MEETING PLACE: Days Inn and Suites of Cedar Rapids (Depart at 7:00 am)
• 2215 Blairs Ferry Rd NE, Cedar Rapids, IA 52402

STOP 1: Highway 100 Extension Project and Rock Island Botanical Preserve (7:15 am-10:45 am)
• Ecosystems: Emergent Wetland, Dry Sand Prairie, Sand Oak Savanna, River Floodplain Forest
• T&E Species: Northern long-eared bat, Prairie vole, Western harvest mouse, Southern flying squirrel, Blanding’s turtle, Bullsnake, Ornate box turtle, Blue racer, Byssus skipper, Zabulon skipper, Wild Indigo duskywing, Acadian hairstreak, Woodland horsetail, Prairie moonwort, Northern Adder’s-tongue, Soft rush, Northern panic-grass, Great Plains Ladies’-tresses, Glomerate sedge, Goats-rue, Field sedge, Flat top white aster
• Invasive Species: Garlic mustard, Common buckthorn, Eurasian honeysuckles, Autumn-olive, Yellow & White sweet-clover, Common mullein, Bouncing bet, Kentucky bluegrass, Siberian elm, Japanese barberry, White mulberry, Smooth brome

LUNCH: BurgerFeen (11:00 am - 12:00 pm)
• 3980 Center Point Rd NE, Cedar Rapids, IA 52402

STOP 2: McLoud Run (12:15 pm – 2:45 pm)
• Current Ecosystems: Disturbed Floodplain Forest
• T&E Species: none
• Invasive Species: Black locust, Bird’s-foot trefoil, Bouncing bet, Crown vetch, Cut-leaved teasel, Eurasian Honeysuckles, Garlic mustard, Japanese knotweed, Reed canary grass, Siberian elm, Tree-of-heaven, White mulberry, Wild parsnip

RETURN TO HOTEL (3:00 pm)

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** Much of the content of this educational booklet is based on data provided by the Iowa Natural Areas Inventory, Iowa Department of Natural Resources; Natural Heritage Information System, Division of Ecological and Water Resources, Minnesota Department of Natural Resources, Michigan’s Natural Heritage Database, and Michigan Natural Features Inventory. These data are based on a variety of sources, including surveys to locate rare plants and animals in their natural habitats, collection of information from museums, herbaria, and scientific literature, and observations from naturalists around the state. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

***T&E Species Prescriptions are not set in stone. Dates and prescriptions may vary depending on region, site characteristics, and additional species present.
INTRODUCTION

| LANDSCAPE ECOSYSTEM |

Perceptible topographic and volumetric entity composed of air, land, and organic contents extended spatially over a particular part of the Earth's surface for a certain time.¹⁰²

| ECOSYSTEM |

**Abiotic Components**
(Physical environmental - site or habitat)

**Biota** (Biotic community)

**Climate (Macro and Micro)**

**Physiography** (form of land and parent material)

**Soil** (edaphic factors of water, air, nutrients, etc.)

**Plants** - Plant communities

**Animals** - Animal communities

**Microbes** - Microbial communities

| LANDSCAPE ECOSYSTEM APPROACH |

- Multi-scale, multi-factor, hierarchical approach to understanding the landscape
- Considers bedrock geology, physiography, climate, soil, hydrology, and vegetation

Credit: Albert et. al. 1986

Credit: Barnes, B.V.
Ecoregion Level I & Level II

Ecological Regions are areas of general similarity in ecosystem and in the type, quality, and quantity of environmental resources. Past mapping approaches recognized the need to consider a full range of physical and biotic characteristics including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology to explain ecosystem regions. Equally, they recognized that the relative importance of each characteristic varies from one ecological region to another regardless of the hierarchical level. Developing and refining a framework of North American ecological regions has been the product of research and consultation between federal, state, provincial, and territorial agencies. These agencies were open government departments, but the initiative also involved nongovernmental groups, universities, and institutes. These maps represent the working group's best consensus on the distribution and characteristics of major ecosystems on two levels throughout the three North American countries.

The methodology incorporated these points in mapping ecological regions:

- Ecological classification incorporates all major components of ecosystems: air, water, land, and biota (including humans).
- The number and relative importance of factors that are helpful in the delineation process vary from one area to another, regardless of the level of generalization.
- Ecological classification is based on hierarchy - ecosystems are nested within ecosystems as mapped, although in reality, they may not always nest.
- Such classification integrates knowledge, it is not an overlay process.
- It recognizes that ecosystems are interactive - characteristics of one ecosystem blend with those of another.
- Map lines depicting ecological classification boundaries generally coincide with the location of transition zones.
| REGIONAL CLIMATE & PHYSIOGRAPHY |

The Great Plains ecological region is found in the central part of the continent and extends over the widest latitudinal range of any single North American ecological region covering about 1.4 million square miles. The North American prairies extend for about 900 miles from Alberta, Saskatchewan and Manitoba in Canada, south through the Great Plains of the United States to southern Texas and adjacent Mexico, and approximately 400 miles from western Indiana to the foothills of the Rockies and into northeastern Mexico. This ecological region is distinguished particularly by relatively little topographic relief, grasslands and a paucity of forests, and subhumid to semiarid climate. The landscape of the northern prairies of the United States have been shaped by a variety of glacial deposits consisting mostly of undulating and kettled glacial till, and level to gently rolling lacustrine deposits. These landforms are associated with intermittent sloughs and ponds. Surficial geology in the remainder of the Great Plains ecological region is varied. In the northern and central Great Plains, most of the rivers have their origins in the Rockies, where rainfall, snowmelt and glacial runoff in the north contribute to their formation. The soils are commonly deep and throughout most of the region were originally highly fertile. Today, soils of agricultural potential throughout the Great Plains face problems of reduced nutrient potential, increasing salinity, and susceptibility to wind and water erosion. The climate is dry and continental, characterized in the north by short, hot summers and long, cold winters. High winds are an important climatic factor in this ecological region. It is also subject to periodic, intense droughts and frosts. The Great Plains were once covered with natural grasslands that supported rich and highly specialized plant and animal communities. The interaction of climate, fire, and grazing influenced the development and maintenance of the Great Plains. Rainfall increases from west to east, defining different types of native prairies. Shortgrass prairie occurs in the west, in the rain shadow of the Rocky Mountains, with mixed-grass prairie in the central Great Plains and tallgrass prairie in the wetter eastern region. Because of the suitability of the Great Plains for agricultural production, many native prairie vegetation types have been radically transformed. The short, mixed, and tallgrass prairies now correspond to the western rangelands, the wheat belt and the corn/soybean regions, respectively, to the central and eastern Great Plains. Drier northern sites are home to yellow cactus and prickly pear, with sagebrush also abundant. Native prairie vegetation ranges from grama grass, wheatgrass, and bluestem prairie in the north to different shrub and grassland combinations and grassland and forest combinations in the south. The eastern border of the region, stretching from central Iowa to Texas, shows patterns of grassland and forest combinations mixed with oak-hickory forest. Throughout the remainder of the Great Plains there are few native deciduous trees that occur, except in the eastern regions or in very sheltered locations along waterways or at upper elevations. Wetland concentrations are generally greatest in the glaciated, subhumid northern grasslands and adjacent aspen parkland of the northern Great Plains, where up to half of the land is wetland. Significant wetlands are also found in the Nebraska Sandhills and a large area of playas is located in the southwestern United States. During winter, the Mexican bodies of water provide habitat for numerous migrant waterfowl from Canada and the United States. Prairie wetlands provide major breeding, staging, and nesting habitat for migratory waterfowl using the central North American flyway. Prior to European settlement, the Great Plains supported millions of bison, pronghorn antelope, elk and mule deer, plains grizzly bears, and plains wolves. Today, the Great Plains is home to a disproportionately high number of rare, threatened, vulnerable, and endangered species. The draining of wetlands and conversion of wildlife habitat for agriculture, industry, and urban development are significant issues in this ecological region. The prairie grasslands are among the largest farming and ranching areas of the Earth, and agriculture is the main stressor.\textsuperscript{168, 16}
The Temperate Prairie covers 303,200 square miles in the United States and Canada. Mean annual low temperature is 360º, and mean annual high temperature is 550º. Mean annual precipitation has a low of 16 inches and a high of 39 inches. This region is characterized by mainly irregular plains, which are flatter to the northwest, interspersed with numerous small lakes and wetlands. Landforms include moraines with some loess in the south, and some lacustrine landforms, consisting of mainly calcareous soils. The vegetation was formerly tallgrass prairie and aspen parkland, but is currently almost entirely cropland. Typical wildlife includes white-tailed deer, waterfowl, pheasant, and meadowlark. Human land use in the region is mostly agriculture (cereal grain, livestock, and feedlots).
**REGIONAL LANDSCAPE ECOSYSTEMS**

**Ecoregion Level III: Western Corn Belt Plains**

The Western Corn Belt Plains stretches across southern Minnesota, most of central and western Iowa, eastern South Dakota, eastern Nebraska, northwest Missouri, and northeast Kansas. The ecoregion has a severe mid-latitude humid continental climate, marked by hot summers and cold winters. The mean annual temperature is 43º in the north to 54º in the south. The frost-free period ranges from 140 to 200 days. The mean annual precipitation is 31 inches, ranging from 24 to 39 inches and occurring mainly during the growing season. Once covered with tallgrass prairie of little bluestem, big bluestem, Indiangrass, switchgrass, and numerous forbs, with small areas of bur oak and oak-hickory woodlands, this region has nearly all been converted to agricultural land. There are many intermittent and perennial streams, many of which have been channelized. A few areas have natural lakes. Surface and groundwater contamination from fertilizer and pesticide applications as well as from concentrated livestock production is a regional issue. The topography consists of nearly level to gently rolling glaciated till plains and hilly loess plains. Thick loess and glacial till cover the Mesozoic and Paleozoic shale, sandstone, and limestone. Mollisols and Alfisols are dominant with mesic soil temperatures and udic soil moisture. Regional wildlife includes white-tailed deer, beaver, raccoon, red-tailed hawk, barn owl, bobwhite quail, western meadowlark, Canada goose, pheasant, gray partridge, mallard, teal, Great Plains toad, walleye, northern pike, bluegill, and sunfish. Over 75% of the Western Corn Belt Plains is now used for cropland agriculture and much of the remainder is in forage or livestock. It is one of the most productive areas in the world for growing corn and soybeans. Hog and cattle production and some dairies also occur. Larger towns and cities include Mankato, Worthington, Albert Lea, Austin, Sioux Falls, Sioux City, Fort Dodge, Mason City, Des Moines, Ames, Marshalltown, Waterloo, Cedar Falls, Cedar Rapids, Iowa City, Omaha, Council Bluffs, Lincoln, Atchison, Maryville, and St. Joseph.11, 193
REGIONAL CLIMATE, PHYSIOGRAPHY, & SOILS

The Eastern Iowa and Minnesota Drift Plains ecoregion, formerly known as the Iowan Surface, is located between the bedrock-dominated landforms of the Paleozoic Plateau/Coulee Section (steep slopes, bluffs, sedimentary rock outcrops, and dense forest) and the relatively recent glacial drift landforms of the Des Moines Lobe (flat, lack of loess over the glacial drift, morainal ridges). This geologically complex area can be broadly characterized by long, gentle slopes and mature drainage patterns occurring in the south and thin glacial deposits and karst features such as sinkholes and sags occurring on shallow limestone bedrock in the north. The upland, deeply lobed, tongue-shaped protrusions have loess-capped knobs and ridges called paha located on the southern terminus. Low gradient streams and rivers result from the general lack of topography. Lakes of glacial origin do not exist in this region, but overflow areas and backwater ponds occur along some of the larger river channels and contribute to the diversity of aquatic habitat.\(^{39, 24}\)

