern aspects.
F109XY022MO	**Till Exposed Backslope Woodland** Till Exposed Backslope Woodlands are downslope, on steep backslopes with southern to western aspects.

Similar sites

F109XY003MO	**Loess Upland Woodland** Loess Upland Woodlands have similar overstory composition but a somewhat drier ground layer composition. Productivity is higher due to the deeper loess influence.

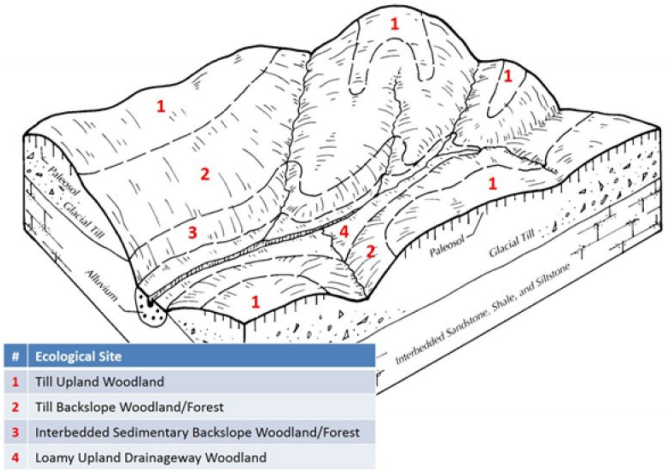
Table 1. Dominant plant species

Tree	(1) *Quercus alba* (2) *Quercus velutina*
Shrub	(1) *Rhus aromatica*
Herbaceous	(1) *Bromus pubescens* (2) *Helianthus hirsutus*

Physiographic features

This site is on upland summits, shoulders and backslopes with slopes of 1 to 15 percent. The site generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Benham, 1995) shows the typical landscape position of this ecological site, and landscape relationships among the major ecological sites in the uplands. The site is within the area labeled “1”, and is typically upslope from steeper backslope till ecological sites. In less dissected landscapes this ecological site may be downslope from a loess ecological site on a summit.



#	Ecological Site
1	Till Upland Woodland
2	Till Backslope Woodland/Forest
3	Interbedded Sedimentary Backslope Woodland/Forest
4	Loamy Upland Drainageway Woodland

Figure 2. Landscape relationships for this ecological site

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Interfluve (3) Hill
Flooding frequency	None
Ponding frequency	None
Slope	5–14%
Water table depth	30–183 cm
Aspect	Aspect is not a significant factor

Climatic features

The Iowa and Missouri Heavy Till Plain MLRA 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.

This MLRA experiences small regional differences in climates that grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line from north to south. Both mean annual temperature and precipitation exhibit fairly minor gradients along this line.

Mean January minimum temperature follows the north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the region. Mean July maximum temperatures have a range of only two to three degrees across the region.

Mean annual precipitation varies along the same gradient as temperature – lower annual precipitation in the north, higher in the south. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages four to five times greater than January precipitation.

During years when precipitation is normal, moisture is stored in the soil profile 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 influences ecological communities by limiting water supplies, especially at times of high temperatures and high evaporation rates. Drought indirectly affects ecological communities by increasing plant and animal susceptibility to the

probability and severity of fire. Frequent fires encourage the development of grass/forb dominated communities and understories.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. 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. Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier, supporting more grass dominated communities than adjacent north- and-east-facing slopes that are cooler and moister that support more woody dominated communities. Finally, the climate within a canopied forest ecological site is measurably different from the climate of the more open grassland or savanna ecological sites.

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 (average)	162 days
Freeze-free period (average)	183 days
Precipitation total (average)	1,092 mm

Climate stations used

- (1) SALISBURY [USC00237514], Salisbury, MO
- (2) RATHBUN DAM [USC00136910], Centerville, IA
- (3) BEACONSFIELD [USC00130536], Ellston, IA
- (4) DONNELLSON [USC00132299], Donnellson, IA
- (5) LONG BRANCH RSVR [USC00235050], Macon, MO
- (6) CHARITON 1 E [USC00131394], Chariton, IA
- (7) KEOSAUQUA [USC00134389], Keosauqua, IA
- (8) LAMONI [USC00134585], Lamoni, IA

Influencing water features

This ecological site is not influenced by wetland or riparian water features. However, seeps may occur in headslope positions, particularly in the spring, and following heavy rainfall events. These seeps are source areas for first-order ephemeral streams, typically within Upland Drainageway ecological sites downslope. Where present, these headslope seeps are in the SLOPE wetlands class of the Hydrogeomorphic (HGM) classification system (Brinson, 1993).

