Ecological Site Description

Till Exposed Backslope Woodland F109XY022MO

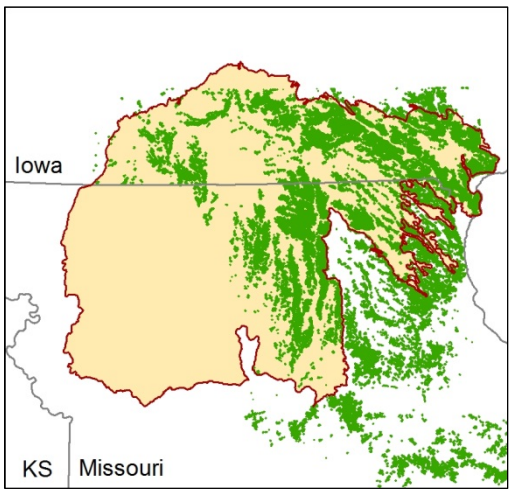
- *(Quercus alba - Quercus velutina/Rhus aromatica/Bromus pubescens - Helianthus hirsutus)*
- (white oak – black oak/fragrant sumac/hairy woodland brome – hairy sunflower)

An Ecological Site Description (ESD) is a reference document of ecological knowledge regarding a particular land area (ecological site). An ESD describes ecological potential and ecosystem dynamics of land areas and their potential management. Ecological sites are linked to soil survey map unit components, which allows for mapping of ecological sites. (***NOTE:*** *This is a "provisional" ESD, and is subject to change. It contains basic ecological information sufficient for conservation planning and land management in Missouri. After additional information is developed and reviewed, a "Correlated" ESD will be published and will be available via the Web Soil Survey* http://websoilsurvey.nrcs.usda.gov .)

Major Land Resource Area (MLRA): 109 – Iowa and Missouri Heavy Till Plain

Introduction

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.



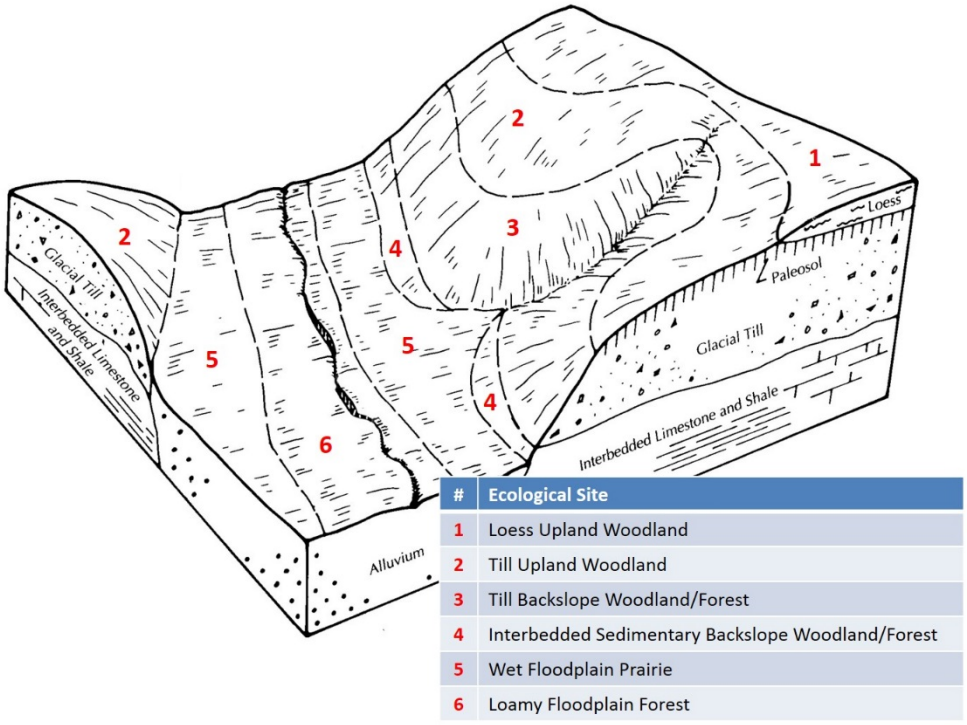
Till Exposed Backslope Woodlands (green areas on the map) occupy the southerly and westerly aspects of steep, dissected slopes, and are mapped in complex with the Till Protected Backslope Forest ecological site. These ecological sites occur primarily in the eastern and southeastern portion of the Till Plain. They are typically downslope from Loess Upland Woodland or Till Upland Woodland ecological sites, and generally occupy the 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 percent. 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 Drainageway or Floodplain ecological sites are directly downslope.



