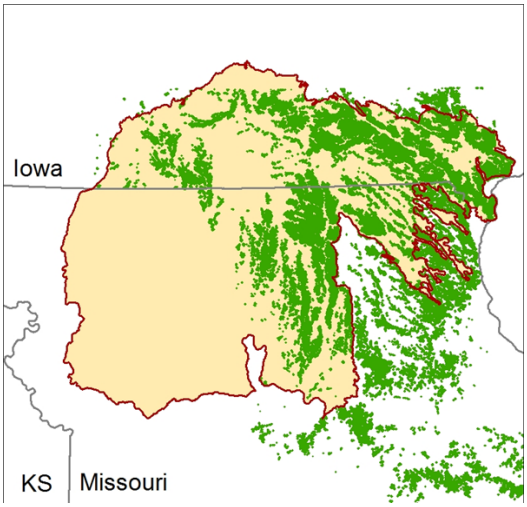
United States Department of Agriculture
Natural Resources Conservation Service
Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site name: **Till Exposed Backslope Woodland**
Quercus alba - *Quercus velutina* / *Rhus aromatica* / *Bromus pubescens* - Helianthus hirsutus
(white oak - black oak / fragrant sumac / hairy woodland brome - hairy sunflower)
Site type: Forestland
Site ID: F109XY022MO
Major land resource area (MLRA): 109-Iowa and Missouri Heavy Till Plain



Location of this ecological site within the MLRA.

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.

Ecological Site Concept

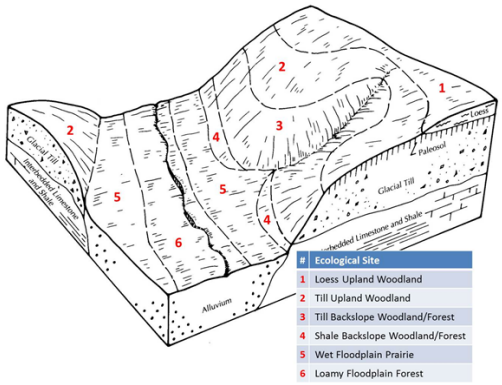
Till Exposed Backslope Woodlands are within the green areas on the map. They occupy the southerly and westerly aspects of steep, dissected slopes, and are mapped in complex with the Till Protected Backslope Forest ecological site. These ecological sites occur primarily in the eastern and southeastern portion of the Till Plain. They are typically downslope from Loess Upland Woodland or Till Upland Woodland ecological sites, and generally occupy the mid to lowest portion of the hillslope. In a few places, a narrow band of Shale Protected Backslope ecological site is downslope. Soils are very deep, with dense till subsoils that are mainly clay loam. The reference plant community is woodland dominated by an overstory of white oak and black oak, with an open understory and a dense, diverse herbaceous ground flora.

Physiographic Features

This site is on upland backslopes, with slopes of 14 to 35%. It is on exposed aspects (south, southwest, and west), which receive significantly more solar radiation than the protected aspects. The site receives runoff from upslope summit and shoulder sites, and generates runoff to adjacent, downslope ecological sites. This site does not flood.

The following figure (adapted from Festervand, 1994) shows the typical landscape position of this ecological site, and landscape relationships

among the major ecological sites in the uplands and adjacent floodplains. The site is within the area labeled “3”, and is typically downslope from Till Upland Woodland ecological sites. In areas where the local drainageways have not dissected into the underlying residuum, Upland Drainagway or Floodplain ecological sites are directly downslope.



Physiographic Image.—Landscape relationships for this ecological site

Landform: (1) Hill

	Minimum	Maximum
Slope (percent):	14	35
Water table depth (inches):	24	72
Flooding		
Frequency:	None	None
Ponding		
Frequency:	None	None
Runoff class:	High	Very high
Aspect:	South West SouthWest	

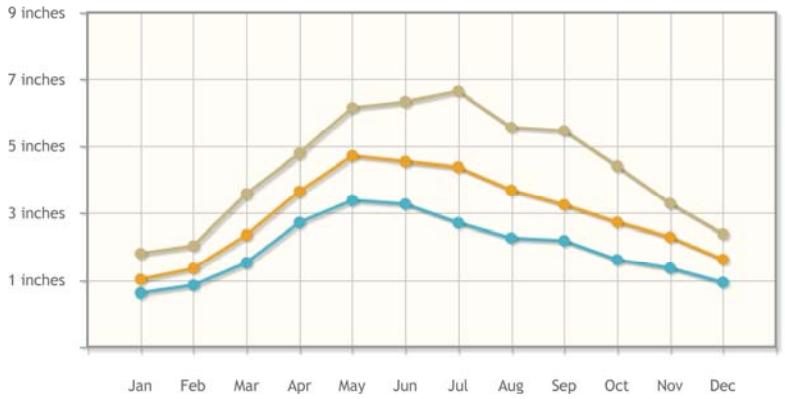
Climatic Features

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/

	Averaged
Frost-free period (days):	156
Freeze-free period (days):	183
Mean annual precipitation (inches):	42.74

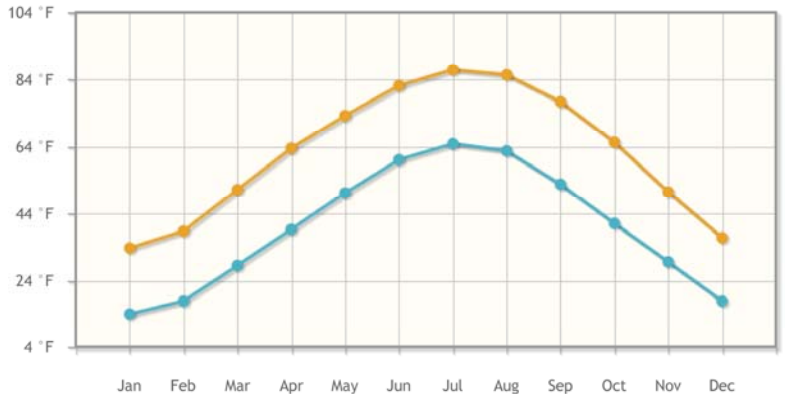
Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	1.80	2.03	3.58	4.78	6.16	6.33	6.65	5.56	5.46	4.40	3.29	2.38
Medium	1.02	1.35	2.35	3.65	4.71	4.54	4.37	3.69	3.25	2.73	2.29	1.62
Low	0.62	0.85	1.52	2.72	3.38	3.27	2.71	2.26	2.18	1.61	1.36	0.93



Monthly Temperature (°F):