Soil features

These soils have no rooting restrictions. The soils were formed under woodland vegetation, and have thin, light-colored surface horizons. Parent material is till. They have loam surface layers, with dense subsoils that are mainly clay loam. Some soils are slightly affected by seasonal wetness. Soil series associated with this site include Ashgrove, Keswick, Lindley, and Winnegan.

The accompanying picture of the Keswick series shows a thin, light-colored surface horizon overlying the brown clayey till. Indicators of seasonal wetness (redoximorphic features) are visible in the picture below about 20 inches, but wetness does not impact the woodland reference community for this ecological site. Picture courtesy of Fred Young; scale is in inches.

Figure 7. Keswick series

Table 4. Representative soil features

Surface texture	(1) Loam (2) Clay loam (3) Silt loam
Family particle size	(1) Clayey
Drainage class	Somewhat poorly drained to well drained
Permeability class	Slow
Surface fragment cover <=3"	0–2%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	12.7–15.24 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)	4.5–6
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0%

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 woodland dominated by an overstory of white oak and black oak. This woodland type has a moderate canopy closure (50 to 80 percent), with an open understory and a dense, diverse herbaceous ground flora. Historically, white oak dominated the canopy, along with black oak and occasional hickories, bur oak

and post oak.

Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving ground flora species. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees, and tree height growth.

Fire played an important role in the maintenance of these systems. It is likely that these ecological sites burned at least once every 5 to 10 years. These periodic fires kept woodlands open, 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 the woodlands up again and stimulate the abundant ground flora.

Today, this community has either been cleared and converted to pasture, or has grown dense in the absence of fire. Most occurrences today exhibit canopy closure of 80 to 100 percent. In addition, the sub-canopy and understory layers are better developed. Black oak and hickory now share dominance with white oak with considerable more saplings in the understory. Under these denser, more shaded conditions, the original sun-loving ground flora has diminished in diversity and cover. While some woodland species persist in the ground flora, many have been replaced by more shade-tolerant species.

In the long term absence of fire, woody species, especially hickory and hornbeam encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration means.

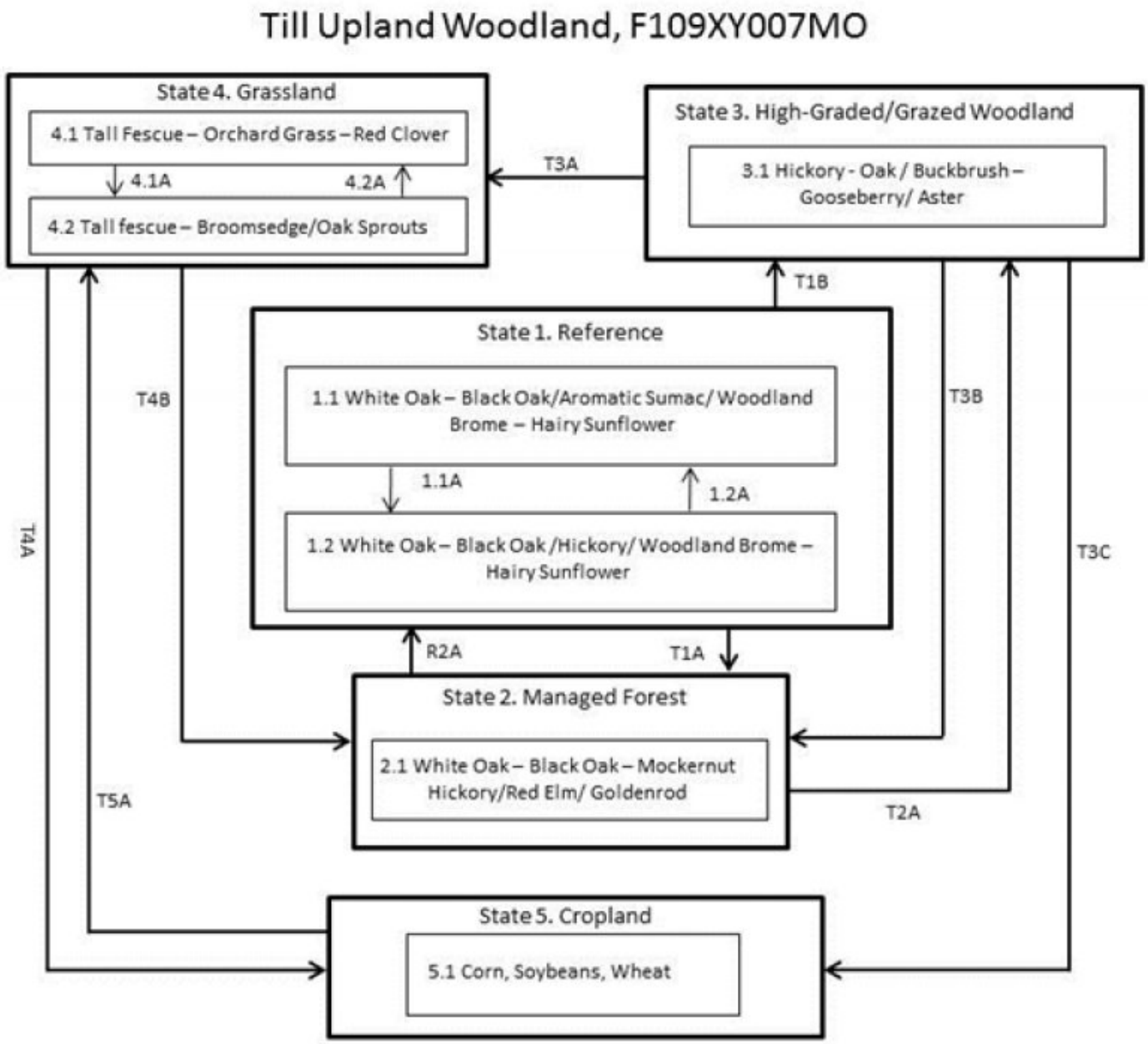
Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as buckbrush, gooseberry, and Virginia creeper. Grazed sites also have a more open understory. In addition, soil compaction and soil erosion related to grazing can be a problem and lower site productivity.