#	Ecological Site
1	Loess Upland Woodland
2	Till Upland Woodland
3	Till Backslope Woodland/Forest
4	Interbedded Sedimentary Backslope Woodland/Forest
5	Wet Floodplain Prairie
6	Loamy Floodplain Forest

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.

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 *(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.

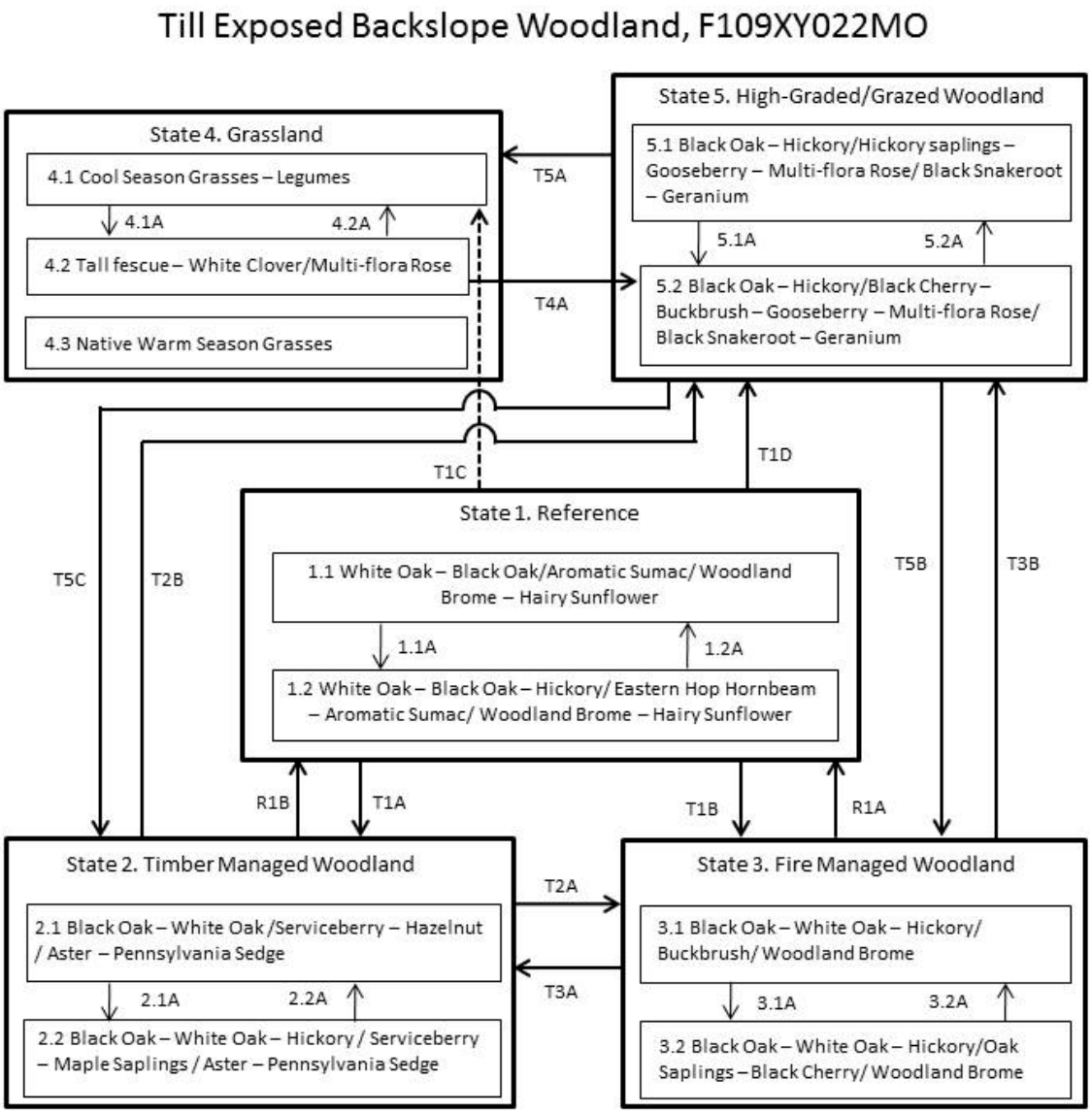
Managed areas show an exceptional resiliency and production. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees, and tree height growth. This type of management can provide timber products, watershed protection, 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.