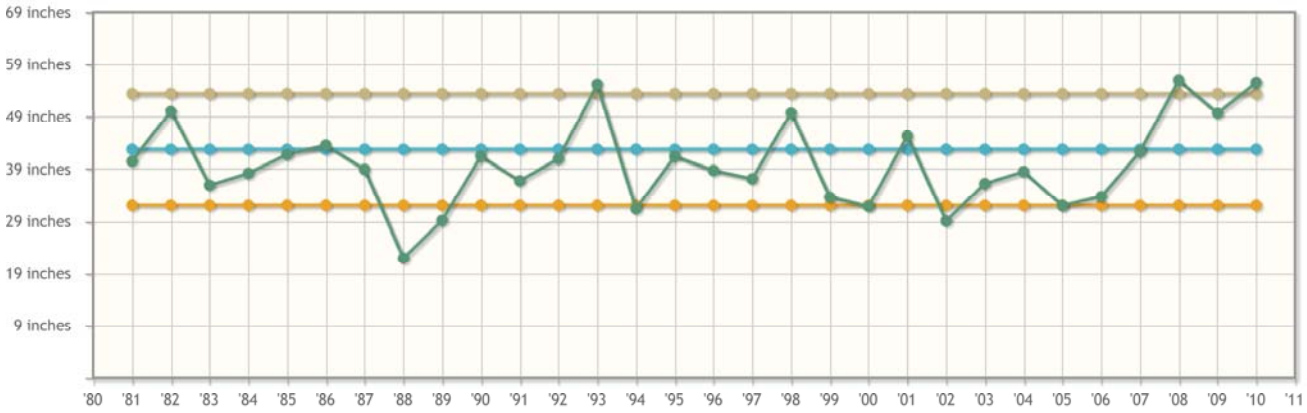
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	34.2	39.3	51.8	64.1	73.9	82.8	87.5	86.0	78.0	65.9	51.1	37.3
Low	14.5	18.4	29.0	39.8	50.8	60.7	65.4	63.3	53.4	41.6	30.1	18.4



30 Year Annual Rainfall (inches):

1981 N	1982 N	1983 N	1984 N	1985 N	1986 N	1987 N	1988 D	1989 D	1990 N	1991 N	1992 N	1993 H	1994 D	1995 N
40.46	50.05	35.94	38.18	41.75	43.49	38.93	21.99	29.15	41.43	36.77	40.95	55.1	31.36	41.39
1996 N	1997 N	1998 N	1999 N	2000 D	2001 N	2002 D	2003 N	2004 N	2005 D	2006 N	2007 N	2008 H	2009 N	2010 H
38.73	37.14	49.77	33.62	31.84	45.27	29.04	36.24	38.51	32	33.72	42.26	55.91	49.72	55.47

D-Drought N-Normal H-Heavy



Climate stations: (1) KEOSAUQUA [USC00134389], Van Buren County IA 52565. Period of record 1981-2010
(2) OSCEOLA [USC00136316], Clarke County IA 50213. Period of record 1981-2010
(3) CHILLICOTHE 2S [USC00231580], Livingston County MO 64601. Period of record 1981-2010
(4) UNIONVILLE [USC00238523], Putnam County MO 63565. Period of record 1981-2010

Influencing Water Features

This ecological site is not influenced by wetland or riparian water features.

Representative Soil Features

These soils have no major rooting restriction. 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. These soils are not affected by seasonal wetness. Soils in this exposed aspect ecological site typically have thinner surface horizons relative to similar soils on protected aspects (Steele, 2011). Soil series associated with this site include Brevator, Keswick, Lindley and Winnegan.

The accompanying picture of the Winnegan series shows a thin surface horizon overlying the brown clayey till. Threads and filaments of calcium carbonate are below about 1 meter in this profile, and are typical in soils of this ecological site. Picture courtesy of Amber Steele; scale is in centimeters.

Soils Profile Image.—Winnegan series

Parent materials
Kind: Till
Surface texture: (1) Loam
(2) Clay loam
(3) Silt loam
Subsurface texture group: Clayey

	Minimum	Maximum
Surface fragments <=3" (% cover):	0	4
Surface fragments >3" (% cover):	0	1
Subsurface fragments <=3" (% volume):	1	10
Subsurface fragments >3" (% volume):	0	4

Drainage class: Moderately well drained to well drained
Permeability class: Slow

	Minimum	Maximum
Available water capacity (inches):	5.00	6.00
Electrical conductivity (mmhos/cm):	0	2
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent (percent):	0	0
Soil reaction (1:1 water):	4.5	6.5

Plant Communities

Ecological Dynamics of the Site

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information is representative of very complex vegetational communities. Not all scenarios or plants are included or discussed. Key indicator plants, animals and ecological processes are described to help guide 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 biological processes on this site are complex. Therefore, representative values are presented in a land management context. 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 (Quercus alba) and black oak (Quercus velutina). 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 (Quercus macrocarpa) and post oak (Quercus stellata). Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving ground flora species (MDC, 2006; Nelson, 2010).

Fire played an important role in the maintenance of these systems. While these ecological sites normally occurred back from the prairie edge, they typically 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 (Frost 1996). 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 denser 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 (Carya sp.) now share dominance with white oak and there are considerably 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 (Steele et al. 2013).

In the long term absence of fire, woody species, especially hickory, hornbeam (Ostrya virginiana) and gooseberry (Ribes sp.) encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels, greatly diminishing ground flora. Opening the canopy, removing the younger understory and applying 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 (Symphoricarpos orbiculatus), gooseberry, and Virginia creeper (Parthenocissus quinquefolia). Grazed sites also have a more open understory. In addition, soil compaction and soil erosion related to over grazing can be a problem and lower site productivity.

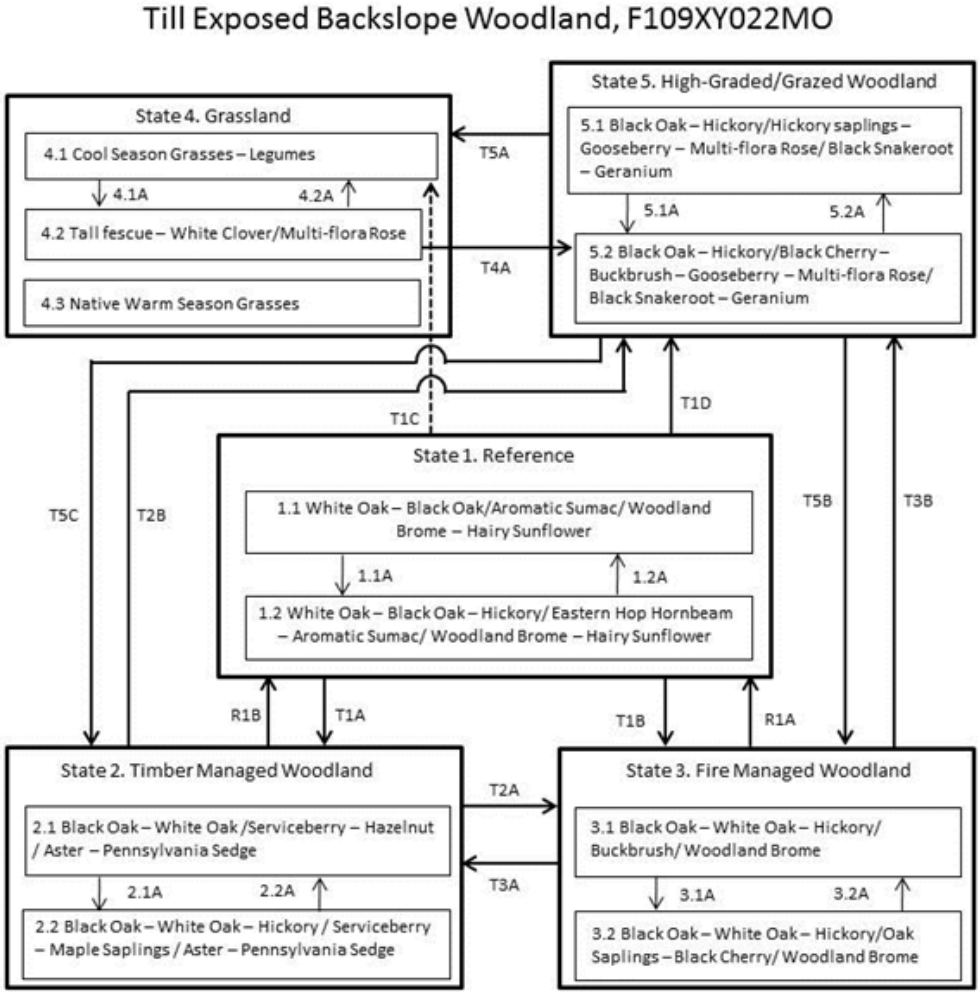
This ecological site, if managed properly, can be a source for timber products. Most areas on this ecological site have been repeatedly logged and high graded. Partial selective cutting will perpetuate the overly dense, shaded conditions of current stands. Even-age management, using clearcut, shelterwood or seed tree harvest systems and prescribed fire can restore the more open structure and diversity of ground flora species.