In undeveloped areas, the Ecoregion soils are generally characterized by a thin cover of loess over loamy till underlain by Devonian and Silurian limestone and dolomite. Additionally, natural vegetation includes big bluestem-Indian grass prairie with areas of savanna and bur oak woodlands.\(^{12}\)
STOP 1

Highway 100 Extension Project and Rock Island Botanical Preserve

| GEOLOGY / LANDFORM |
The project site for the Highway 100 extension project (Hwy 100) spans 8 miles and utilizes a section of abandoned railroad corridor. The project site crosses over the Cedar River, a tributary of the Iowa River which flows to the Mississippi River and its floodplains. Hence the site crosses a variety of artificial and natural landforms. Rock Island Botanical Preserve is approximately 20 acres located just south of the Hwy 100 project on the east side of the Cedar River. Across both sites, fractured carbonate bedrock consisting of limestones, dolostones, and shale from the Devonian System is prominent. In and along the floodplain of the Cedar River, fractured carbonate bedrock from the Silurian System, which is the principal bedrock aquifer in Linn County, includes fossiliferous dolostones with lime packstone, wackstone, to mudstone fabrics. Generally, the bedrock is deeply buried beneath glacial deposits (except in the north) and therefore it has little influence on plant distribution and abundance. However, bedrock outcrops occur along some of the major rivers, including the Cedar River, which extends the range of some of the northern and eastern plant species. Extensive sandy areas, mostly wind-deposited, are also common along the Cedar River. 68

| SOILS |
Of the 75 soil types present on and adjacent to the 8 mile long Highway 100 Extension project, the majorities are loam (~28%), silty clay loam (~24%), and loamy fine sand (~15%). 165
ECOSYSTEMS

The Highway 100 project will cross through or run adjacent to multiple natural communities, including those on the Rock Island State Preserve, such as: dry sand prairie, sand oak savanna, floodplain forest, emergent wetland, and sandy mesic woodland.

T&E SPECIES

MAMMALS: Northern long-eared bat, Prairie vole, Southern flying squirrel, Western harvest mouse
REPTILES: Blanding’s turtle, Blue race, Bullsnake, Ornate box turtle
INSECTS: Acadian hairstreak, Byssus skipper, Wild indigo duskywing, Zabulon skipper
PLANTS: Field sedge, Flat top white aster, Glomerate sedge, Goats-rue, Great Plains ladies'-tresses, Northern Adder’s-tongue, Northern panic-grass, Prairie moonwort, Soft rush, Woodland horsetail

INVASIVE SPECIES

Autumn-olive, Bouncing bet, Common buckthorn, Common mullein, Eurasian honeysuckles, Garlic mustard, Japanese barberry, Kentucky bluegrass, Siberian elm, Smooth brome, White mulberry, White & Yellow sweet-clover
STOP 1

| SIZE / LOCATION / OWNERSHIP / MANAGEMENT |

**HIGHWAY 100 RIGHT-OF-WAY:** 8 mile-long project corridor located on the west side of Cedar Rapids in Linn County, connecting the current Highway 100 terminus (at Edgewood Road) with US 30 to the southwest. Iowa Department of Transportation (IDOT), Federal Highway Administration (FHWA).

**ROCK ISLAND BOTANICAL PRESERVE:** Approximately 20 acre property located south of the Hwy 100 project at 4401 Preserve Lane, Cedar Rapids, IA 52411. Owned by Linn County and managed by Linn County Conservation Board.

| HISTORY |

**HIGHWAY 100**

In 2001, IDOT and FHWA approved a Draft Supplemental Environmental Impact Statement (DSEIS) for the Highway 100 Extension project to supplement the approved Final Environmental Impact Statement from 1979, outlining existing and predicted future traffic trends, project alternatives and their impacts, as well as socioeconomic and environmental resources. In 2007 a Final Supplemental Environmental Impact Statement was approved with Alternative 1, the addition of...
an 8 mile-long section from Edgewood Road to US 30 generally via an abandoned railroad right-of-way, as the proposed action. The proposed pathway, would
directly impact suitable habitat for two state threatened species - the ornate box turtle and Blanding's turtle – on the Rock Island Botanical Preserve property.
To accommodate these species and others known from the site, such as state endangered northern panic grass and Byssus skipper butterfly, IDOT adjusted the
highway's alignment near the preserve. To further mitigate adverse impacts, IDOT agreed to purchase and restore 30 acres of cropland to prairie as well as move
and expand Seeman's Pond, after transmitter studies determined that the most utilized Blanding's turtle path runs from overwintering habitat in Seeman's Pond
on the preserve to feeding habitat in Swan Pond, north of and across the highway from the preserve. To ensure that turtles can still access both ponds via their
preferred path, IDOT has incorporated a 10 x 10 box culvert under the highway and plans to install appropriate fencing to funnel all wildlife to the culvert, thus,
reducing the number of anticipated wildlife fatalities caused by vehicles.\textsuperscript{152, 48}

In winter 2014-2015, ITC partnered with IDOT to perform two structure replacements on either side of the Cedar River adjacent to the new Hwy 100 alignment.
Although not protected at the time, now federally threatened northern long-eared bat (NLEB) was observed during mist netting surveys along the project corridor.
Per standard IDOT specifications, necessary tree removals were performed before April 1\textsuperscript{st} to abide by USFWS guidelines to protect listed bat species. All
vegetation management and construction activities were performed between December 15\textsuperscript{th} and February 15\textsuperscript{th} to avoid impacting state threatened Blanding's
turtles. Cutting, and herbicide application have been used to combat woody encroachment of savanna and prairie habitats as well as to combat invasive species.

\textbf{ROCK ISLAND BOTANICAL PRESERVE}
Prior to acquisition by Linn County, the area of land south of the Hwy 100 project (see map on page 9) was owned by the Rock Island Railroad Company. As
evidenced in 1930 aerial photographs and historical accounts, portions of the upland were farmed, and the wetland areas were created as a result of soil removal
used in railroad construction. The approximately 20-acre tract of land was subsequently ignored, allowing a diversity of flora and fauna to recolonize the site.
In 1962, the land was gifted by the Rock Island Railroad Company with the understanding that the Linn County Conservation Board would manage the area as
a biological preserve. In 1978 the land was accepted into the Iowa preserve system, which provides special protection to lands either maintained near natural
condition or that contain rare flora, fauna, or other significant scientific or historical features. In 2002, 100 acres of nearby land, which included upland sand
prairie, wetlands, and forested areas which support Byssus skipper butterfly and Blanding's turtle, were gifted by James Buresh and James LaMorgese of James
Properties, Incorporated and placed in the custody of the Linn County Conservation Board. Surveys conducted in 1989 – 2003 have documented eight animal and
nine plant species currently recognized as Threatened (T), Endangered (E) or Special Concern (SC) in Iowa and one federally threatened bird at the Preserve.\textsuperscript{7, 189, 141, 84}
McLoud Run

| GEOLOGY / LANDFORM |
McLoud Run, which is fed by both surface runoff and groundwater, is Iowa’s only urban stream with cool enough water temperatures to support trout. The cold water is supplied by a spring near 42nd Street (1.25 miles to the north of the site). For approximately two of its four miles, it runs adjacent to I-380, Cedar Nature Trail, and the Illinois Central Railroad, until entering the Cedar River confluence near the center of downtown Cedar Rapids. Due to the significant portion of impervious surfaces in the watershed, McLoud Run experiences extreme flashiness, with water levels quickly rising during storm events.\(^\text{74, 47}\)

| SOILS |
Of the nine soil types present on the McLoud Run property, the majority are silt loam (~44%), silty clay loam (~33%), or loam (~13%).\(^\text{165}\)
Currently, McLoud Run Park is primarily a disturbed floodplain forest with sections of turf grass and a number of invasive species. However, ITC plans to seed two formerly turf grass areas with a mesic tallgrass prairie seed mix and dry-mesic shortgrass prairie seed mix in 2016. These areas will help prevent rapid surface flow into McLoud Run and will support native fauna, including pollinator species.

**T&E SPECIES**
None

**INVASIVE SPECIES**
- **PLANTS:** Bird's-foot trefoil, Black locust, Bouncing bet, Crown vetch, Cut-leaved teasel, Eurasian Honeysuckles, Garlic mustard, Japanese knotweed, Reed canary grass, Siberian elm, Tree-of-heaven, White mulberry, Wild parsnip

**SIZE / LOCATION / OWNERSHIP / MANAGEMENT**
4 miles of stream and approximately 43 acres of adjacent property with the 5.7 mile located within the Cedar River Trail-North. Parking lot off of McLoud Place and another trail access point near intersection of J Ave NE and 11th St NE, Cedar Rapids, IA 52402 and City of Cedar Rapids, Linn County Trails Association.

**HISTORY**
Located in Linn County, Iowa, in the City of Cedar Rapids, McLoud Run is widely praised as Iowa's only urban trout stream. Occasionally stocked with trout by the Iowa DNR, the perennial stream is fed by both storm and cold groundwater and flows for approximately 4 miles prior to joining the Cedar River. It has been used as a source of cold water for local residents and as a state fish hatchery in the 1870's. Today, it primarily functions as a recreational amenity (approximately 4,600 people use the adjacent trail during summer months) and drainage system for the populations of Cedar Rapids and Hiawatha. Due to increasing urbanization, which has continued to increase the percentage of impervious area in the watershed, McLoud Run experiences extreme flashiness as water levels quickly rise during storm events due to rapid surface runoff entering the stream. Average annual flow in the stream is approximately 2 cubic feet per second (cfs), but stream volumes during storm events can rapidly increase from 1 cfs to 30-45 cfs. Monitoring data from 2006 reported storm flows as high as 112 cfs. Flashy flows can alter the biota of the stream by washing away or smothering benthic macroinvertebrates (aquatic insects important to fish diets) and by changing the water chemistry,
including temperature and pollution levels. Thus in response to these degradations, which can impair trout and other fish populations, McLoud Run has become the focus of increased monitoring and restoration efforts since 2007.\textsuperscript{75, 122}

ITC has been surveying and implementing integrated vegetation management in their corridors at McLoud Run Park since 2012. In January 2016, ITC removed vegetation along the southern portion of the stream, including cottonwood and the invasive Siberian elm, while attempting to retain northern hackberry and black walnut when possible to maintain shade and lower stream temperatures. The majority of invasive shrubs were removed with the exception of some Eurasian honeysuckle, which was deemed important for bank stabilization. Planned for spring 2016, 0.86 acres will be seeded with a combination of tallgrass prairie pollinator mix and dry-mesic short grass prairie mix near the Saints Run Substation on Coldstream Ave NE. Where feasible, natural fiber erosion control matting will be installed on slopes to prevent erosion while lowering the risk of entrapment for reptiles. The resulting habitat will improve water quality by infiltrating more storm water than the current turf grass and, hence, reducing direct runoff into the stream. Additionally, the prairie will enhance pollinator habitat by providing diverse native larval host plants and flowers throughout the growing season. ITC and the City of Cedar Rapids Parks & Recreation Department will pursue Conservation Certification for McLoud Run Park through the Wildlife Habitat Council, which recognizes conservation efforts by corporations that collaborate with management, employees, and the community to conserve and restore wildlife habitats on corporate lands. ITC has participated in the program since 2008 and currently has 14 successfully certified sites, including Beverly Park, Sac & Fox Trail Park, and Squaw Creek Park which were newly certified in 2015.
SAND PRAIRIE

DESCRIPTION: A native grassland occurring on sandy glacial outwash plains, sandy lake plains, steep slopes, alluvial deposits, and occasionally on sand ridges, such as inland dunes, coarse textured end-moraines, or sand blowouts caused by wind storms. Often associated with white oak barrens, oak-pine barrens, and pine barrens, the dry sand prairie is characterized by short, patchy vegetation, large areas of native grasses, and less than one mature tree per acre.103

LANDFORM AND SOILS: Primarily occurs on sandy glacial outwash plains and lakebeds, but occasionally on coarse-textured end and ground moraines as well as sandy, hilly deposits in ice-contact terrain and post-glacial Eolian (wind-deposited) landforms. Relatively stable well-drained to excessively drained coarse textured sands, loamy sands, and sandy loams facilitate sand prairie establishment. Loamy sand soils, which have an average pH of 5.1 and average water retention capacity of 38%, are generally loose, well-drained, unconsolidated, and lacking in organic matter, which makes them poor for agricultural purposes. Overall, the low nutrient levels, lack of organic matter, and low water retention capacities of the soils strongly influences species composition and structure.