Figure 1: 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

Ecological States

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

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

This community phase is productive upland woodland in the MLRA. The overstory is dominated by white oak and black oak with hickory and post oak also present. This woodland community has a two-tiered structure, and a canopy that is 60 to 80 feet tall with 50 to 80 percent closure along 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. In the absence of disturbance, more shade tolerant species such as eastern hop hornbeam, hickories, white ash and others increase in importance and add structural diversity to the system. Over time, these gradual species changes result in a community phase transition to Community Phase 1.2

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

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. This woodland community has a multi-tiered structure due to lack of disturbance activities with a canopy that is 60 to 80 feet tall and a 70 to 90 percent canopy closure. In the long term absence of disturbance, woody species, especially hickory and hop hornbeam, encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels, greatly diminishing ground flora.

State 2: Timber Managed Woodland

These forests 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. 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)

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)

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.

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.

Browsing by goats using good rotational management can open up the shrub layer, eliminate many of the weedy species and increase both native herbaceous vegetation and may induce regeneration of oak and hickory species helping to bring about a long process of rehabilitation. Cessation of active logging and exclusion of livestock from sites in this state will create an idle phase that experiences an increase in black cherry and Ohio buckeye in the understory layer.

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)

Reference State Plant Community

Canopy Trees

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
WHITE OAK	*Quercus alba*	40-70	70
BLACK OAK	*Quercus velutina*	20-40	80
MOCKERNUT HICKORY	*Carya alba*	5-20	70
SHAGBARK HICKORY	*Carya ovata*	5-20	60
POST OAK	*Quercus stellata*	5-10	60
BUR OAK	*Quercus macrocarpa*	5-10	70

Understory Trees

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
EASTERN HOP HORNBEAM	*Ostrya virginiana*	10-30	40

Shrubs

Common Name	Botanical Name	Cover % (low-high)	Canopy Height (ft)
HAZELNUT	*Corylus americana*	10-20	4
FRAGRANT SUMAC	*Rhus aromatica*	10-30	3
NEW JERSEY TEA	*Ceanothus americanus*	5-20	3

Forbs

Common Name	Botanical Name	Cover % (low-high)
ELM-LEAFED GOLDENROD	*Solidago ulmifolia*	5-20
HAIRY SUNFLOWER	*Helianthus hirsutus*	10-30
SMOOTH BLUE ASTER	*Aster laevis*	10-20
PURPLE CONEFLOWER	*Echinacea purpurea*	5-20
NAKED FLOWER TICK TREFOIL	*Desmodium nudiflorum*	10-20
SLENDER LESPEDEZA	*Lespedeza virginica*	10-20
CANADIAN BLACK SNAKEROOT	*Sanicula canadensis*	10-20
EASTERN BEEBALM	*Monarda bradburiana*	10-20
WHORLED MILKWEED	*Asclepias quadrifolia*	10-20
CULVER'S ROOT	*Veronicastrum virginicum*	5-10
SMOOTH SPIDERWORT	*Tradescantia ohiensis*	5-10

Grasses and sedges

Common Name	Botanical Name	Cover % (low-high)
WOODLAND BROME	*Bromus pubescens*	10-30
BIG BLUESTEM	*Andropogon gerardii*	5-20
LITTLE BLUESTEM	*Schizachyrium scoparium*	5-20
PENNSYLVANIA SEDGE	*Carex pensylvanica*	5-20
PARASOL SEDGE	*Carex umbellata*	5-20
ROCK MUHLY	*Muhlenbergia sobolifera*	5-20
VIRGINIA WILD-RYE	*Elymus virginicus*	5-20
BOTTLEBRUSH GRASS	*Elymus hystrix*	5-20

Site Interpretations

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.

Forestry

- Management: Field measured site index values average 58 for white oak and 65 for black oak. Timber management opportunities are good. 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.

- Limitations: Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35%, traction problems increase and equipment use is not recommended.

Glossary

Backslope – a hillslope profile position that forms the steepest and generally linear, middle portion of the slope.