Managed areas show an exceptional resiliency and production. 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. This type of management can provide timber products, watershed protection, wildlife habitat, and potential native forage.

Finally, on some forested sites in the northern part of the MLRA, invasive non-native species of earthworms (suborder Lumbricina) are beginning to have broad effects on the nutrient cycles in temperate forests. These earthworms increase the cycling and leaching of nutrients by breaking up decaying organic matter and spreading it into the soil. Temperate forests rely on thick layers of decaying organic matter for growth and nutrition. The invasive earthworm presence and activity is diminishing the diversity of native plants in these environments. This change in the plant diversity directly affects the other organisms of the environment and often leads to increased invasions of exotic species as well as overall forest decline. Restoration to a reference state under these conditions will be more difficult if not dramatically reduced or impossible (Hendrix et al. 2006; Nuzzo et al. 2009).

A State and Transition Model Diagram is depicted in Figure 1. 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. The diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

State-and-Transition Diagram



Code	Event/Process/Activity
T1A	Fire suppression; forest timber management
T1B	Prescribed burning; forest stand improvement
T1C, T5A	Clearing; pasture planting; grassland management
T1D, T2B, T3B	High-grading harvesting; uncontrolled grazing
T2A	Prescribed fire; thinning
T3A	Fire suppression; forest timber management
T4A	Long-term succession; no grazing
T5B	Forest stand improvement; no grazing; prescribed burning
T5C	Forest stand improvement; no grazing; thinning

Code	Event/Process/Activity
R1A	Extended rotations; selective thinning
R1B	Prescribed fire; extended rotations; selective thinning

Code	Event/Process/Activity
1.1A	No disturbance (10+ years)
1.2A	Disturbance (fire, wind, ice) < 10 years
2.1A	No activity; idle
2.2A	Forest timber management
3.1A	No activity; idle; fire suppression
3.2A	Prescribed fire; selective thinning
4.1A	Over grazing; no management
4.2A	Brush management; grassland seeding; grassland management
5.1A	No activity; idle
5.2A	High-grading; uncontrolled grazing

State and transition model diagram

State 1: Reference

The reference state is dominated by white oak associated with black oak and other mixed hardwoods. Maximum tree age is likely 150 to 300 years. Periodic disturbances from fire, wind or ice maintain the dominance of white oak by opening up the canopy and allowing more light for white oak reproduction. Long disturbance-free periods allowed an increase in more shade tolerant species such as hop hornbeam and hickory. Two community phases are recognized in this state, with shifts between phases based on disturbance frequency.

The reference state is very rare throughout the MLRA. Many sites have been converted to grassland (State 4). Others have been subject to repeated, high-graded timber harvests coupled with domestic livestock grazing (State 5). Fire suppression has resulted in increased canopy density, which has affected the abundance and diversity of ground flora. Some reference sites have been managed for timber harvest,

resulting in a timber managed woodland (State 2) or if prescribed fire has been maintained or introduced (State 3) as a fire managed woodland.

Community Phase 1.1: White Oak – Black Oak/Aromatic Sumac/ Woodland Brome – Hairy Sunflower

Reference woodland at Rudolf Bennitt State Wildlife Area near Clark, Missouri - photo from MDC

This phase has an overstory that is dominated by white oak and black oak with hickory 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.

Community Phase Pathway 1.1A
This pathway results from the absence of disturbance allowing more shade tolerant species such as eastern hop hornbeam, hickories, white ash and others increase in importance and add structural diversity to the system. Some displacement of grasses and forbs may be occurring due to shading and competition from the increased densities of hickories and oaks

Structure and Cover

Soil Surface Cover

Cover type	Minimum	Maximum
Litter	0.2%	6%

Downed woody material	Minimum	Maximum	Predominant decomposition class*
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0.1%	2%	I
Downed wood, coarse-small (3.00-8.99" diameter; 1000-hour fuels)	0.1%	2%	I
Downed wood, coarse-large (>9.00" diameter; 10000-hour fuels)	0%	2%	I

Tree snags** per acre		
Hard snags***	0	10
Soft snags***	0	0

* Decomposition classes: N=No or little integration with the soil surface. I=Partial to nearly full integration with the soil surface.

** >4" diameter at 4.5' above ground and >6' height. If diameter or height is smaller, use applicable downed wood type. For pinyon and juniper, use 1.0' above ground.

*** Hard=Tree is dead with most or all of bark intact. Soft=Most of bark has sloughed off.

Ground Cover

Vegetative cover	Minimum	Maximum
Grasses/grasslikes	0.1%	0.99%
Forbs	0.1%	2%
Shrubs/vines	0.1%	0.99%
Trees	1%	2%

Nonvascular plants	0%	0%
Biological crust	0%	0%

Nonvegetative cover	Minimum	Maximum
Litter	50%	95%
Surface fragments >0.25" and <=3"	0%	0.1%
Surface fragments >3"	0%	0.1%
Bedrock	0%	0%
Water	0%	0%
Bare ground	0.01%	2%

Structure of Canopy Cover

Height above ground	Grasses/grasslikes		Forbs		Shrubs/vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 foot	2%	10%	5%	50%	1%	2%	1%	5%
>0.5 to <1 foot	0%	2%	5%	75%	0%	25%	2%	25%
>1 to <=2 feet	0%	2%	2%	50%	0%	5%	2%	25%
>2 to <4.5 feet	0%	0%	0%	2%	0%	10%	0%	5%
>4.5 to <=13 feet	0%	0%	0%	0%	0%	5%	1%	50%
>13 to <40 feet	0%	0%	0%	0%	0%	0%	0%	50%
<40 to >=80 feet	0%	0%	0%	0%	0%	0%	2%	75%
>80 to <120 feet	0%	0%	0%	0%	0%	0%	0%	95%
>=120 feet	0%	0%	0%	0%	0%	0%	0%	0%

Forest Overstory

White oak and black oak dominate with scattered hickory and post oak.

Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)

	Low canopy cover %	RV canopy cover %	High canopy cover %
Forest canopy:	50	65	80

Overstory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top	Tree diameter low	Tree diameter high	Basal area low	Basal area high
SHAGBARK HICKORY *Carya ovata*	CAOV2	N	2.0	10.0		90.0	5.0	11.0	6.7	8.6
WHITE OAK *Quercus alba*	QUAL	N	2.0	95.0		90.0	5.0	27.0	90.0	134.0
NORTHERN RED OAK *Quercus rubra*	QURU	N	5.0	25.0		90.0	13.0	21.0	9.3	24.0
BLACK OAK *Quercus velutina*	QUVE	N	10.0	25.0		85.0	13.0	17.0	25.0	25.0
mockernut hickory *Carya alba(syn)*	CAAL27	N	5.0	20.0		70.0				
BUR OAK *Quercus macrocarpa*	QUMA2	N	5.0	10.0		70.0				
POST OAK *Quercus stellata*	QUST	N	5.0	10.0		60.0				

Forest Understory

The understory layer is a dense native forb and grass ground layer with scattered shrubs.

Forest Understory Canopy Cover Summary (all species <13 feet in height)

Understory plant type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
	ANGE	N	0.1	1.0	0.0	8.0

BIG BLUESTEM *Andropogon gerardii*						
LITTLE BLUESTEM *Schizachyrium scoparium*	SCSC	N	5.0	20.0		4.0
eastern bottlebrush grass *Elymus hystrix*	ELHY	N	0.1	1.0	0.0	3.0
Virginia wildrye *Elymus virginicus*	ELVI3	N	5.0	20.0		3.0
HAIRY WOODLAND BROME *Bromus pubescens*	BRPU6	N	0.0	1.0	0.0	2.0
PARASOL SEDGE *Carex umbellata*	CAUM4	N	5.0	20.0		2.0
Heller's rosette grass *Dichanthelium oligosanthes*	DIOL	N	0.1	1.0	0.0	2.0
HAIRY WILDRYE *Elymus villosus*	ELVI	N	0.1	1.0	1.0	2.0
NODDING FESCUE *Festuca subverticillata*	FESU3	N	0.1	1.0	0.0	2.0
ROCK MUHLY *Muhlenbergia sobolifera*	MUSO	N	0.1	1.0	0.0	2.0
WOODLAND SEDGE *Carex blanda*	CABL	N	0.0	0.1	0.0	1.0
WOODBANK SEDGE *Carex cephalophora*	CACE	N	0.1	1.0	0.0	1.0
FUZZY-WUZZY SEDGE *Carex hirsutella*	CAHI6	N	0.1	1.0	0.0	1.0
Muhlenberg's sedge *Carex muehlenbergii*	CAMU4	N	0.0	0.1	0.0	1.0
PENNSYLVANIA SEDGE *Carex pensylvanica*	CAPE6	N	2.0	10.0	0.0	1.0
Bosc's panicgrass *Dichanthelium boscii*	DIBO2	N	0.0	0.1	0.0	1.0
Ravenel's rosette grass *Dichanthelium ravenelii*	DIRA	N	0.1	1.0	0.0	1.0
POVERTY OATGRASS *Danthonia spicata*	DASP2	N	0.0	5.0	0.0	0.5
slimleaf panicgrass *Dichanthelium linearifolium*	DILI2	N	0.1	1.0	0.0	0.5

Understory plant type: Forb/Herb

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
button eryngo *Eryngium yuccifolium*	ERYU	N	0.0	0.1	2.0	6.0
BALDWIN IRONWEED *Vernonia baldwinii*	VEBA	N	0.1	1.0	0.0	4.0
PURPLE CONEFLOWER *Echinacea purpurea*	ECPU	N	5.0	20.0		3.0
EASTERN BEEBALM *Monarda bradburiana*	MOBR2	N	10.0	20.0		3.0
Canadian blacksnakeroot *Sanicula canadensis*	SACA15	N	10.0	20.0		3.0
widowsfrill *Silene stellata*	SIST	N	0.1	1.0	0.0	3.0
DOWNY AGRIMONY *Agrimonia pubescens*	AGPU	N	0.1	1.0	0.0	2.0
HEMP DOGBANE *Apocynum cannabinum*	APCA	N	0.0	0.1	0.0	2.0
smooth blue aster *Aster laevis(syn)*	ASLA5	N	10.0	20.0		2.0
smooth yellow false foxglove *Aureolaria flava*	AUFL	N	0.1	1.0	1.0	2.0
TALL COREOPSIS *Coreopsis tripteris*	COTR4	N	0.0	0.1	1.0	2.0
panicledleaf ticktrefoil *Desmodium paniculatum*	DEPA6	N	0.1	2.0	0.0	2.0
	DEPE80	N	0.0	5.0	0.0	2.0

perplexed ticktrefoil *Desmodium perplexum*						
WHITE AVENS *Geum canadense*	GECA7	N	0.0	0.1	0.0	2.0
HAIRY SUNFLOWER *Helianthus hirsutus*	HEHI2	N	0.1	25.0	0.0	2.0
SLENDER LESPEDEZA *Lespedeza virginica*	LEVI7	N	10.0	20.0		2.0
wild quinine *Parthenium integrifolium*	PAIN3	N	0.0	0.1	0.0	2.0
NARROW-LEAF MOUNTAIN-MINT *Pycnanthemum tenuifolium*	PYTE	N	0.0	0.1	1.0	2.0
clustered blacksnakeroot *Sanicula odorata*	SAOD	N	0.1	1.0	0.0	2.0
wholeleaf rosinweed *Silphium integrifolium*	SIIN2	N	0.0	0.1	0.0	2.0
BROADLEAF GOLDENROD *Solidago flexicaulis*	SOFL2	N	0.1	1.0	0.0	2.0
ELMLEAF GOLDENROD *Solidago ulmifolia*	SOUL2	N	5.0	10.0	0.0	2.0
Drummond's aster *Symphyotrichum drummondii*	SYDR	N	0.0	1.0	0.0	2.0
smooth blue aster *Symphyotrichum laeve*	SYLA3	N	0.1	1.0	0.0	2.0
calico aster *Symphyotrichum lateriflorum*	SYLA4	N	0.1	1.0	0.0	2.0
WOODLAND AGRIMONY *Agrimonia rostellata*	AGRO3	N	0.1	1.0	0.0	1.0
WESTERN ROCKJASMINE *Androsace occidentalis*	ANOC2	N	0.0	1.0	0.0	1.0
VIRGINIA-SNAKEROOT *Aristolochia serpentaria*	ARSE3	N	0.0	0.1	0.0	1.0
CANADA MILKVETCH *Astragalus canadensis*	ASCA11	N	0.1	1.0	0.0	1.0
FOUR-LEAF MILKWEED *Asclepias quadrifolia*	ASQU	N	0.0	0.1	0.0	1.0
FINGER COREOPSIS *Coreopsis palmata*	COPA10	N	0.0	1.0	0.0	1.0
LARGE FLOWER TICKCLOVER *Desmodium glutinosum*	DEGL5	N	0.1	2.0	0.0	1.0
NAKED-FLOWER TICK-TREFOIL *Desmodium nudiflorum*	DENU4	N	10.0	25.0	0.0	1.0
FLOWERING SPURGE *Euphorbia corollata*	EUCO10	N	0.1	1.0	0.0	1.0
WILD STRAWBERRY *Fragaria virginiana*	FRVI	N	0.1	1.0	0.0	1.0
shrubby lespedeza *Lespedeza frutescens*	LEFR5	N	1.0	50.0	0.0	1.0
FEATHERY FALSE SOLOMON'S-SEAL *Maianthemum racemosum*	MARA7	N	0.1	1.0	0.0	1.0
WILD PETUNIA *Ruellia humilis*	RUHU	N	0.0	0.1	0.0	1.0
BABY WHITE ASTER *Symphyotrichum anomalum*	SYAN2	N	0.0	0.1	0.0	1.0
SMOOTH VIOLET PRAIRIE ASTER *Symphyotrichum turbinellum*	SYTU2	N	0.0	0.1	0.0	1.0
RUE-ANEMONE *Thalictrum thalictroides*	THTH2	N	0.1	1.0	0.0	1.0
bluejacket *Tradescantia ohiensis*	TROH	N	0.0	0.1	0.0	1.0
HOGPEANUT *Amphicarpaea bracteata*	AMBR2	N	1.0	5.0	0.0	0.5
PARLIN'S PUSSYTOES *Antennaria parlinii*	ANPA9	N	0.0	1.0	0.0	0.5