This ecological site is moderately productive and, if managed properly, can be a valuable source for timber products especially white oak. Most areas on this ecological site have been repeatedly logged and high graded. Even-age management, using clearcut, or shelterwood and seed tree harvest systems without fire will perpetuate the overly dense, shaded conditions of current stands. Thinning and/or occasional partial cuts, using an uneven-age management system can provide sunlight to the woodland floor, stimulating native woodland ground flora. However, in the absence of fire and continual cultural treatments, oaks sprout and grow into a dense stand, again shading out the sun-loving ground flora.

Partial cutting and prescribed fire can, however, restore the more open structure and diversity of ground flora species. Managed areas show an exceptional resiliency and production. This type of management can provide timber products, wildlife habitat, and potential native forage.

A State and Transition 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 is likely to change as knowledge increases.

State and transition model



Code	Event/Activity/Process
T1A	Fire suppression; controlled harvesting
T1B	Poorly planned harvest; uncontrolled grazing
T2A	Uncontrolled harvesting and grazing
T3A	Clearing; pasture planting; prescribed grazing
T3B	forest management; tree planting; no grazing
T3C	Clearing; tillage; crop rotation
T4A	Tillage; crop rotation
T4B	forest management; tree planting;
T5A	Pasture planting; prescribed grazing
R2A	Prescribed fire; extended rotations; thinning

Code	Event/Activity/Process
1.1A	No disturbance >10 years
1.2A	Disturbance (fire, wind, ice) < 10 years
4.1A	Over grazing; no fertilization
4.2A	Brush management; prescribed grazing

Figure 8. Till Upland Woodland

State 1

Reference

The reference state for this ecological site was old growth oak woodland. The woodland was dominated by white oak and black oak. Maximum tree age was likely 150-300 years. Periodic disturbances from fire, wind and ice as well as grazing by native large herbivores maintained the woodland structure and diverse ground flora species. Long disturbance-free periods allowed an increase in both the density of trees and an increase in abundance of shade tolerant species. Two community phases are recognized in the Reference State, with shifts between phases based on disturbance frequency. Reference states are very rare today. Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Most Reference States are currently altered because of timber harvesting, domestic grazing or clearing and conversion to grassland or cropland.

Community 1.1
White Oak-Black Oak/Aromatic Sumac/Woodland Brome-Hairy Sunflower

Figure 9. Dark Hollow Conservation Area, Sullivan County, Missouri

This phase has an overstory that is dominated by white oak and black oak with hickory and northern red oak and post oak also present. This woodland community has a two-tiered structure with an open understory and a dense, diverse herbaceous ground flora. Periodic disturbances including fire, ice and wind create canopy gaps, allowing white oak and black oak to successfully reproduce and remain in the canopy.