NATURAL PROCESSES: Frequent fires and droughty soils were historically responsible for maintaining open conditions by limiting tree establishment. Prior to settlement, fire frequency was dependent upon the type and volume of fuel, topography, and natural firebreaks, as well as the practices of Native Americans, which were a significant source of ignition. Fires increased visibility across the land by clearing vegetation, which facilitated large game hunting and advance notice of attack by neighboring tribes. In the absence of fire, species diversity is often found to decline. Since fires often burn patchily, fire-adapted and early successional colonizer species establish quickly on burned sections, while unburned refugia patches continue to support later successional species. Without fire, system variability decreases and studies suggest that the accumulation of litter and the decrease in open area favor the establishment of taller vegetation, which out-compete species with small growth habits, small seeds, and nitrogen-fixing symbioses. Other natural processes, such as nutrient cycling, are also altered when fire is removed from the system and can have cascading effects on other species in the prairie environment that depend on particular host plants or an open grassland structure. In addition to fire, animals also play an important role in shaping the prairie ecosystem. Ants, especially the genus Formica, frequently create and abandon large mounds, which consequently mixes and aerates the prairie soils. Records indicate that ant mounds, which can measure 1.5’ (.5 m) in height and span 3.3’ (1 m) wide, can number 40 to 50 per acre. Moles, mice, skunks, and badgers also contribute to prairie soil aeration. Historically, large herbivores also played an influential role in plant species diversity and community composition through selective foraging and trampling. These activities altered community dynamics by reducing the populations of favored vegetation and through the creation of microsites for seed germination and establishment. These localized disturbances created open spaces with distinctive moisture and light conditions, creating niches suitable to early or mid-successional species, and thus, allowing for more heterogeneity within the prairie ecosystem.62, 103

ANIMALS: Prior to market hunting and habitat destruction in the 1800s, prairies contained a wide variety of wildlife adapted to the grassland habitat. Large mammals such as bison, elk, antelope, and wolves were an important component of the prairie ecosystem, but are unlikely to be reintroduced given the widespread conversion of land to agriculture. The following animals can still be found in Iowa prairies: pocket gopher, ground squirrel, grasshopper mice, white-tailed deer, coyote, fox,
ornate box turtle, skink spp., chorus frog, American toad, dickcissel, red-winged blackbird, goldfinch, meadowlark, bobolink, bluebird, nighthawk, grasshopper sparrow, red-tailed hawk, northern harrier, and American kestrel.

**VEGETATION:** The ecosystem is dominated by little bluestem, June grass, poverty oat grass, porcupine grass, and Pennsylvania sedge. Others graminoids include hairy grama, fall witchgrass, panic grass, and sand dropseed. Forbs include whorled milkweed, western ragweed, prairie sagewort, flowering spurge, bird’s-foot violet, everlasting, hawkweed, slender-leaved pinweed, tall and rough blazing star, frost weed, toadflax, hoary puccoon, wild lupine, sand primrose, purple milkwort, prairie ragwort, gray goldenrod, goats-rue, ladies’ tobacco, large-flowered beardless, hairy puccoon, and false heather.

**INVASIVE THREATS:** Spotted knapweed, common St. John’s wort, autumn-olive, multiflora rose, common buckthorn, Eurasian honeysuckles, and black locust.

**MANAGEMENT:** To protect and enhance species diversity and prevent tall shrub and tree encroachment, an appropriate prescribed fire regime should be determined and implemented. To reduce the negative impact of fire on intolerant species such as insects, adjacent management units should generally be burned in alternating cycles to maintain a refuge and allow for recolonization. To combat re-sprouting native woody species and invasive species establishment, brush cutting and herbicide stump application may need to be employed. The reduction of woody vegetation and detritus due to prescribed fire has also been shown to promote prairie ants (*Formica*) as opposed to carpenter and woodland ants due to a lack of litter for nest construction. In addition to reestablishing ecological processes, small, isolated sand prairie remnants will also necessitate seeding or seedling transplants of native species and genotypes to increase gene flow. Lastly, general grassland management and restoration efforts are critical to grassland bird populations, which have suffered due to habitat loss and agricultural practices. To encourage grassland bird populations: avoid fragmentation, protect large tracts (125+ acres), maximize the interior space by avoiding narrow plantings, and create a feathered edge with border habitats rather than sharply contrasting edges (i.e. if possible, allow fire to enter the forest stand rather than creating stark breaks).
**SAND OAK SAVANNA**

**DESCRIPTION:** Oak savanna is a fire-dependent community that typically has spreading, open-grown oak trees with sun-loving grasses, sedges, and wildflowers growing under them. Oak savannas have open canopies, allowing light to reach the ground layer. Older trees that initially established in a savanna setting often have widely spreading branches, indicating they grew under conditions where they did not have to compete for light. Savannas are mosaic communities with variation of sunny, shaded, and partially shaded areas. The shifting light under the canopy provides an environment for a unique mixture of herbaceous plants. Savanna understory consists of a mosaic of both sun-loving plants typical of prairie and species adapted to dappled or heavy shade environments under trees, depending on whether the tree canopy is more open or closed. Herbaceous species typical of prairie and forest co-occur, in addition to a set of very specific savanna species that have high fidelity to the savanna community. The non-woody plants and oak leaves provide fuel for fire that is often slow and creeping, compared to the fast-moving prairie fires.

**LANDFORM AND SOILS:** Oak savannas in the Midwest occur on dry or dry-mesic sites across varied topography, including flat, rolling, and very steep terrain. Today, areas of hilly terrain or sandy soils are more likely to have remnant oak savanna ecosystems, since areas with those characteristics are generally not conducive to agriculture. In Iowa, savannas occur in the transition zone between eastern forests and the prairies.

**NATURAL PROCESSES:** Prior to human settlement, Midwest oak savannas were maintained by low-frequency fires resulting from lightning. These fires were integral because oaks are extremely fire-resistant, but very shade intolerant, meaning they cannot survive in the shade of other species. As the Wisconsin glaciation receded, the land was colonized by Native peoples who altered the landscape by setting more frequent fires. Additionally, the grazing, browsing, and rubbing of bison and elk also provided disturbance in oak savannas and influenced the vegetation. Today, the lack of these disturbances allows for woody vegetation to encroach, creating forested areas.

**ANIMALS:** American kestrel, barn owl, wild turkey, red-headed woodpecker, northern flicker, loggerhead shrike, blue jay, gray catbird, great crested flycatcher, eastern bluebird, eastern towhee, indigo bunting, orchard oriole, black-capped chickadee, white-breasted nuthatch, tufted titmouse, Karner blue butterfly, elk, bison.

**VEGETATION:** Dominant trees include bur oak and white oak interspersed with northern red oak, black oak, shagbark hickory, and bitternut hickory. Other plants include: Pennsylvania sedge, creamy gentian, purple milkweed, wild lupine, and leather flower.

**INVASIVE THREATS:** Autumn-olive, common buckthorn, Eurasian honeysuckles, multiflora rose, wild parsnip.

**MANAGEMENT:** Oak savannas, which once comprised an estimated 10% of Iowa’s native landscape, are now considered one of the least understood and most rare ecosystems. Restoring oak savannas requires removing fire-intolerant trees and burning the understory.
to allow light to reach the ground so that herbaceous vegetation, including grasses and sedges, can grow. Grasses and sedges burn easily, so their presence makes prescribed burning easier to initiate and spread across the site. If a remnant oak savanna is overgrown with fire-intolerant species, it may be necessary to begin with tree thinning, which will improve air circulation through the site and reduce the risks of initiating a prescribed burn program. Oaks are shade intolerant species, so removing other trees through thinning and fire allows for improved oak regeneration.

Although not all oak seedlings will survive repeated fires, a small number will be able to reach maturity. Oak trees are long-lived, surviving 200 years or more. Unlike some other tree species, mature oaks have thicker bark that can withstand low intensity burns. In fact, oaks promote fire through the chemical composition and physical form of their leaf litter. For example, lobed oak leaves curl as they dry, creating air pockets that promote fire movement along the ground.

Establishing the correct fire regime, specifically the timing, frequency, intensity, and type (patchy burns with refugia vs. complete burns) are dependent upon the geographic location, site history, and desired vegetative community. A considerable amount of research and experienced help is required to restore a savanna ecosystem. It is important to remember that a healthy savanna will have trees of varying ages, so that younger trees will be ready to fill in when old trees die. Even after death, oak trees provide habitat for wildlife species including many cavity-nesting birds and bats.\textsuperscript{166, 77, 149}
FLOODPLAIN FOREST

DESCRIPTION: A bottomland deciduous or deciduous-conifer forest community occupying low-lying areas adjacent to streams and rivers of third order or greater subject to periodic over-the-bank flooding and cycles of erosion and deposition.

LANDFORM & SOILS: In the Midwest, generally occur on the following physiographic systems (landforms): moraine, outwash plain, ice-contact terrain, and lakeplain. Soil is highly variable and strongly correlated with fluvial landforms. The coarsest sediment is deposited on the natural levee, immediately adjacent to the stream channel, where the soil texture is often sandy loam to loam. Progressively finer soil particles are deposited with increasing distance from the stream. Soil texture of the first bottom is often silt loam, with silty clay loam to clay-textured soil often occurring in swales and backswamps. Cycles of periodic over-the-bank flooding followed by soil aeration when the floodwaters recede generally prevent the accumulation of organic soils. Floodplain soils are generally circumneutral to mildly alkaline and characterized by high nutrient availability and an abundance of soil water throughout much of the growing season.

NATURAL PROCESSES: Direct interaction between terrestrial and aquatic ecosystems occurs in floodplain forests through the processes of over-the-bank flooding, bank cutting, and sedimentation. Over-the-bank flooding can directly cause treefall or indirectly lead to windthrow through increased soil saturation. Spring floodwaters often carry ice flows and debris that can scour trees, leading to the development of multiple-stemmed canopy trees. The input of organic matter from the floodplain forest provides sources of energy for aquatic organisms. Shade from streamside vegetation moderates temperature regimes in aquatic systems, preventing excessive warming of the river during summer months. Woody debris from floodplain vegetation influences the development of channel morphology and provides necessary habitat for many aquatic organisms. Riparian vegetation reduces overland water flow and sediment transport. The dynamic process of channel migration creates a diversity of landscape features in floodplains. Hydrogeomorphic processes such as over-the-bank flooding, transport and deposition of sediment, and erosive and abrasive water movement cause the floodplains of large rivers to exhibit a variety of fluvial landforms, each of which is associated with a particular kind of vegetation. Such fluvial landforms are distinguished by their size, shape, elevation, soil characteristics, and location in relation to the stream channel. Several of the most characteristic fluvial landforms are natural levee, first bottom, backswamp, oxbow, and terrace.