BASTARD TOADFLAX *Comandra umbellata*	COUM	N	0.1	1.0	0.0	0.5
SHINING BEDSTRAW *Galium concinnum*	GACO3	N	0.1	1.0	0.0	0.5
VIRGINIA STICKTIGHT *Hackelia virginiana*	HAVI2	N	0.0	0.1	0.0	0.5
American ginseng *Panax quinquefolius*	PAQU	N	0.1	1.0	0.0	0.5
wild blue phlox *Phlox divaricata*	PHDI5	N	0.1	1.0	0.0	0.5
LOPSEED *Phryma leptostachya*	PHLE5	N	0.0	1.0	0.0	0.5
VIRGINIA GROUNDCHERRY *Physalis virginiana*	PHVI5	N	0.0	1.0	0.0	0.5
GRAYHEAD PRAIRIE CONEFLOWER *Ratibida pinnata*	RAPI	N	0.0	0.1	0.0	0.5

Understory plant type: Shrub/Subshrub

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
HAZELNUT *Corylus americana*	COAM3	N	0.1	2.0	0.0	8.0
FRAGRANT SUMAC *Rhus aromatica*	RHAR4	N	2.0	50.0	0.0	8.0
NEW JERSEY TEA *Ceanothus americanus*	CEAM	N	5.0	20.0		3.0
BUCKBRUSH *Symphoricarpos orbiculatus*	SYOR	N	0.1	2.0	0.0	3.0
stiff dogwood *Cornus foemina*	COFO	N	0.0	0.1	0.0	2.0
DEWBERRY *Rubus flagellaris*	RUFL	N	0.1	2.0	0.0	2.0
blackhaw *Viburnum prunifolium*	VIPR	N	0.0	0.1	0.0	2.0
shrubby St. Johnswort *Hypericum prolificum*	HYPR	N	2.0	5.0	0.0	1.0
CAROLINA ROSE *Rosa carolina*	ROCA4	N	0.0	0.1	0.0	1.0

Understory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
EASTERN REDCEDAR *Juniperus virginiana*	JUVI	N	0.0	0.1	0.0	16.0
EASTERN HOPHORNBEAM *Ostrya virginiana*	OSVI	N	0.1	25.0	0.0	16.0
BLACK HICKORY *Carya texana*	CATE9	N	0.1	1.0	0.0	8.0
JUNEBERRY *Amelanchier arborea*	AMAR3	N	0.1	1.0	0.0	2.0
mockernut hickory *Carya alba(syn)*	CAAL27	N	0.1	1.0	0.0	2.0
PIGNUT HICKORY *Carya cordiformis*	CACO15	N	0.0	0.1	0.0	2.0
PERSIMMON *Diospyros virginiana*	DIVI5	N	0.1	1.0	0.0	2.0
BLACK CHERRY *Prunus serotina*	PRSE2	N	0.1	1.0	0.0	2.0
SHINGLE OAK *Quercus imbricaria*	QUIM	N	0.0	2.0	0.0	2.0

Understory plant type: Vine/Liana

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top

POISON IVY *Toxicodendron radicans*	TORA2	N	0.1	2.0	0.0	16.0
BITTERSWEET *Celastrus scandens*	CESC	N	0.0	1.0	0.0	1.0
VIRGINIA CREEPER *Parthenocissus quinquefolia*	PAQU2	N	1.0	5.0	0.0	1.0
WINTER GRAPE *Vitis vulpina*	VIVU	N	0.0	1.0	0.0	1.0

Community Phase 1.2: White Oak-Black Oak-Hickory/Eastern Hop Hornbeam – Aromatic Sumac/Woodland Brome – Hairy Sunflower

This phase is similar to community phase 1.1 but oak and hickory 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.

Community Phase Pathway 1.2A
This pathway results from disturbance intervals that are decreasing and occur less than once every 10 years.

Forest Overstory
The overstory of this community phase is a mixture of white oak and black oak, with increasing densities of hickory and other more shade tolerant species.

Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)

	Low canopy cover %	RV canopy cover %	High canopy cover %
Forest canopy:	50	65	80

Overstory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top	Tree diameter low	Tree diameter high	Basal area low	Basal area high
BLACK OAK *Quercus velutina*	QUVE	N	20.0	40.0		80.0				
mockernut hickory *Carya tomentosa*	CATO6	N	10.0	30.0		70.0				
WHITE OAK *Quercus alba*	QUAL	N	40.0	70.0		70.0				
BUR OAK *Quercus macrocarpa*	QUMA2	N	5.0	10.0		70.0				
SHAGBARK HICKORY *Carya ovata*	CAOV2	N	10.0	30.0		60.0				
POST OAK *Quercus stellata*	QUST	N	5.0	10.0		60.0				

Forest Understory
This woodland community has a multi-tiered structure due to lack of disturbance activities. Ground cover densities are decreasing due increasing overstory cover.

Forest Understory Canopy Cover Summary (all species <13 feet in height)

Understory plant type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
BIG BLUESTEM *Andropogon gerardii*	ANGE	N	5.0	10.0		5.0
LITTLE BLUESTEM *Schizachyrium scoparium*	SCSC	N	5.0	10.0		4.0
HAIRY WOODLAND BROME *Bromus pubescens*	BRPU6	N	10.0	20.0		3.0
eastern bottlebrush grass *Elymus hystrix*	ELHY	N	5.0	10.0		3.0

Virginia wildrye *Elymus virginicus*	ELVI3	N	10.0	20.0		3.0
FOUR-LEAF MILKWEED *Asclepias quadrifolia*	ASQU	N	5.0	10.0		2.0
PENNSYLVANIA SEDGE *Carex pensylvanica*	CAPE6	N	5.0	10.0		2.0
PARASOL SEDGE *Carex umbellata*	CAUM4	N	5.0	10.0		2.0
ROCK MUHLY *Muhlenbergia sobolifera*	MUSO	N	10.0	20.0		2.0