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

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

Community 1.2
White Oak-Black Oak/Hickory/Woodland Brome-Hairy Sunflower

This phase is similar to community phase 1.1 but oak and hickory understory densities are increasing due to longer periods of fire suppression. Displacement of some grasses and forbs may be occurring due to shading and competition from the increased densities of oak and hickory saplings in the understory.

State 2
Managed Forest

Composition is altered from the Reference State depending on tree selections during harvesting. This state will slowly increase with more shade tolerant species and white oak will become less dominant and is also dense because of fire suppression. Without periodic canopy disturbance, stem density and fire intolerant species, like hickory, will increase in abundance. Uncontrolled grazing if present will also have an impact on community composition and understory quality diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as buckbrush, gooseberry, and Virginia creeper and will transition the site to a High-Graded/Grazed Woodland.

Community 2.1
White Oak-Black Oak-Mockernut Hickory/Red Elm/Goldenrod

State 3
High-Graded/Grazed Woodland

States that were subjected to repeated, high-grading timber harvests and uncontrolled domestic grazing will transition to a High-Graded, Grazed Woodland State. This state exhibits an over-abundance of hickory and other less desirable tree species, and weedy understory species such as buckbrush, gooseberry, poison ivy and Virginia creeper. The existing vegetation offers little nutritional value for cattle, and excessive cattle stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff. Two common transitions from this state are woody clearing and conversion to State 4, Grassland or removing livestock, limited harvesting, and allowing long term succession to occur to some other woodland or forest state.

Community 3.1
Hickory-Oak/Buckbrush-Gooseberry/Aster

State 4
Grassland

Conversion of woodlands to planted, non-native cool season grassland species such as tall fescue and red clover is common for this region. Two community phases are recognized in the Grassland State, with shifts between phases based on types and levels of management. Poor management will result in a shift to Community 4.2 that shows an increase in oak sprouting and increases in broomsedge densities. If grazing and active pasture management is discontinued, the site will eventually transition to State 2 or if grazing is continued will transition to State 3.

Community 4.1
Tall Fescue-Orchard Grass-Red Clover

This phase is well-managed grassland, composed of non-native cool season grasses and legumes. Grazing and haying is occurring. The effects of long-term liming on soil pH, and calcium and magnesium content, is most evident in this phase. Studies show that these soils have higher pH and higher base status in soil horizons as much as two feet below the surface, relative to poorly managed grassland (phase 4.2) and to woodland communities (where liming is not practiced).

Community 4.2
Tall Fescue-Broomsedge/Oak Sprouts

This phase is the result of over use, poor grassland and grazing management and lack of adequate nutrient application.

State 5
Cropland

This State exists currently with intensive cropping of corn, soybeans, and wheat occurring especially when commodity prices are high. Some conversion to cool season grassland occurs for a limited period of time before transitioning back to cropland. Limited acres are sometimes converted to native warm season grassland.

Community 5.1
Corn, Soybeans, Wheat

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							
white oak	QUAL	*Quercus alba*	Native	–	40–70	–	–
black oak	QUVE	*Quercus velutina*	Native	–	20–40	–	–
American plum	PRAM	*Prunus americana*	Native	–	10–20	–	–
hophornbeam	OSVI	*Ostrya virginiana*	Native	–	10–20	–	–
post oak	QUST	*Quercus stellata*	Native	–	10–20	–	–
slippery elm	ULRU	*Ulmus rubra*	Native	–	0–20	–	–
shagbark hickory	CAOV2	*Carya ovata*	Native	–	0–10	–	–
northern red oak	QURU	*Quercus rubra*	Native	–	0–10	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
hairy woodland brome	BRPU6	*Bromus pubescens*	Native	–	10–30
Virginia wildrye	ELVI3	*Elymus virginicus*	Native	–	5–20
eastern bottlebrush grass	ELHY	*Elymus hystrix*	Native	–	5–20
little bluestem	SCSC	*Schizachyrium scoparium*	Native	–	5–20
big bluestem	ANGE	*Andropogon gerardii*	Native	–	5–20
Pennsylvania sedge	CAPE6	*Carex pensylvanica*	Native	–	5–20
parasol sedge	CAUM4	*Carex umbellata*	Native	–	5–20
rock muhly	MUSO	*Muhlenbergia sobolifera*	Native	–	5–20
Forb/Herb					
elmleaf goldenrod	SOUL2	*Solidago ulmifolia*	Native	–	5–30
hairy sunflower	HEHI2	*Helianthus hirsutus*	Native	–	10–30
eastern purple coneflower	ECPU	*Echinacea purpurea*	Native	–	5–20
slender lespedeza	LEVI7	*Lespedeza virginica*	Native	–	10–20
Canadian blacksnakeroot	SACA15	*Sanicula canadensis*	Native	–	10–20
eastern beebalm	MOBR2	*Monarda bradburiana*	Native	–	10–20
fourleaf milkweed	ASQU	*Asclepias quadrifolia*	Native	–	10–20
smooth blue aster	SYLAC	*Symphyotrichum laeve var. concinnum*	Native	–	10–20
nakedflower ticktrefoil	DENU4	*Desmodium nudiflorum*	Native	–	10–20
bluejacket	TROH	*Tradescantia ohiensis*	Native	–	5–10
Shrub/Subshrub					
fragrant sumac	RHAR4	*Rhus aromatica*	Native	–	10–30
New Jersey tea	CEAM	*Ceanothus americanus*	Native	–	5–20
American hazelnut	COAM3	*Corylus americana*	Native	–	10–20
Vine/Liana					
Virginia creeper	PAQU2	*Parthenocissus quinquefolia*	Native	–	10–20
summer grape	VIAE	*Vitis aestivalis*	Native	–	10–20