ANIMALS: Large contiguous tracts of old-growth and mature floodplain forest provide important habitat for cavity nesters, species of detritus-based food webs, canopy-dwelling species, and interior forest obligates, including numerous neotropical migrants such as Black-throated green warbler, Scarlet tanager, and Ovenbird. Floodplain forests often support disproportionately large numbers of breeding bird species compared to upland landscapes and provide critical habitat for species closely associated with wetlands including several more rare species such as Prothonotary warbler and Louisiana waterthrush. Indiana bats establish roosts and maternity colonies in standing snags within floodplain forests. Great blue herons often construct rookeries within floodplain forests. Seasonally inundated portions of floodplains provide crucial habitat for reptiles and amphibians.

VEGETATION: As a result of the dynamic, local nature of natural disturbance along stream channels, a typical floodplain forest consists of many small patches of vegetation with different species composition and successional stages often correlated with fluvial landforms. Within a single floodplain forest, vegetation changes
along a gradient of flooding frequency and duration. Fluvial landforms, defined by their size, shape, elevation, soil, and position in relation to the stream channel, exert a strong influence on the patterning of floodplain vegetation. New land deposits immediately adjacent to the stream channel are generally dominated by black willow, eastern cottonwood, and black ash. The natural levee is often dominated by silver maple and green ash, but a variety of additional tree species may also be common, including basswood, swamp white oak, bur oak, sycamore, hackberry, and box elder. The low frequency and short duration of flooding on the levee result in dense cover of shrubs and small trees that might include: musclewood, alternate-leaved dogwood, gray dogwood, prickly-ash, redbud, hawthorns, nannyberry, elderberry, bladder nut, and choke cherry. Adjacent to the levee, the first bottom flat is flooded more frequently and for a longer period, limiting the tree canopy to flood-tolerant species such as: silver maple, green ash, black ash, and American elm. Shrubs are typically rare within the first bottom flat, but vines including riverbank grape, poison ivy, Virginia creeper, and moonseed may be abundant. Second bottoms are typically dominated by the same tree and shrub species common to the levee but can also include bitternut hickory, butternut, black walnut, black maple, and white ash. Occasionally, royal fern can be found in the ground cover. Low terraces, within the floodplain but above the influence of floodwaters, often contain oaks and hickories as well as basswood, butternut, black cherry, and sugar maple. Higher terraces are often dominated by oak and hickory.

**INVASIVE THREATS:** Garlic mustard, dame’s rocket, ground ivy, purple loosestrife, narrow-leaved cattail, hybrid cattail, phragmites, reed canarygrass, glossy buckthorn, common buckthorn, Eurasian honeysuckles, Japanese barberry, multiflora rose, autumn-olive, and white mulberry.

**MANAGEMENT:** Conservation and management of floodplain forests require an ecosystem management perspective because of the complex longitudinal, lateral, and vertical dimensions of river systems. It is crucial to maintain the connectivity and longitudinal environmental gradients from headwater streams to the broad floodplains located downstream. The natural spatial and temporal patterns of stream flow rates, water levels, and runoff patterns must be maintained or reestablished where feasible, because these hydrologic processes create the diverse structure that characterizes floodplain forests. Maintaining vegetated buffers in the uplands bordering floodplain forests will help improve stream water quality. Restoration of channel morphology may be important in areas where stream channelization, channel constriction, and dams have altered water delivery and geomorphology. Additionally, floodplain forests are highly susceptible to invasions by non-native species. Because of their linear shape and location between aquatic and terrestrial environments, floodplain forests have a high ratio of edge to interior habitat that may facilitate the movement of opportunistic species. Rivers and streams provide a route of transport that facilitates the spread of species across the landscape. Floodplain forests are highly and frequently disturbed systems that contain extensive areas of exposed mineral soil with high nutrient availability which are characteristics that facilitate invasion by non-native species. Preemptive measures to minimize impacts of invasive species include maintaining mature floodplain forest, minimizing and eliminating trails and roads through floodplains, and buffering riparian areas with mature, continuous uplands.
**EMERGENT WETLAND**

**DESCRIPTION:** Wetlands are transitional areas between aquatic and terrestrial systems where either a depression in the land is covered by shallow water or the water table exists at or near the surface. Wetlands have one or more of the following attributes: 1) at least periodically, the site vegetation is dominated by hydrophytes (plants adapted to grow in water), 2) the substrate is mostly undrained hydric soil, or 3) the non-soil substrate is saturated with water at some time during the growing season of each year. Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes that are present for most of the growing season most years.18

**LANDFORM & SOILS:** Emergent wetlands can be fed by rain and ground water in upland areas, such as prairie potholes, or receive a combination of surface water, groundwater, and floodwaters of adjacent waterbodies in bottomland areas, such as oxbows. Wetland hydric soils form under conditions of saturation long enough to develop anaerobic features such as the accumulation or loss of iron, manganese, sulfur, or carbon compounds. The features that develop due to these processes include: bluish-gray or greenish-gray color (reduced iron); redox depletions or concentrations (gray and reddish gray colors related to iron loss or accumulation); “rotten egg” smell (microbial conversion of sulfate to hydrogen sulfide); and accumulated, partially decomposed, black organic matter, such as peat or muck (lower rate of carbon use by microbes).126, 164

**NATURAL PROCESSES:** Emergent wetlands are subject to frequent or seasonal flooding. Periods of low water facilitate seed bank expression and seedling establishment when litter levels are low. Beaver dams in nearby streams cause major changes to soils and vegetation. One of the most important results of flooding is the creation of oxygen-deprived sediments and accumulation of peat. Muskrat feeding within emergent marshes can create openings that are colonized by submergent and floating vegetation. Historically, where emergent marshes bordered fire-dependent uplands, wildfires likely burned across the community, reducing litter levels and facilitating seed bank expression and seedling establishment.

**ANIMALS:** Depending on wetland size and location, animals that might be encountered include: beaver, muskrat, mink, bats, great blue heron, eastern kingbird, red-winged blackbird, bitterns, rails, northern harrier, mallard, wood duck, blue-winged teal, leopard frog, pickerel frog, chorus frog, bullfrog, American toad, tiger salamander, snapping turtle, softshell turtle, water snake, garter snake, bull snake, bluegill, crappie, largemouth bass, crayfish, and bullheads.63

**VEGETATION:** Swamp horsetail, pussy willow, soft rush, giant bur reed, common cattail, water plantain, arrowhead, spikerush, American sloughgrass, soft stem bulrush, river bulrush, water smartweed.85, 64, 3

**INVASIVE THREATS:** Reed canary grass, narrow-leaved cattail, and purple loosestrife.30

**MANAGEMENT:** Eliminate off-road vehicle traffic; nutrient and sediment inputs; dredging, ditching, and draining activity; dumping and placement of fill; and invasive species establishment. Ditching alters the hydroperiod and allows shrubs and trees to establish, eventually replacing emergent herbaceous species. Wetlands should be monitored for invasive species, which, if found, should be removed after researching effective and safe techniques. A licensed commercial herbicide applicator should be employed if herbicide is determined to be the preferred option. A surfactant, a product added to enhance an herbicide’s performance that improves sticking of the herbicide to the invasive plant, should be employed. Additionally, the technique that is most effective for the job and will cause the
least damage to neighboring desirable species should be utilized. For example, if the infestation is small, hand-wicking (i.e. applying herbicide via a soaked glove directly to the plant) may be appropriate. The upland adjacent to the wetland should also be managed for invasive species and disturbance in the area should be limited so as to prevent tracking in non-native species, damaging sensitive plants, or altering the hydrology of the area.

When bordered by fire-dependent upland communities, management should include prescribed fire in both the marsh and adjacent uplands to encourage the establishment of native species from the seed bank. Prevention of invasive species establishment is key since it saves time and money and maintains a healthy, native ecosystem. See the box for a link to a helpful BMP document created by the Wisconsin DNR.65, 4, 197, 82

**Wisconsin DNR BMP Documents**

**DEFINITION:** According to the National Invasive Species Council, invasive species are “species that are non-native to the ecosystem under consideration, and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.” The Association of Fish and Wildlife Agencies takes the position: “at this point in time, the greatest single threat to wildlife of all kinds and sizes is the spread of exotic species, especially invasive plants.”

**PROBLEMS AND IMPACTS:** Environmental harm comes from invasive species aggressively colonizing sites at the exclusion of other species. The result is a reduction in biodiversity that not only affects the plant community but also affects the other biological constituents of the ecosystem that depend on plants, including the microbial community, micro- and macroinvertebrates, mammals, reptiles, amphibians, and birds.

The Northeastern Agricultural and Resource Economics Association reported a negative economic impact of $34.5 billion per year caused by invasive terrestrial plants in the United States. A still widely cited scholarly paper, published in 2005, estimated the total cost of all invasive species in the United States to exceed $120 billion per year. In 2011, the Department of the Interior allocated $100 million for invasive species prevention, detection, management, research, outreach, and habitat restoration. Today, the cost of invasive species has presumably grown significantly, given that globalization and further research has likely expanded the documented number of plants, animals, and microbes determined to be detrimental to the U.S. economy.

**SEVEN MANAGEMENT SOLUTIONS:** Managing invasive species can be difficult and may require several years of intense, costly, and repetitive effort. Depending upon site conditions, complete eradication may not be a realistic goal. Since biota, including humans, and the landscape ecosystems they
inhabit are in a constant flux, managing invasive species will continue to be an ongoing challenge, responsibility, and act of environmental stewardship. The seven critical aspects of invasive species control are as follows:

1. **Prevention**
   Prevention is the most important step in control of invasive species and starts with awareness and recognition of the most common types of invasive species. Learning to recognize invasive species can begin by reviewing published photos and descriptions. Taking a field trip with someone who knows the plants can aid in the process of learning to identify invasive plant species. See the call-out box below for online references to get started with invasive plant recognition. Knowledge of how plants reproduce and spread, such as through seed dispersal, fragmentation, sending out lateral shoots, and stump sprouting, allows managers to develop strategies to recognize and avoid practices that may cause invasive plants to spread to new areas. For example, when feasible, avoid disturbance of areas that have invasive species with mature seed heads. Disturbance is likely to launch seeds airborne or collect on clothing or vehicles to be carried offsite. If invasive shrubs are to be cut, cuttings should be collected and removed to an appropriate disposal facility. The cut stumps often require treatment with an approved herbicide to prevent regrowth.

2. **Early Detection and Rapid Response**
   Early detection and swift treatment of invasive species generally offers the best chance of success and lowest cost of treatment and effort. It is critically important to stay informed about current and potential invasive species in your area. Once location and abundance of invasive plants have been documented, strive to treat new infestations during the current growing season to prevent additional spread via sexual and asexual reproduction. Priority treatment areas should be (1) isolated plants, then (2) the “advancing front” of a dense stand, and (3) the established dense stand.

3. **Containment and Control**
   Too often, the invasive species are too dense and widespread to be eradicated without unacceptable costs. At that point, it is advisable to stop the spread of the invasive plants and develop an integrated pest management plan to address the problem long term.