Understory plant type: Forb/Herb

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
CULVER'S-ROOT *Veronicastrum virginicum*	VEVI4	N	0.0	5.0		4.0
PURPLE CONEFLOWER *Echinacea purpurea*	ECPU	N	5.0	10.0		3.0
HAIRY SUNFLOWER *Helianthus hirsutus*	HEHI2	N	10.0	20.0		3.0
EASTERN BEEBALM *Monarda bradburiana*	MOBR2	N	5.0	10.0		3.0
Canadian blacksnakeroot *Sanicula canadensis*	SACA15	N	5.0	10.0		3.0
ELMLEAF GOLDENROD *Solidago ulmifolia*	SOUL2	N	5.0	10.0		3.0
smooth blue aster *Aster laevis(syn)*	ASLA5	N	5.0	10.0		2.0
NAKED-FLOWER TICK-TREFOIL *Desmodium nudiflorum*	DENU4	N	5.0	10.0		2.0
SLENDER LESPEDEZA *Lespedeza virginica*	LEVI7	N	5.0	10.0		2.0
bluejacket *Tradescantia ohiensis*	TROH	N	0.0	5.0		2.0

Understory plant type: Shrub/Subshrub

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
HAZELNUT *Corylus americana*	COAM3	N	5.0	10.0		4.0
NEW JERSEY TEA *Ceanothus americanus*	CEAM	N	5.0	10.0		3.0
FRAGRANT SUMAC *Rhus aromatica*	RHAR4	N	10.0	20.0		3.0

Understory plant type: Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
EASTERN HOPHORNBEAM *Ostrya virginiana*	OSVI	N	20.0	40.0		40.0
WHITE ASH *Fraxinus americana*	FRAM2	N	5.0	10.0		20.0
SLIPPERY ELM *Ulmus rubra*	ULRU	N	5.0	10.0		20.0

Transition 1A

Fire suppression and forest timber management will result in a transition to community phase 2.1.

Transition 1B

Prescribed fire and forest timber management will result in a transition to community phase 3.1.

Transition 1C

Clearing, pasture planting and grassland management will result in a transition to community phase 4.1.

Transition 1D

High grade logging and uncontrolled grazing will result in a transition to community phase 5.1.

State 2: Timber Managed Woodland

This state develops from mixed oak woodlands, which over time, increase in canopy cover, eventually transitioning into forest-like communities. These woodlands tend to be rather dense, with a higher developed understory but a more under developed ground flora. Thinning can increase overall tree vigor and improve and control understory density. Continual timber management, depending on the practices used, should maintain this state. Over time white oak will become less dominant with black oak increasing. With cessation of harvesting and no other management inputs this community phase will slowly increase in more shade tolerant species such as hickories, white ash and maple and transition to community phase 2.2. Over time white oak may become less dominant. Re-initiation of harvesting and other forest management activities will transition this community phase back to community phase 2.1. Repeated, high-grading timber harvests coupled with introduction of uncontrolled domestic livestock grazing will transition this state to state 5, High-Graded/Grazed Woodland.

This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire.

(See Ecological Dynamics section for caution on sites with invasive non-native species of earthworms)

Community Phase 2.1: Black Oak – White Oak /Serviceberry – Hazelnut / Aster – Pennsylvania Sedge

Timber managed site with recent harvest (notice stump in foreground) - photo from MDC

These woodlands tend to be rather dense, with a higher developed understory but a more under developed ground flora. Thinning can increase overall tree vigor and improve and control understory density. Continual timber management, depending on the practices used, should maintain this state. Over time white oak will become less dominant. Canopy cover ranges from 70 to 85 percent. Most stands are 50 to 80 years of age.

Community Phase Pathway 2.1A
This pathway results in a cessation or reduction of harvesting frequencies.

Forest Overstory
Black oak and white oak are common overstory species along with an hickory. Canopy levels can approach 90 percent.

Forest Understory
A multi-layered understory is present. Due to increased shading, the ground flora is under developed.

Community Phase 2.2: Black Oak – White Oak - Hickory/Serviceberry - Maple Saplings/ Aster – Pennsylvania Sedge

With cessation of harvesting and no other management inputs this community phase will slowly increase in more shade tolerant species such as hickories, white ash and maple. Over time white oak will become less dominant.

Community Phase Pathway 2.2A
Re-initiation of harvesting and other forest management activities will transition this community phase back to community phase 2.1.

Transition 2A

This state will tansition to a fire managed woodland state by incorporating selective thinning and re-introducing prescribed fire.

Transition 2B

This state will transition to a high-graded/grazed woodland state with high-grade logging and allowing uncontrolled grazing.

Restoration Pathway 1B

This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, incorporating selective thinning, and re-introducing prescribed fire.

State 3: Fire Managed Woodland

The fire managed woodland state most closely resembles the reference state. The principal difference is tree age with most canopy trees being only 50 to 90 years old. Composition and reduction in tree size are also likely altered from the reference state depending on tree selection during any previous harvest cycles.

Without a regular fire regime or harvesting, this community phase will slowly increase in more shade tolerant species such as hickories and other more shade tolerant species and transition to community phase 3.2. Over time white oak may become less dominant. Repeated, high-grading timber harvests coupled with introduction of uncontrolled domestic livestock grazing and cessation of prescribed fire will transition this state to state 5, High-Graded/Grazed Woodland.

This state can be restored to a reference state by modifying timber harvests, extending rotations, incorporating selective thinning, and possibly increasing fire frequencies. (See Ecological Dynamics section for caution on sites with invasive non-native species of earthworms)

Community Phase 3.1: Black Oak – White Oak – Hickory/ Buckbrush/ Woodland Brome

Fire managed woodland at Union Ridge Conservation Area near Green City, Missouri - photo from MDC

This is a fire managed phase. Fire frequencies occur at a 5 to 10 year interval usually preceeding a timber harvest. Logging activites are removing higher volumes of white oak causing a decrease in white oak in the canopy and an increase in black oak.

Community Phase Pathway 3.1A
This pathway results in reduced fire frequencies and logging activity. No disturbance periods can exceed 10 years.

Forest Overstory
Black oak and white oak dominate with occasional hickories. Canopy cover ranges from 60 percent to 80 percent.

Forest Understory
Dense rich ground cover dominated by forbs and shrubs.

Community Phase 3.2: Black Oak – White Oak – Hickory/Oak Saplings – Black Cherry/ Woodland Brome

In the long term absence of fire, woody species, especially oak and hickory saplings, black cherry and hornbeam encroach into the understory of these woodlands. Hickory species will increase in the overstory.

Community Phase Pathway 3.2A
This pathway results in increased prescribed fire frequencies and the reinstating of selective thinning.

Transition 3A

This state will transition to a timber managed state by modifying timber harvests and suppressing prescribed fire.

Transition 3B

This state will transition to a high-graded/grazed woodland state with high-grade logging and allowing uncontrolled grazing.

Restoration Pathway 1A

This state can be restored to a reference state by modifying or eliminating timber harvests, extending rotations, and incorporating selective thinning.

State 4: Grassland

Conversion of woodland to planted, non-native cool season grasses and legumes has been common. Without proper grassland management these ecological sites are challenging to maintain in a healthy, productive state. With over grazing and cessation of active pasture management, tall fescue, white clover and multi-flora rose will increase in density. Over a long period of time with no grazing, phase 4.2 will eventually transition to a phase that resembles community phase 5.2, Black Oak – Hickory/Black Cherry – Buckbrush – Gooseberry – Multi-flora Rose/ Black Snakeroot – Geranium.

In some instances, this state has been converted to native warm season grasses, primarily big bluestem, switchgrass, and Indian grass or pure stands of single species. These sites are typically converted through a federal cost share program such as the Conservation Reserve Program (CRP) or the Environmental Quality Incentives Program (EQIP). Some sites are associated with an active rotational grazing system. Without active management with prescribed fire and grassland management these sites will transition to phase 5.2.