Backswamp – marshy or swampy, depressed areas of flood plains between natural levees and valley sides or terraces

Calcareous – the presence of calcium carbonate in the soil parent material within the rooting zone; relatively alkaline

Claypan – a dense, compact, slowly permeable layer in the subsoil having much higher clay content than the overlying material

Chert – hard, extremely dense or compact crystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz

Cliff – a significant vertical, or near vertical, rock exposure

Dolomite – a type of sedimentary rock that is a carbonate mineral composed of calcium magnesium carbonate

Drainageway – the upper most reach of a stream channel system characterized by little meandering

Dry – a site where soil moisture is limiting during the growing season; low available water capacity

Dune – a low mound, ridge, bank or hill of loose, wind-blown sand

Exposed – steep, south and west-facing slopes, which are warmer and drier than other slope aspects

Flatwoods – a type of woodland that occurs on soils with a root restricting subsoil layer within 20 to 30 inches, resulting in very slow runoff and ponding that remains saturated for most of the winter and early spring months but dries out and becomes very dry in the summer months; plants that grow there must be adapted to both conditions

Floodplain – the nearly level plain that borders a stream and is subject to inundation under flood-stage conditions

Footslope – a hillslope position at the base of a slope where hillslope sediment (colluvium) accumulates

Forest – a vegetative community dominated by trees forming a closed canopy and interspersed with shade-tolerant understory species

Fragipan – a dense, brittle subsoil horizon that is extremely hard and compact when dry

Glade – open, rocky, barren vegetative community dominated by drought-adapted forbs and grasses, typically with scattered, stunted woody plants

Igneous –bedrock formed by cooling and solidification of magma. Granite and rhyolite are typical igneous bedrocks in Missouri

Limestone – a type of sedimentary rock composed largely of calcium carbonate

Loess – material transported and deposited by wind and consisting predominantly of silt-size particles

Loamy – soil material containing a relatively equal mixture of sand and silt and a somewhat smaller proportion of clay

Marsh – a type of wetland that is dominated by herbaceous rather than woody plant species

Moist – a site that is moderately well to well drained and has high available water capacity, resulting in a well-balanced supply of moisture (neither too dry nor too wet).

Mudstone – blocky or massive, fine-grained sedimentary rock in which the proportions of clay and silt are approximately equal

Natric – a soil horizon that displays a blocky, columnar, or prismatic structure and has a subhorizon with an exchangeable-sodium saturation of over 15%

Outwash – stratified sediments of sand and gravel removed or "washed out" from a glacier by melt-water streams

Prairie – a vegetative community dominated by perennial grasses and forbs with scattered shrubs and very few trees

Protected – steep, north- and east-facing slopes, which are cooler and moister than other slope aspects

Residuum - unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place

Riser – a component of terraces and flood-plain steps consisting of the steep side slope; the escarpment

Riverfront – a vegetative community in the floodplain immediately adjacent and generally parallel to a river or stream channel

River hills – a geographic area characterized by thick, dissected loess deposits, formed immediately adjacent to the edges of the Missouri and Mississippi River floodplains

Sandy – a coarse-sized soil containing a large mixture of sand and gravels and a somewhat smaller proportion of silts and clays with excessive drainage

Sandstone – a sedimentary rock containing dominantly sand-size particles

Savanna – grasslands interspersed with open-grown scattered trees, groupings of trees, and shrubs

Shale – a sedimentary rock formed from clay, silty clay, or silty clay loam deposits and having the tendency to split into thin layers

Shallow – a site with bedrock within 20 inches of the surface

Shoulder – the slope profile position that forms the convex surface near the top of a hill slope; it comprises the transition zone from summit to backslope

Sinkhole – a closed, circular or elliptical depression, commonly funnel-shaped, characterized by subsurface drainage and formed either by dissolution of the surface of underlying bedrock or by collapse of underlying caves within bedrock

Summit – the top or highest area of a hillslope

Swale –shallow, closed depressions irregularly spaced across a floodplain or terrace with an irregularly undulating surface.

Swamp – an area of low, saturated ground, intermittently or permanently covered with water, and predominantly vegetated by shrubs and trees.

Talus – rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep rock slope.

Terrace – a step-like surface, bordering a valley floor that represents the former position of a flood plain

Till – dominantly unsorted and unstratified soil material deposited directly by a glacier

Upland – a general term for the higher ground of a region, in contrast with a low-lying, adjacent land such as a valley or floodplain

Wet – a somewhat poorly, poorly or very poorly drained site that has an oversupply of moisture during the growing season

Woodland – a highly variable vegetative community with a canopy of trees ranging from 30 to 100 percent closure with a sparse midstory and a dense ground flora of grasses, sedges and forbs

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