4. **Monitoring**
   It is important to regularly inspect sites for occurrence of invasive species, both to evaluate the efficacy of previous treatment efforts and to detect the early onset of a new invasive species infestation.

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**Invasive Plant Online Identification Resources**

- a. **A Field Identification Guide to Invasive Plants of Michigan’s Natural Communities**
  http://mnfi.anr.msu.edu/invasive-species/fieldguide.cfm
- b. **A Field Guide to Invasive Plants of Aquatic and Wetland Habitats for Michigan**
  http://mnfi.anr.msu.edu/invasive-species/aquaticsfieldguide.cfm
- c. **Minnesota Invasive Non-Native Terrestrial Plants: An Identification Guide for Natural Resource Managers**
  http://www.dnr.state.mn.us/invasives/ttterrestrialplan/index.html
- d. **Iowa DNR Invasive Plant Species**
  http://www.iowadnr.gov/Environment/Forestry/ForestHealth/InvasivePlants.asas
- e. **A Field Guide to Terrestrial Invasive Plants in Wisconsin**
- f. **A Field Guide to Invasive Plants of the Midwest & MIPN Fact Sheets**
  http://mipn.org/publications.html
- g. **Bugwood and Invasive.org: The University of Georgia Center for Invasive Species and Ecosystem Health**
  http://www.invasive.org/species/weeds.cfm
5. **Come Clean, Leave Clean**
   Inspect and clean boots, clothing, equipment and personal gear for soil, seeds, plant parts, and invertebrates before and after field activities. Prior to moving equipment out of an infested area or into a non-infested area, clean equipment by removing plant parts, soil, seed, and invertebrates off of equipment wheels, tracks and other surfaces.
   Pack cleaning tools such as hoof picks for boots, brushes or brooms for equipment, and spray bottles of 10% bleach solution for sterilization. Clean equipment and clothing at cleaning stations designated for containment and disposal of debris.

6. **Restoration of Disturbed Sites**
   When feasible, locate staging and access areas in places free of invasive species to avoid their spread via contamination of equipment and clothing with seeds, other plant parts, or invertebrates.
   Minimize soil disturbance by using existing corridors, strive to reduce the size of staging areas, access points, and construction footprints.
   Invasive species often get a “foothold” in disturbed soils, such as construction sites, new road construction, and utility corridors. By replacing topsoil and reseeding or replanting with native species, the invasive species can be denied the opportunity to establish and spread.
   When feasible, use soil and plant materials onsite, rather than exporting and importing material that may contain invasive species.
   If importing soil, fill, mulch, or plants, verify that they are from sources free of invasive species, such as certified weed-free straw.
   Monitoring of newly restored sites is a key step in preventing invasive species from colonizing an area before mature plants are established. The small size and low density of invasive plants found during the revegetation phase of a restoration provides the most opportune time to employ management actions that result in eradication of invasive species.

7. **Communication and Education**
   Training field personnel to recognize and treat invasive species is recommended on an ongoing basis. Some management strategies, especially those proposed for wetlands, require permits from government agencies. State natural resource management agencies typically post information regarding new infestations and treatment methods.9, 119, 155, 162, 195

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Credit: ECT, Inc.
**DEFINITION:** Pollination is the transference of pollen grains from the male anther of a flower to the female stigma. When picturing a “pollinator,” the most common agent that comes to mind is a bee. However, in addition to the 4,000 native bee species identified in the USA, many other pollinators provide this vital ecosystem service. These include species of moths, butterflies, ants, beetles, bats, birds, flies, and wasps. These animals, along with wind and water, are vital to the act of pollination and maintaining a functioning ecosystem. Pollinators are important because they facilitate plant reproduction and ensure viable seed for propagation, genetic diversity within a plant population, and food resources for animals.

With respect to human requirements, the USDA reports that “worldwide, approximately 1,000 plants grown for food, beverages, fibers, spices, and medicines depend upon pollination by animals in order to produce the goods which we require”. In a joint publication from NRCS and the Wildlife Habitat Council, the economic value of pollinators, which includes insect-pollinated crops and indirect products such as milk and beef from cattle fed on alfalfa, is estimated at $40 billion in the USA alone.

**PROBLEMS:** Recently, in a widely documented phenomenon, insect pollinators have suffered substantial declines in abundance and diversity. For example, native bee species and introduced honey bees, both of which are integral to agricultural production, have suffered alarming population and/or range declines. Reports of honey bee colony collapse disorder, a “syndrome defined as a dead colony with no adult bees or bee bodies but with a live queen and usually honey and immature bees still present,” have risen in recent years and no scientific cause has been proven. However, scientists suspect that synergistic effects caused by the following threats are likely to blame:

**Habitat loss and Degradation**
Agriculture is a major land use comprising around 50% of the world’s habitable land and 38% of the world’s overall land area. Today, agriculture often takes the form of large-scale intensive crop monocultures, which fewer species find suitable; therefore, the diversity of species...
over a given land area is reduced. A scientific study published in the Proceedings of the National Academy of Science used a model to estimate that between 2008 and 2013, bee abundance declined across 23% of US land area. This decline was generally associated with conversion of natural habitats to row crops.\(^{198, 80}\)

**Lack of Native Plants and Plant Diversity**

Unsurprisingly, the diversity of plants at a site, or lack thereof, impacts the diversity of pollinators. This is acutely observed in agricultural monocultures, where the crop may only be suitable for a limited number of pollinators and/or might support them for only a few weeks during peak bloom time. Increasing the abundance and diversity of floral resources, with particular attention to providing a consistent supply over the pollinator flight season, has a significant impact on site suitability. Additionally, a study in Restoration Ecology found that both native bees and honey bees displayed a preference for native plants over co-occurring exotic plants. Currently, farmland borders and fringes are attractive sites for non-native, weedy species that can out-compete natives in disturbed or altered landscapes.\(^{121}\)

**Pesticides**

As defined by the Environmental Protection Agency, “a pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest; use as a plant regulator, defoliant, or desiccant; or use as a nitrogen stabilizer. In a report from the USDA’s Economic Research Service, pesticide use for 21 crops in 2008 included the use of 516 million pounds of active ingredient, the chemical agent that controls pests. Unfortunately, pollinators, which are extremely valuable assets in an agricultural system, are equally impacted by pesticide usage. One category of pesticides that have received media attention are neonicotinoids, a relatively new group of systemic insecticides introduced in the last 20 years. Over time, they have demonstrated the following effects on honey bee health: compromised immune system, shortened adult life cycles, impaired memory and learning, reduced social communication (reduces foraging efficiency), disorientation, delayed larval development and disrupted brood cycle, and gut microbe disruption leading to malnutrition. In addition, residential property owners who use pesticides are also impacting pollinator health. Although the pesticides available for homeowner use are used in significantly smaller quantities, they are often incorrectly applied, which can lead to unnecessary environmental impacts.\(^{167, 131, 34}\)

**Non-native Species and Diseases**

In addition to exotic plants outcompeting native flora, which provide specialist pollinator species with nutritional nectar and pollen, non-native pollinators present a potential threat to native pollinator species. Further scientific studies regarding these interactions are required before any generalizations can be made, but given the history of introductions there could be significant ecological impacts. Less speculative is the damage caused by introduced parasites and diseases - Varroa and Tracheal mites, African hive beetles, and Nosema - that have had severe impacts on pollinator populations, although the effects have generally been species-specific.
According to the Intergovernmental Panel on Climate Change, the human-induced current warming trend is proceeding at a rate that is unprecedented in the past 1,300 years, and the panel of 1,300 scientists forecasts a temperature rise between 2.5 to 10°F over the next century. Not all areas will be uniformly impacted nor impacted simultaneously, since different societal and environmental systems will be better or less suited to mitigating changes or adapting. Similarly, pollinators are likely to be directly and/or indirectly impacted by changes to the growing season length, precipitation patterns, and the frequency and intensity of extreme weather events.123

**SOLUTIONS:** In June 2014 amid rising concern for pollinator welfare, President Obama created The Pollinator Health Task Force, which used federal agency collaboration to develop plans aimed at reversing pollinator loss and restoring populations to self-sustaining levels. The resulting 2015 documents outlined strategies for reaching three overarching goals: 1) the reduction of honey bee colony losses during winter to no more than 15% within 10 years, 2) an increase in Eastern monarch butterfly populations to 225 million butterflies/15 acres in overwintering grounds in Mexico, and 3) the restoration or enhancement of 7 million acres of land suitable for pollinators over the next five years. Although this strategy is a step in the right direction, critics lambasted the plans for not taking a harder stance on pesticides, particularly neonicotinoids that have been reported to cause chronic neurotoxicity. Regardless of federal restrictions, all landowners – whether farmers, suburban homeowners, or corporations – should seek out information about pesticide use and application to better protect the environment, employees, customers, and themselves (recommended sites can be found in the call-out box on the next page). Pesticides should only be used when other means (such as mechanical removal) are not effective, efficient, or applicable. The pesticide with the lowest toxicity, fastest degradation rate (i.e. rate at which it becomes benign), highest selectivity (i.e. targets only the intended pest) should be chosen and the smallest effective amount applied.90

Through the Conservation Reserve Program (CRP), the United States Department of Agriculture’s Farm Service Agency has promoted the Pollinator Habitat Initiative (CP-42). The program is designed to offer farmers support in the installation of high-quality, native wildflowers that will sustain pollinators and other wildlife throughout the growing season. Newly enrolled participants receive compensation and subsidies to support the implementation of suitable pollinator habitat.160

Other organizations have risen to promote pollinator health and protection, such as the non-profit Pollinator Partnership and the Xerces Society for Invertebrate Conservation. These organizations and others encourage individuals, corporations, farmers, etc. to institute practices on their property that promote pollinator health and habitat. These practices include: 1) establishing native plants with overlapping bloom times to provide nutrition throughout the growing season, 2) provide potential homes for pollinators by leaving patches of bare ground, brush piles, or installing nesting blocks, 3) eliminate or reduce pesticide use, and 4) educate others about the importance of pollinators and how they can aid in pollinator protection. Once areas have been restored, landowners are encouraged to register the location of suitable pollinator habitats via an online map database called S.H.A.R.E., which documents the spatial pattern of pollinator habitat establishment.
ITC has already begun implementing these practices at many of their Wildlife Habitat Council certified sites (Sac and Fox Trail Park, Beverly Park, and Squaw Creek Park) as well as along their other transmission line corridors (McLoud Run Park and Cedar Valley Nature Trail). Additionally, the City of Cedar Rapids Parks & Recreation Department (City) and Linn County Conservation are partnering on a 1,000-acre Pollinator Initiative, with the goal of increasing pollinator habitat by 1,000 acres in and around Cedar Rapids. To reach this goal, the partners plan to target underutilized public land, such as areas around bike trails, landscaped spaces in parks, and public right-of-way, as well as convert areas currently hosting non-native species, such as golf course flower beds. New pollinator habitat is also expected to reduce flash flooding by decreasing the amount and rate of runoff into storm sewers as well as lessen City labor and fuel costs by shrinking maintenance requirements, such as mowing. Linn County Conservation is also spreading pollinator awareness by raising monarchs and placing honey bee demonstration hives on one of their properties. By partnering with natural resource managers, such as the City and Linn County Conservation, ITC can continue to help bolster pollinator habitats across the Midwest through the removal of invasive plants, encouragement of native plants and compatible shrubs, and limited application of herbicides and pesticides.  