Animal community

Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type.

Oaks provide hard mast; scattered shrubs provide soft mast; native legumes provide high-quality wildlife food; sedges and native cool-season grasses provide green browse; patchy native warm-season grasses provide cover and nesting habitat; and a diversity of forbs provides a diversity and abundance of insects. Post-burn areas can provide temporary bare-ground – herbaceous cover habitat important for turkey poults and quail chicks.

Bird species associated with mature communities include Indigo Bunting, Red-headed Woodpecker, Eastern Bluebird, Northern Bobwhite, Eastern Wood-Pewee, Broad-winged Hawk, Great-Crested Flycatcher, Summer Tanager, and Red-eyed Vireo.

Reptile and amphibian species associated with the Till Upland Woodland include tiger salamander, small-mouthed salamander, ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, flat-headed snake, and rough earth snake. (MDC 2006)

Other information

Forestry
Management: Site index values range from 55 to 70 for oak. These groups respond well to management and prescribed fire. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or group selection cuttings of 1 to 5 acres are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality and should be used with caution on a particular site if timber management is the primary objective.

Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Tier II Reconnaissance Plots
Potential Reference

Plot CURISP02 – Keswick soil – not yet sampled (as of 3/15)
Cuivre River State Park, Lincoln County, MO
Latitude: 39.052144
Longitude: -90.933587

Plot DAHOCA02 - Winnegan soil – not yet sampled (as of 3/15)
Dark Hollow CA, Sullivan County, MO
Latitude: 40.32494
Longitude: - 92.92907

Plot DAHOCA07 – Winnegan soil – not yet sampled (as of 3/15)
Dark Hollow CA, Sullivan County, MO
Latitude: 40.325239
Longitude: - 92.935185

Plot THHISP03 – Winnegan soil – Unburned, reference phase – not yet sampled (as of 3/15)
Thousand Hills State Park, Adair County, MO
Latitude: 40.17707
Longitude: - 92.62789

Alternate states or phases:

Plot PERSPO6 – Winnegan soil – Managed Woodland
Pershing State Park, Linn County, MO
Latitude: 39.761599
Longitude: - 92.21663

Plot PERSP07 – Winnegan soil – Managed Woodland
Pershing State Park, Linn County, MO
Latitude: 39.7161979
Longitude: -93.21388

Plot UNRICA02 – Keswick soil – High-graded, grazed, burned
Union Ridge CA, Sullivan County, MO
Latitude: 40.34788
Longitude: - 92.87608

Other references

Benham, Ken E. 1995. Soil Survey of Sullivan County, Missouri. U.S. Dept. of Agric. Natural Resources Conservation Service.

Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4, U.S. Army Corps of Engineers, Engineer Waterways Experiment Station, Vicksburg, MS.

Missouri Department of Conservation. 2006. Missouri Forest and Woodland Community Profiles. Missouri Department of Conservation, Jefferson City, Missouri.

NatureServe, 2010. Vegetation Associations of Missouri (revised). NatureServe, St. Paul, Minnesota.

Nelson, Paul W. 2010. The Terrestrial Natural Communities of Missouri. Missouri Department of Conservation, Jefferson City, Missouri.

Nigh, Timothy A., & Walter A. Schroeder. 2002. Atlas of Missouri Ecoregions. Missouri Department of Conservation, Jefferson City, Missouri.

Contributors

Doug Wallace
Fred Young

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:**