Community Phase 4.1: Cool Season Grasses – Legumes

Well-managed cool season pasture near Lake Wapello State Park, Iowa - photo from MDC

This phase is a 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 Phase Pathway 4.1A
This pathway results from over grazing and cessation of active pasture management.

Community Phase 4.2: Tall fescue – White Clover/Multi-flora Rose

Cool season pasture showing weedy invasion due to poor management near Bloomfield, Iowa - photo from MDC

This phase is the result of poor grassland management. Over grazing and inadequate or no fertility application has allowed tall fescue, multi-flora rose, thistle and other weedy species to increase in cover and density reducing overall forage quality and site productivity. White clovers such as ladino and alsike will decrease or go away with no fertilization and overgrazing although Dutch white clover will leave last. Soil pH and bases such as calcium and magnesium are lower, relative to well-managed pastures (Phase 4.1).

Community Phase Pathway 4.2A
To return to Community Phase 4.1, brush management, grassland seeding, rotational grazing, and integrated pest management will be needed.

Community Phase 4.3: Native Warm Season Grasses

Native grasses and legumes on CRP land in southern Iowa - photo from NRCS

In some instances, this state has been converted to native warm season grasses, primarily big bluestem, switchgrass, and Indian grass or pure stands of single species. These sites are typically converted through a federal cost share program such as the Conservation Reserve Program (CRP) or the Environmental Quality Incentives Program (EQIP). Some sites are associated with an active rotational grazing system.

Transition 4A
This state will transition to a high-graded/grazed woodland idle phase with long term succession and little to no grazing.

State 5: High-Graded/Grazed Woodland

Reference or managed woodland states subjected to repeated, high-grading timber harvests and uncontrolled cattle grazing transition to this degraded state. This state exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The understory vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff.

Transition back to either an even-age managed or uneven-age managed forest will required dynamic and sustained forest stand improvements, cessation of grazing, and selective thinning of overstory and understory canopies.

(See Ecological Dynamics section for caution on sites with invasive non-native species of earthworms)

Community Phase 5.1: Black Oak-Hickory/Hickory saplings-Gooseberry-Multiflora Rose/Black Snakeroot-Geranium

Grazed woodland with open understory

Due to high-grade logging and uncontrolled grazing, this community phase exhibits an over-abundance of hickory and other less economically desirable tree species and weedy understory species such as buckbrush, gooseberry, poison ivy and multi-flora rose. The understory vegetation offers little nutritional value for cattle, and excessive livestock stocking damages tree boles, degrades understory species composition and results in soil compaction and accelerated erosion and runoff.

Community Phase Pathway 5.1A
This pathway results from cessation of active logging and exclusion of livestock or reduction in grazing intensity.

Community Phase 5.2: Black Oak-Hickory/Black Cherry-Buckbrush-Gooseberry-Multiflora Rose/Black Snakeroot-Geranium

Lamson Woods State Preserve showing a high-graded formerly grazed woodland near Fairfield, Iowa - photo from MDC

Cessation of active logging and reduction in grazing intensity will create an idle phase that experiences an increase in black cherry and Ohio buckeye and weedy species such as buckbrush and gooseberry in the understory layer.

Community Phase Pathway 5.2A
This pathway results in a return to logging activity and increased grazing intensities and frequencies.

Transition 5A
This state will transition to a grassland state with clearing, pasture planting, and grassland managment.

Transition 5B
This state will transition to a fire managed woodland state with timber management, forest stand improvement, suppression of grazing and prescribed burning.

Transition 5C
This state will transition to a timber managed woodland state with timber management, forest stand improvement, and suppression of grazing.

Section II: Ecological Site Interpretations

Forest Site Productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
WHITE OAK	*QUAL*	48	60	32	46	50	820	50TA	Schnur, G. Luther. 1937. Yield, stand, and volume tables for even-aged upland oak forests. United States Department of Agriculture Technical Bulletin 560.
BLACK OAK	*QUVE*	42	73	32	48	50	820	50TA	Schnur, G. Luther. 1937. Yield, stand, and volume tables for even-aged upland oak forests. United States Department of Agriculture Technical Bulletin 560.

Animal Community

Wildlife

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.

Reptiles and amphibians associated with these forests include: ringed salamander, spotted salamander, marbled salamander, central newt, long-tailed salamander, dark-sided salamander, southern red-backed salamander, small-mouthed salamander, three-toed box turtle, ground skink, western worm snake, western earth snake, American toad, and eastern timber rattlesnake.

Domestic livestock:
On sites that have been converted to cool-season grasses and legumes, cattle grazing occurs along with some uncontrolled grazing in adjacent uncleared woodlands.

Hydrology Functions

Most precipitation on sites in reference or well-managed timber states infiltrates the soil, and either recharges the local groundwater or moves slowly as lateral flow, surfacing in headwaters of ephemeral streams. The trees, the shrub and herbaceous understories, and the litter provide nearly 100 percent soil cover. Little or no surface runoff occurs on these sites, except for rare, high-intensity storms. These sites provide high yields of good-quality groundwater, which is released slowly into ephemeral streams over time.

In high graded woodland or poorly managed pasture states, soil compaction and reduced surface cover generally results in reduced infiltration and increased runoff. Groundwater recharge is reduced. Surface runoff results in soil erosion, which degrades water quality. The rapid release of runoff into ephemeral streams increases the risk of downstream flooding, and shortens the time when ephemeral streams are active.

Recreational Uses

Hunting, bird watching, horseback riding, camping, and hiking are recreational uses of this ecological site. Reference and well managed sites provide good hunting for turkey, white-tailed deer, and squirrel. Recreational uses are reduced in the heavily grazed grassland state and high-graded woodland state. In many areas of this predominantly agricultural MLRA, these sites provide the only woodlands available for recreational use.

Wood Products

This ecological site is moderately productive. Timber harvesting can occur but care must be taken to maintain the integrity and character of the site.

Potential products include lumber, oak staves, pallet materials, and in some cases oak veneer (only on well managed or old growth sites).

Other Information

Forest management: Site index values range from 50 to 60 for oak. Timber management opportunities are good. These groups respond well to even-aged management. 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 and group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Prescribed fire is an effective management tool. Using prescribed fire as a management tool however, 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. Favor white oak, post oak, chinkapin oak, black oak and scarlet oak.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Loess Upland Woodland	*F109XY003MO*	Loess Upland Woodlands are often upslope from Till Exposed Backslope Woodlands.
Till Upland Woodland	*F109XY007MO*	Till Upland Woodlands are often upslope from Till Exposed Backslope Woodlands.
Till Protected Backslope Forest	*F109XY009MO*	Till Protected Backslope Forests are mapped in complex with the Till Exposed Backslope Woodlands, on northerly and easterly aspects.
Shale Exposed Backslope Woodland	*F109XY025MO*	Shale Exposed Backslope Woodlands are downslope from Till Exposed Backslope Woodlands in some places.