**Invasive Plant Online Identification Resources**

1. **The Pollinator Partnership**  
   www.pollinator.org

2. **S.H.A.R.E. Map**  
   http://www.pollinator.org/SHARE.htm

3. **The Xerces Society for Invertebrate Conservation**  
   www.xerces.org

4. **National Pesticide Information Center**  
   http://npic.orst.edu/index.html

5. **EPA – Protecting Bees and Other Pollinators from Pesticides**  
   http://www.epa.gov/pollinator-protection

6. **Bumble bee Identification Guide**  
**INDIANA BAT & NORTHERN LONG-EARED BAT**

| STATUS |
Indiana bats are currently listed as a federally endangered species by the U.S. Fish and Wildlife Service (USFWS) and have been since 1967. Their range includes a majority of the eastern half of the United States. Northern long-eared bats (NLEB) were recently listed as a federally threatened species by USFWS on April 2, 2015, and their range extends further north, east, south, and west than that of Indiana bat.

| NATURAL HISTORY |
Both bats migrate seasonally between winter hibernacula and summer roosting habitats, although NLEB tends to migrate shorter distances from hibernacula to roost sites. Winter hibernacula include caves and abandoned mines. Indiana bats hibernate in very large groups, while NLEB hibernacula tend to only have a few individuals. They breed in late summer when males begin swarming near hibernacula. After copulation, females store sperm during hibernation. In spring, they emerge from their hibernacula, ovulate, and fertilize their egg with the stored sperm. After fertilization, pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies are formed under the loose bark of trees (dead or alive) and/or cavities. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Indiana bat maternity colonies with young generally have 30-60 bats, although larger maternity colonies have been observed. NLEBs tend to roost alone or in small colonies underneath bark, in cavities, or in crevices of live or dead trees. They are more flexible than Indiana bats when it comes to roost tree selection, utilizing smaller diameter and shorter trees and more crevices and cavities than Indiana bat. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending on colony location. Young bats start flying 18-21 days after birth. Both species of bats can live up to 19 years. They emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. They also feed by gleaning motionless insects from vegetation and water surfaces. During the summer, the bats frequent the corridors of small streams with riparian woods as well as mature upland forests. They forage for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, over farm ponds, and in pastures.¹⁷¹,¹⁸⁴

| HABITAT |
**SUITABLE HABITAT CONSISTS OF:**

- **ROOSTING HABITAT:** Live, dead, or dying trees with exfoliating bark, split tree trunk, split branches, holes, cracks, crevices, or hollow trunks or branches.
- **FORAGING HABITAT:** Within and on the edges of wooded areas. Frequently associated with streams, floodplain forests, forested wetlands, and impounded water bodies.
- **TRAVEL CORRIDORS:** Areas that link roosting and foraging habitat, including open understory forest, wooded fence-rows, and open paths through wooded areas, including streams, trails, and small roads with canopy cover.
- **HIBERNACULA:** Caves or underground mines.

Suitable roost trees defined as live trees and/or snags ≥5 “ diameter at breast height (DBH) (12.7 cm) for Indiana bat and ≥3” dbh (7.6 cm) for NLEB that have exfoliating bark, cracks, crevices, and/or hollows. Male bats of both species may roost in trees 3 inches dbh or greater.¹⁷²
### THREATS

No other threat is as severe and immediate as white-nose syndrome. If this disease had not emerged, it is unlikely the Northern long-eared population would be declining so dramatically. Since symptoms were first observed in New York in 2006, white-nose syndrome has spread rapidly from the Northeast to the Midwest and Southeast, an area that includes the core of the NLEB’s range where it was most common before this disease. Numbers have declined by 99 percent in the Northeast. Although there is uncertainty about the rate that white-nose syndrome will spread within the species’ range, it is expected to spread throughout the entire United States. Although significant population declines have not been observed due to other sources of mortality, they may now be important factors affecting this bat’s ability to persist while experiencing dramatic declines caused by white-nose syndrome. Other sources of mortality include impacts to hibernacula, loss or degradation of summer habitat, and wind farm operation. Gates or other structures should be erected to exclude people from caves and mines that could be used as hibernacula; However, they should not restrict bat flight and movement or change airflow and internal cave and mine microclimates. A few degrees change can make a cave unsuitable for hibernating bats. Cave-dwelling bats are vulnerable to human disturbance while hibernating. Bats use up their energy stores when roused and may not survive the winter or females may not successfully give birth or rear young. Highway and commercial development, surface mining, and wind facility construction permanently remove habitat and are prevalent in many areas of this bat’s range. Timber harvest and forest management can remove or alter (improving or degrading) summer roosting and foraging habitat. Wind turbines kill bats, including Northern long-eared bats, although only a small number have been documented to date. There are many wind projects within a large portion of the bat’s range and many more are planned.

### MANAGEMENT

**DO NOT DISTURB HIBERNATING BATS.** Many agencies and organizations have protected caves and mines that are important hibernacula for cave-dwelling bats. Comply with all cave and mine closures, advisories, and regulations. In areas without a cave and mine closure policy, follow approved decontamination protocols (see whitenosesyndrome.org/topics/decontamination). Under no circumstances should clothing, footwear, or equipment that was used in a white-nose syndrome affected state or region be used in unaffected states or regions. Actions have been taken to slow the spread of white-nose syndrome through human transmission of the fungus into caves (e.g. cave and mine closures and advisories; national decontamination protocols). A national plan was prepared by the USFWS and other state and federal agencies that details actions needed to investigate and manage white-nose syndrome. Many state and federal agencies, universities and non-governmental organizations are researching this disease to try to control its spread and address its effect.

Where possible and not a safety hazard, leave dead or dying trees standing on your property. Northern long-eared bats and many other animals use these trees. Dead and dying trees are usually not left standing, so trees suitable for roosting may be in short supply.

Install bat boxes to provide additional roost sites.

USFWS and others are working to minimize bat mortality from wind turbines on several fronts. They fund and conduct research to determine why bats are susceptible to turbines, how to operate turbines to minimize mortality, and where important bat migration routes are located. USFWS, state natural resource agencies, and wind energy industry are developing a Midwest Wind Energy Multi-Species Habitat Conservation Plan that will provide wind farms a mechanism to continue operating legally while minimizing and mitigating listed bat mortality.169, 98, 171, 184, 101
The Endangered Species Act (ESA) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies responsible for implementing the ESA are the U.S. Fish and Wildlife Service (USFWS) and the U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries Service. The USFWS maintains a worldwide list of endangered species. Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees.

The ESA requires federal agencies, in consultation with the USFWS and/or the NOAA Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat for such species. The ESA also prohibits any

**VEGETATION MANAGEMENT PROJECT INDIANA BAT DECISION FLOW CHART**

**DOES YOUR PROJECT INVOLVE...**

- **New build / rebuild within an Indiana bat county?**
  - **YES**
  - **NO**
  - **Crossing federal/state land within an Indiana bat county?**
    - **YES**
    - **NO**
    - **IA DNR record of Indiana bat within 5 miles of the corridor?**
      - **YES**
      - **NO**
      - **Indiana bat county with a known IA DNR bat record & must impact potential roost trees**
        - **YES**
        - **NO**
        - **Contact and obtain approval from Regional Forester & ITC Environmental when planning work in this area.**
        - **Proceed like normal**

* For Capital new build and rebuild projects, also consult the ITC Permit Policy Specialist when planning work.
action that causes a “taking” of any listed species of endangered fish or wildlife. Likewise, import, export, interstate, and foreign commerce of listed species are all generally prohibited.

If suitable habitat is present at the proposed site, it is possible that Indiana bats are also present, and an appropriate determination at this point is that the project “may affect” the Indiana bat, and consultation with USFWS may be required, especially if tree cutting restriction dates cannot be observed. If no habitat suitable for the Indiana bat is present, a determination of “no effect” is likely appropriate. If habitat is present or Indiana bats are known to be present, they must not be harmed, harassed or disturbed when present, and the USFWS Regional Field Office should be contacted for further assistance per the 2016 Range-Wide Indiana Bat Summer Survey Guidelines. The only listed critical habitat in Illinois, Iowa, Michigan and Minnesota is the Blackball Mine in LaSalle Co., Illinois.176

| TREE CLEARING RESTRICTIONS |
Seasonal tree clearing restrictions are a required avoidance measure that can minimize potential adverse effects to Indiana bats caused by timber removal, or other disruptions of habitat, during Indiana bat occupancy periods. In general and when unavoidable, summer and swarming habitat may be removed when bats are not likely to be present, which is typically the winter months when Indiana bats are hibernating. Tree clearing is defined as the removal of all trees ≥5 inches DBH. Per the latest verbal guidance from USFWS, tree clearing should not occur from April 1 – September 30 in the Midwest. If tree cutting restrictions cannot be followed, species-specific surveys can be conducted to determine if impact will occur. These surveys (both mist netting & acoustic) must occur from May 15 – August 15.

ROCK ISLAND FIELD OFFICE
http://www.fws.gov/midwest/RockIsland/contactus.html
1511 47th Ave.
Moline, IL 61265
309-757-5800

[Map Image]
POTENTIAL NLEB IMPACTS & REGULATIONS

THE FINAL 4(D) RULE FOR NLEB

On January 14th, 2016 the USFWS published a Final 4(d) rule for northern long-eared bat, which focuses prohibition of incidental take on those activities most harmful to the species. The Final 4(d) Rule for NLEB states:

PURPOSEFUL TAKE:
• Prohibited throughout the species range (exceptions include removal of bats from human structures, defense of human life, removal of hazardous trees, and authorized capture).

INCIDENTAL TAKE:
• Activities not involving tree removal are exempted (e.g. prescribed burning and wind energy facilities)
• Hazardous tree removal is exempted
• Within the White-Nose Syndrome (WNS) zone (encompasses all of IA, IL, and most of MN, see map here: http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf), incidental take is prohibited under the following circumstances:
  • If it occurs within a hibernaculum;
  • If it results from tree removal activities and
  • The activity occurs within .25 miles of a known hibernaculum; or
  • The activity destroys a known, occupied maternity roost tree (or other trees within a 150-ft radius from the maternity roost tree) between June 1 and July 31 (the pup season).

VEGETATION MANAGEMENT PROJECT NLEB BAT DECISION FLOW CHART

DOES YOUR PROJECT INVOLVE...

Tree removal within a .25 miles of a known hibernaculum at any time of year?

YES

Contact and obtain approval from Regional Forester & ITC Environmental when planning work in this area.*

If can’t abide by tree cutting restriction dates (6/1-7/31), agency correspondence and/or additional field surveys may be necessary.

NO

NO

NO

Crossing federal land?
Note: ECT provided prescriptions in the rare species layer for this scenario.

YES

Proceed; Incidental take that may result is exempted

Tree removal in MN Township with known NLEB maternity roost trees or IA/IL DNR NLEB records within 5 miles of the corridor?
Note: ECT provided prescriptions in the rare species layer for this scenario.

NO

* For Capital new build and rebuild projects, also consult the ITC Permit Policy Specialist when planning work.
4(D) RULE CONSERVATION MEASURES/TREE CLEARING RESTRICTIONS

To be exempted from incidental take, a qualifying project must follow these measures:

- Do not conduct activities that alter the entrance or the environment (physical or other alteration) of a NLEB hibernaculum,
- Do not remove trees within .25 miles of known, occupied hibernacula at any time of year
- Do not cut or destroy a known, occupied maternity roost tree or surrounding trees within a 150’ radius from June 1 - July 31 (the pup season)

When looking for information on the presence of maternity roost trees or hibernacula within a given project area, USFWS’s expectation is that a project proponent will complete due diligence to determine available data, e.g. review USFWS township maps, if available for the state, or consult the state’s Natural Heritage Inventory database. If information is not available, the project proponent must document their attempt to find the information and may then move forward with the project.