Similar Sites

Site name	Site ID	Site narrative
Till Upland Woodland	*F109XY007MO*	Till Upland Woodlands are on upper slopes and shoulders, and are not as steep. Canopy composition is similar to Till Exposed Backslope Woodlands but more open with a ground flora having a higher grass density grass.
Till Backslope Savanna	*R109XY008MO*	Till Backslope Savannas have thicker, darker surface layers from historic grassland vegetation. Bur oak and post oak dominated the much more open canopy. Ground flora were similar to adjacent prairie site and fire frequencies were higher.
Shale Exposed Backslope Woodland	*F109XY025MO*	Shale Exposed Backslope Woodlands are downslope from Till Exposed Backslope Woodlands in some places. Canopy composition and structure are similar to Till Exposed Backslope Woodlands. Fire frequency was generally less.

State Correlation

This site has been correlated with the following states: IA MO

Inventory Data References

The data contained in this document is derived from analysis of inventories, ecological interpretation from field evaluations, and various reference papers and books.

Steele, Amber M.; Kabrick, John M.; Miles, Randall J. 2013. Regional and geomorphic influence on the productivity, composition, and structure of oak ecosystems in the western central hardwoods region. In: Miller, Gary W.; Schuler, Thomas M.; Gottschalk, Kurt W.; Brooks, John R.; Grushecky, Shawn T.; Spong, Ben D.; Rentch, James S., eds. Proceedings, 18th Central Hardwood Forest Conference; 2012 March 26-28; Morgantown, WV; Gen. Tech. Rep. NRS-P-117. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 80-92.

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

Yatskievych, George A. 1999/2006/2013. Flora of Missouri. Missouri Dept. of Conservation in cooperation with Missouri Botanical Garden Press, Volumes 1-3.

Sampling methods (nested plots/transects/releve)

Reference Inventory Plots:
THHISP02 Thousand Hills State Park
DAHOCA02 Dark Hollow Natural Area
RUBECA02 Rudolf Bennitt Wildlife Conservation Area

Timber Managed Woodland State Inventory Plots:
RECOCA01 Rebel's Cove Conservation Area
HNMOCA02 Hungry Mother Conservation Area

Fire Managed Woodland State Inventory Plots:
UNRICA03 Union Ridge Conservation Area

Level 2 and reconnaissance inventory:

Concept developed from Paul Nelson's Terrestrial Natural Communities and other works, refined with Amber Steele's thesis

2007: Kolaks/Meinert reconnaissance at Little Lost Creek CA and Rudolph Bennitt CA

2009/10: Steele/Steele/Kabrick reconnaissance for Till Backslope thesis study site selection (Atlanta CA, Hidden Hollow CA, Hungry Mother CA, Rebel's Cove CA, Union Ridge CA, Sugar Creek CA, others)

2014: Reconnaissance in Iowa: (Lamson Woods, Lacey Keosaqua SP. others)

2014: Reconnaissance and Tier III plot establishment in Missouri (Dark Hollow CA, Mineral Hills CA, Union Ridge CA, Thousand Hills SP, Rudolph Bennitt CA)

Inventory Data References by Plot (Range-417, Wood-4, Wood-5)

	Sample ID					
Data source	Number	Year	State code	County code	State	County
ECS-5	2	1990	29	01	Missouri	
	7	1990	29	01	Missouri	
	8	1990	29	01	Missouri	
	2	1964	29	019	Missouri	Boone
	10	1984	29	027	Missouri	Callaway
	8	1984	29	027	Missouri	Callaway
	8	1991	29	041	Missouri	Chariton
	11	1984	29	113	Missouri	Lincoln
	11	1984	29	115	Missouri	Linn
	12	1984	29	115	Missouri	Linn
	8	1988	29	121	Missouri	Macon
	1	1975	29	127	Missouri	Marion
	1	1983	29	175	Missouri	Randolph
	2	1983	29	175	Missouri	Randolph
	7	1985	29	195	Missouri	Saline
	9	1990	29	211	Missouri	Sullivan

Type Locality

State:	MO
County:	Adair
Township:	62N
Range:	15W
Section:	18
Datum:	NAD83
Zone:	15
Northing:	4447630.34
Easting:	531737.44
General legal description:	Plot THHISP02 Thousand Hills State Park
Latitude degrees:	40
Latitude minutes:	10
Latitude seconds:	42
Latitude decimal:	42
Longitude degrees:	92
Longitude minutes:	37
Longitude seconds:	37
Longitude decimal:	99
Universal Transverse Mercator (UTM) system:	NAD83154447630.34531737.44
State:	MO
County:	Randolph
Township:	52N
Range:	14W
Section:	36
Datum:	NAD83
Zone:	15
Northing:	4345191.15
Easting:	547626.93
General legal description:	Plot RUBECA02 Rudolf Bennitt Wildlife Conservation Area
Latitude degrees:	39
Latitude minutes:	15
Latitude seconds:	17
Latitude decimal:	6

Longitude degrees:	92
Longitude minutes:	26
Longitude seconds:	52
Longitude decimal:	80
Universal Transverse Mercator (UTM) system:	NAD83154345191.15547626.93
State:	MO
County:	Sullivan
Township:	64N
Range:	18W
Section:	28
Datum:	NAD83
Zone:	15
Northing:	4463745.93
Easting:	506076.80
General legal description:	Plot DAHOCA01 Dark Hollow Natural Area Winnegan pedon
Latitude degrees:	40
Latitude minutes:	19
Latitude seconds:	27
Latitude decimal:	19
Longitude degrees:	92
Longitude minutes:	55
Longitude seconds:	42
Longitude decimal:	49
Universal Transverse Mercator (UTM) system:	NAD83154463745.93506076.80

Hierarchical Classification Relationships

Atlas of Missouri Ecoregions (Nigh & Schroeder, 2002):
This ecological site occurs in many Land Type Associations within the following Subsections:
Chariton River Hills
Claypan Till Plains
Mississippi River Hills
Wyaconda River Dissected Till Plains

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 White Oak Loess/Glacial Till Woodland.

National Vegetation Classification System Vegetation Association (NatureServe, 2010):
The reference state for this ecological site is within the North-Central Interior Dry-Mesic Oak Forest and Woodland (CES202.046), and is most similar to Quercus alba - (Carya ovata)/ Carex pensylvanica Glaciated Woodland (CEGL002134).

Other References

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Frost, C., 1996. Pre-settlement Fire Frequency Regimes of the United States: A First Approximation. Pages 70-81, Proceedings of the 20nd Tall Timbers Fire Ecology Conference: Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Tall Timbers Research Station, Tallahassee, FL.

Hendrix, P. F., G. H. Baker, M. A. Callaham Jr, G. A. Damoff, C. Fragoso, G. Gonzalez,
S. W. James, S. L. Lachnicht, T. Winsome and X. Zou. 2006. Invasion of exotic earthworms into ecosystems inhabited by native earthworms. Biol Invasions (2006) 8:1287–1300.

Maerz, J., V. A. Nuzzo, and B. Blossey. 2009. Declines in Woodland Salamander Abundance Associated with Non-Native Earthworm and Plant Invasions. Conservation Biology, Volume 23, No. 4, 975–981.

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

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

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Nuzzo, V., J. C. Maerz, and B. Blossey. 2009. Earthworm invasion as the Driving Force Behind Plant Invasion and Community Change in Northeastern North American Forests. Conservation Biology 23: No. 4, 966–974.

Steele, Amber M. 2011. Regional and geomorphic influence on soil genesis and oak ecosystems in the Chariton River Hills of Missouri. MS Thesis, University of Missouri, Columbia, Missouri.

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