Tree removal is defined in the 4(d) rule as cutting down, harvesting, destroying, trimming, or manipulating in any other way the trees, saplings, snags, or any other form of woody vegetation likely to be used by northern long-eared bats, e.g. trees ≥3” dbh. If tree cutting restrictions (e.g. June 1 - July 31) cannot be followed, species-specific surveys can be conducted to determine if impact will occur. These surveys (both mist netting & acoustic) must occur from May 15 – August 15.177, 178

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Keep in mind, given that the geographic ranges of the two species greatly overlap, the stricter prohibitions for Indiana bat essentially protect both bat species. According to USFW’s Environmental Conservation Online System (ECOS) and Iowa DNR Natural Areas Inventory, both Indiana and northern long-eared bats are known to occur in Iowa, but only northern long-eared bat is known to occur in Linn County.175, 176, 72
**T&E: MAMMALS**

| NORTHERN LONG-EARED BAT | *Myotis septentrionalis* |

**T&E STATUS:** MN Special Concern, IL Threatened, Federally Threatened.

**HABITAT:** Winter hibernacula in large caves or mines with large passages and entrances, constant temperatures, high humidity, and no air currents. Roost in summer singularly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Rarely found roosting in man-made structures like barns and sheds.

**ACTIVE SEASON:** Breed in late summer, fertilize egg the following spring. In late May to late July, give birth to a single pup in maternity colonies of 30-60 bats. Young bats fly 18-21 days after birth. Live up to 19 years. Emerge at dusk, feed on moths, flies, leafhoppers, caddisflies, and beetles in flight or from vegetation and water surfaces.

**IDENTIFICATION:** Medium-sized bat 3-3.7” long, 9-10” wingspan, fur medium - dark brown on the back and tawny - pale-brown on the underside. Distinguished from other Myotis bats by long ears.

**MANAGEMENT:** Protect known and suspected winter hibernacula, avoid disturbance to hibernating bats, protect summer habitat, leave dead and dying trees standing, install bat boxes.109, 49, 174, 184

**PRESCRIPTION:** Please contact and obtain approval from Regional Forester/ITC Environmental Manager if planning work in this area & need to trim/remove trees with 3” dbh or greater in diameter. Consultation with U.S. Fish & Wildlife Service and Iowa Department of Natural Resources is required and permit acquisition may be necessary prior to start of work. No manual or vehicular tree trimming/removal from 6/1-7/31. Vehicular or manual mowing/brush removal and vehicular or manual herbicide application have no seasonal restrictions. Leave and/or create snag habitat when possible.
**T&E STATUS:** MN Special Concern, MI Endangered.

**HABITAT:** Prefer dry sites, such as grasslands, prairies, upland old agricultural fields, and thickets. Important prey species for snakes, skunks, weasels, owls, foxes, raptors, coyotes, etc. Diet consists of grasses, forbs, sedges, leaves, seeds, nuts, bulbs, tubers, and twigs which they store in underground caches.

**ACTIVE SEASON:** Active year-round during both day and night, but most active during dusk and dawn. In the summer, diurnal activity decreases, while during the winter, nocturnal activity decreases. Breed throughout the year, but most reproductive activity occurs between May-October.

**IDENTIFICATION:** This species is uniform in coloration throughout the year and there is no distinction between sexes. The fur is dark brown to black and tipped with black or brownish-yellow that creates a shabby looking effect. The belly fur is light tan and the tail is bicolored. Occasionally, color variants (yellow, black, albino, spotted) may be identified. Adults range in length from 5-7” and a tail length of 1-1.8”. They weigh 1-25 oz. This species has five plantar tubercles, knobby foot pads, on their hind feet and the third lower molar has no closed triangles and three transverse loops. Females have three pairs of mammary glands. Grass lined nests are built in burrows, under logs, or in above-ground grass clumps. They create extensive shallow tunnel systems that help hide them from predators.

**MANAGEMENT:** Leave brush piles and downed woody debris for habitat and to provide cover. When possible refrain from or limit mowing during the growing season to reduce nest mortality. Reduce sources of unnecessary artificial lighting at night. To meet species dietary needs, plant native species that produce plentiful seeds.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, manual or vehicular herbicide application, or manual or vehicular tree trimming/removal from 5/1 through 11/1.
SOUTHERN FLYING SQUIRREL | 
_Glaucomys volans_

**T&E STATUS:** IA Special Concern.

**HABITAT:** Upland, eastern deciduous/mixed forests, specifically oak-hickory or beech-maple forests, and floodplain forests. Prefers hollow trees and abandoned woodpecker holes for den sites but also uses nest boxes and abandoned bird and squirrel nests.

**ACTIVE SEASON:** Nocturnal and sometimes lives in family groups. Females produce two litters each year, generally in April-May and again in late summer. Litters typically range from 2-4 offspring. Highly sociable with a home range of 1-3 acres; may nest communally in winter (10-20 individuals). Feed on insects, nuts, seeds, fruits, and occasionally birds and carrion. Active at night throughout the year, except during extreme cold during which they enter a state of torpor.

**IDENTIFICATION:** Easily distinguished from most squirrels by the flap of loose skin that extends from wrist to ankle along either side of the body, which allows the animal to glide through the air when stretched taught. At 7-10” in length, smaller with completely white belly hair compared to the longer (10-12”) northern flying squirrel whose belly hair is gray at the base.

**MANAGEMENT:** Threats include loss of large stands of mature mast producing trees and the removal of woody debris. Maintain older woodlots, especially those with mature mast producing stands. Do not remove fallen and rotting logs and maintain snag trees. Plant hickory, oak, and maple trees along edges of existing stands. Place artificial nest boxes. 

**PRESCRIPTION:** No manual or vehicular tree trimming/removal from 1/1 through 9/30. Vehicular or manual mowing/brush removal and vehicular or manual herbicide application have no seasonal restrictions. Leave and/or create snag habitat when possible and do not remove fallen and rotting logs.
**WESTERN HARVEST MOUSE**

*Reithrodontomys megalotis*

**T&E STATUS:** MN Special Concern.

**HABITAT:** Grasslands, prairies, meadows, and marshes. Important prey species for snakes, owls, squirrels, foxes, raptors, coyotes, etc.

**ACTIVE SEASON:** Nocturnal and most active before midnight. Activity level is greatest on overcast (moonless) or rainy nights. Breed spring to late autumn before undergoing torpor in winter months.

**IDENTIFICATION:** The adult mouse is long-tailed, slender bodied, pale-gray to brown in coloration, and has naked ears. Belly fur is white to deep gray and there is a dark stripe from the forehead along the middle of the back. Length ranges from 4.5-6.7” and the tail is shorter than the body (2-3.8”). Weight ranges between 0.3-0.6 oz (8-17 grams) and there is no difference in size or coloration between sexes. However, the fur of juveniles is gray-brown, short, and woolly, while the sub-adult has longer, thicker, and brighter fur. Typically, the species builds spherical nests, approximately 5” in diameter, on the ground beneath grasses, bushes, weeds, or logs. They line their nests with soft, fine plant material and have one or more entrance holes at the base. Occasionally, nests have been built in bushes or in burrows. The primary diet of this species is seeds, which it will sometimes cache, but it will also eat plant shoots and insects.

**MANAGEMENT:** Leave brush piles and downed woody debris for habitat and to provide cover. When possible refrain from or limit mowing during the growing season to reduce nest mortality. Reduce sources of unnecessary artificial lighting at night. To meet species dietary needs, plant native species that produce plentiful seeds.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, manual or vehicular herbicide application, or manual or vehicular tree trimming/removal from 4/15 - 11/1.
IDENTIFICATION: Adults black, bluish-gray, to olive brown with smooth shiny scales, divided anal plate, 15 scale rows near the tail. The adult length ranges from 3-6.25' and have 17 scale rows at mid-body. Head narrow, but wider than the neck with distinct brow ridges. The chin and throat white to yellow and remainder of underbelly varies from black, dark gray, light blue, white, cream, or yellow. Males have longer tails with wider bases than females, whose tails taper abruptly. Juveniles patterned with grays, browns, and reds.

MANAGEMENT: Protect and manage grasslands and savannas to retain habitat. Educate the public about ecological role of snakes and how to protect people and pets without causing harm to snakes. Limit pesticide and herbicide use which impact snake populations and their prey base.\textsuperscript{109, 44}

PRESCRIPTION: No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 4/1 and 11/1. Manual herbicide application and manual tree removal have no seasonal restrictions.
**BLANDING’S TURTLE**
*Emydoidea blandingii*

**T&E STATUS:** MI Special Concern, IA & MN Threatened, IL Endangered.

**HABITAT:** Clean, shallow waters with abundant aquatic vegetation and soft muddy bottoms over firm substrates, nest in open uplands adjacent to wetland habitats, preferring sunny areas with moist but well-drained sandy or loamy soil; if suitable natural nesting habitat is not available, will nest in lawns, gardens, plowed fields, or gravel road embankments; downed woody debris needed in submerged wetlands.

**ACTIVE SEASON:** Breed 1st week of April to 4th week of October, active 1st week of April to 4th week of October, nest 4th week of May to 4th week of June.

**IDENTIFICATION:** Medium turtle 6-11”, carapace black with yellowish spots, domed, elongated, smooth; very long neck, bright yellow chin and throat; head dark with brown or yellow spots, flat with short rounded snout and notched upper jaw giving appearance of a permanent grin.

**MANAGEMENT:** Maintain water quality, restrict pesticide use in or near wetlands, implement minimum development setback distances, leave buffer zones during timber harvest, grazing and agricultural operations, and minimize road construction in or near suitable wetlands. Timber harvesting can benefit this species by creating or maintaining open habitat conditions for thermoregulation and nesting. Minimize adult mortality and illegal collection. On-site nest protection may be necessary.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 11/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Maintain natural vegetation buffers around wetlands.
**BULLSNAKE**

*Pituophis catenifer sayi*

**T&E STATUS:** IA & MN Special Concern.

**HABITAT:** Native open large grasslands and sand prairies bordered by woodland. Prefer loose sandy soil for burrowing. Active in the morning and evening. Hibernate in mammal burrows or rock crevices.

**ACTIVE SEASON:** Emerge in April; sun themselves on gopher mounds in spring, spend most time underground in summer. Breed in May, lay 12 eggs in sand in late June into July. Eggs hatch August or September. Winter dormancy in October. Primarily eat mammals, but also birds, eggs, frogs, and lizards.

**IDENTIFICATION:** Largest snake in Iowa; 37-72” long, up to 100”. Ground color variable straw yellow, white, dull yellow-brown, or bright yellow. 40 large, dark, body blotches usually black to lighter brown becoming dark black bands or rings on the tail. Smaller lateral spots on the side where scales tipped with brown or black appear speckled. Head yellow or brown; boldly marked with a stripe across the top of the head from eye to eye, and a stripe from the eye to the corner of the mouth; very pointed snout. Belly porcelain white to yellowish with brown spots. In the southern and western portions of range, the ground color is entirely brown and all the blotches are brown. In the northern and eastern portions of range (including Iowa), displays black to brown appearance.

**MANAGEMENT:** Threats include loss and fragmentation of habitat; need large tracks of grassland, often forced to cross roads. Prescribed burn outside of active period. Remove encroaching woody trees. Establish tall grassland habitat.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application or tree trimming/removal from 4/1 through 11/1. Manual herbicide application and manual tree trimming/removal have no seasonal restrictions. Maintain natural vegetation buffers around prairies and sandy soils.
ORNATE BOX TURTLE  
*Terrapene ornata*

**T&E STATUS:** IA & IL Threatened.

**HABITAT:** Open, shifting, and unstable sand habitat important for nesting and overwintering. The rest of the year they will use tallgrass prairie when available. If only shortgrass prairie is available, they will prefer shrubs in order to keep cool from the sun. Overwinter in deep sand in open canopy habitat.

**ACTIVE SEASON:** Eat fruits such as blackberries, wild strawberries, and wild plums. Nest from late May through mid-June, hatch in August or early September, active between April and October.

**IDENTIFICATION:** A small terrestrial turtle up to 6.1” long, upper shell dark brown or black with conspicuous yellow lines that radiate from the center of each plate and forms a discontinuous mid-dorsal stripe. Lower shell is brown with yellow lines that radiate on each scale.

**MANAGEMENT:** Threats include loss of habitat, nest predation, illegal pet collection, motorized recreation, farm machinery, and roads. Remove encroaching woody species from sand dunes and adjacent grassland habitat. Establish native grassland with a mix of tall grasses for shade and high forb concentration to open up the grass stands for basking. Light grazing helps keep grassland areas open and free of brush encroachment. Prescribed fire should be conducted between late September and early April. Nests can be protected from predators by using a mesh screen cage during nest building and egg development. Limit cultivation to less than 6” deep in areas known to support turtles. Cease collection. Be aware of turtles crossing roads between April and September.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 3/1 through 10/15. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Maintain natural vegetation buffers around prairies and open patches of sand.
**T&E STATUS:** IA Special Concern.

**HABITAT:** Streams lined with willow species, marshes, pond edges, swamps, wet roadside ditches, moist meadows, and moist woodlands. Willows (Salix spp.) are the larval host plant. Adult nectar plants include: milkweed, meadowsweet, New Jersey tea and other moisture-loving flowers.

**ACTIVE SEASON:** One flight from late June through mid-July.

**IDENTIFICATION:** The wingspan ranges from 1.125” – 1.5” (2.9 -3.8 cm). The upperside of the wings are brown-gray with a tail on each hindwing. The underside of the hindwing is uniform gray with a sub-marginal row of orange crescent shaped spots and a silvery-blue patch capped with orange near each tail. Also on the underside is a line of white-rimmed black dots near the middle of the wing.

**MANAGEMENT:** Conserve habitat and populations of host plants as well as adult nectar plants. Limit use of pesticides and herbicides to prevent damage to butterfly population or host plants.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 6/1 and 8/1. Operate equipment/vehicles on road/two-track or off road on a minimum of 4” of snow cover. Manual herbicide application and manual tree removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only. Do not impact willows.
| BYSSUS SKIPPER |

*Problema byssus*

**T&E STATUS:** IA Threatened.

**HABITAT:** Tallgrass prairie. Adult food source is nectar from flowers including pickerelweed. Caterpillars feed on grasses such as eastern grama grass (host plant).

**ACTIVE SEASON:** One brood from June-July, females lay eggs singly on host plant leaves. Caterpillars live in shelters of rolled or tied leaves, feed on leaves, and overwinter on their fourth stage of development. After completing their growth in the spring, caterpillars pupate in dense silk cocoons in litter at the base of the host plant.

**IDENTIFICATION:** Upper side bright yellow-orange with black borders and a black bar at the end of the cell. Females darker than males. Underside of hindwing is dull yellow in males and rust or orange in females; both with a band of pale spots. 1.4-1.8” wingspan.

**MANAGEMENT:** Extirpation of local populations should be avoided by avoiding or limiting the use of fire as a management tool.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal from 6/1 through 8/15. No vehicular herbicide application or vehicular tree trimming/removal from 6/1 through 8/15. Operate equipment/vehicles on road/two-track only or offroad on a minimum of 4” of snow cover. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only. Do not impact native prairie grasses.
**WILD INDIGO DUSKYWING**  
*Erynnis baptisae*

**T&E STATUS:** IA & MI Special Concern.

**HABITAT:** In the recent past, primarily restricted to dry prairies supporting large colonies of wild indigo; however, a race from Pennsylvania that eats invasive crown vetch has dispersed quickly along roadside ditches, and has now been identified at sites across Iowa. Host plants include yellow wild indigo, blue wild indigo, white wild indigo, Canada milk vetch, wild lupine, and crown vetch. Adult nectar plants include blackberry, white sweet-clover, dogbane, sunflower, crimson clover, etc.

**ACTIVE SEASON:** Three broods between May and mid-August with a possible fourth brood between early September and early October. Populations in Loess Hills prairies may have two broods occurring in early May and July.

**IDENTIFICATION:** Wingspan ranges from 1.1-1.7” (2.8-4.3 cm), subapical region of forewing has 3-4 misaligned, glassy white spots and a reddish-brown patch located near the end of the cell. A faint cell-end bar can typically be found on the hindwing. Two irregular rows of dull yellowish dots, best seen when wings are folded, are visible on underside of hindwing.

**MANAGEMENT:** No reported management requirements; prevent woody vegetation encroachment and plant/maintain host and nectar plants. Likely susceptible to fire, so prescribed burns should be timed carefully with the life history.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 4/15 and 10/15. Operate equipment/vehicles on road/two-track or off road on a minimum of 4” of snow cover. Manual herbicide application and manual tree removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only. Do not impact yellow wild indigo, blue wild indigo, white wild indigo, Canada milk vetch, wild lupine, or crown vetch.
**| ZABULON SKIPPER |**

*Poanes zabulon*

**T&E STATUS:** IA Special Concern.

**HABITAT:** Brushy openings near moist forests and streams. In Iowa, woodland edges, prairies, and remnant savannas. Host plants include lovegrass, bluegrass, orchard grass, and wild rye. Adult nectar plants include blackberry, vetch, milkweed, and non-natives such as Eurasian honeysuckles and red clover.

**ACTIVE SEASON:** Males perch in sunlit openings or edges for up to a week and defend their territory. Females lay single eggs under grass host plant leaves. 2-3 broods occur in June, early July, and August in Iowa.

**IDENTIFICATION:** Adult male has black borders around wings and no stigma (specialized scales that release pheromones). The underside of the hindwing is predominantly yellow with a brown wing-base and outer margins where brown flecking gives a checkered appearance. Adult female has white angular spots on the dark, purple-brown, dorsal forewings. The underside of the hindwing has a violet hued outer edge but is primarily dark tan to brown. Both sexes have a wingspan of about 1.38”–1.63” (3.5–4.2 cm).

**MANAGEMENT:** No known management requirements but likely requires both forest and grassland for survival. Woody vegetation should be a management priority. Likely susceptible to fire so prescribed burns should be timed carefully with the species life history.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 5/1 and 9/1. Operate equipment/vehicles on road/two-track or off road on a minimum of 4” of snow cover. Manual herbicide application and manual tree removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only. Do not impact lovegrass, bluegrass, orchard grass, wild rye, and other native prairie grasses.
**FIELD SEDGE**

*Carex conoidea*

**T&E STATUS:** IA Special Concern.

**HABITAT:** A wide variety of open sites, forests, and managed areas, including wet to seasonally wet grasslands, meadows, prairies, shores of waterbodies, fens, utility rights-of-way, thickets, and roadsides. In Iowa, found in sandy swales, prairie seeps, moist meadows, and along shore lines. Often grows with rigid sedge.

**SURVEY PERIOD:** The fruiting period is spring-summer.

**IDENTIFICATION:** A graminoid that can reach up to 2.5’ tall grows in dense clumps. Stems yellow-brown to dark brown at base and roughly triangular in cross-section. Leaf sheaths are green, glabrous, and generally range from 0.1-0.15” (3-3.9 mm) wide. There may be some sparse roughness along the main viens on the underside of the leaves. The membrane sacs enclosing the flowers or fruit are essentially beakless and are typically more than 20 per spike (inflorescence). The smooth achenes are about 0.07-0.1” (1.8-2.6 mm) in length and 0.04-0.05” (1-1.4 mm) in width and the style (stalk that connects stigma to ovary) falls off at maturity. The peduncles (stems) of the lateral spikes are finely scabrous and the staminate spike (male inflorescence) is on a longer peduncle.

**MANAGEMENT:** Prevent woody encroachment and grazing, maintain natural hydrology, and prevent/manage invasive species. Limit herbicide and pesticide use; apply directly to target species; avoid unintended damage to desirable plants. Prescribed burns, which also help to limit woody encroachment and manage most invasive species, might be preferred dependent upon site location and characteristics.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 11/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
**FLAT TOP WHITE ASTER |**

*Doellingeria umbellata var. pubens,* aka *Aster umbellatus var. pubens*

**T&E STATUS:** IA Special Concern.

**HABITAT:** Shores of lakes and marshes; wet to moist sand prairies; sandy thickets; soggy meadows; and openings in wooded areas. Flowers attract long and short-tongued bees, wasps, flies, butterflies, beetles, etc. Swamp sparrows and eastern goldfinch eat the seeds; white-tailed deer and cottontail rabbits often browse on the foliage. Occurs with Joe-pye weed, blue lobelia, and false foxglove.

**SURVEY PERIOD:** Blooms July–October.

**IDENTIFICATION:** An herbaceous perennial, 2-5’ tall, lacking basal leaves, prefers full to partial sun. The tapering, erect, generally unbranched stems light green, purplish red, or yellowish brown and is pubescent (unlike var. *umbellatus* which is glabrous or nearly so). Alternate leaves occur along the entire stem, 3-5” long and 0.5-1” wide except small, scale-like leaves near the bottom. The leaves taper to a point at each end and are sessile or nearly so. Leaves entire and feel rough. The central stem terminates in a flat, branching cluster (3-12” across) of 0.5-0.75” wide flowers. 0.5-1.5” long, lanceolate to narrowly elliptic leafy bracts along the inflorescence branches. White-tufted nutty fruits replace the flowers in the fall.

**MANAGEMENT:** Prevent woody encroachment, maintain natural hydrology, and prevent/manage invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants. 67, 53, 54, 21, 114

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 6/1 through 12/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody
**GLOMERATE SEDGE**  
*Carex aggregata*

**T&E STATUS:** IA Special Concern.

**HABITAT:** Moist to dry, open ground; algific talus slopes, meadows, thickets, and open forests, usually on calcareous soils. Associated with common woodland sedge, Bush's sedge, oval-leaf sedge, Leavenworth's sedge, greater straw sedge.

**SURVEY PERIOD:** Blooms April-May.

**IDENTIFICATION:** A graminoid that can grow 2' tall with leaf blades measuring from 0.1-0.4” (3-10 mm) wide. The loose leaf sheaths are white with green veins or mottled green and white on back. The flowerhead is composed of dense spikelets with scales that have narrowly pointy or awned tips and stigmas, which when intact and well developed, are elongate and slender. The ventral surface of the leaf sheath is concave and thickened at the tip. The underside structures surrounding the ovary are green at maturity.

**MANAGEMENT:** Maintain habitats by preventing woody encroachment and preventing/managing invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants.  

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 11/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
**T&E STATUS:** MN Special Concern.

**HABITAT:** Oak and pine woods, oak savannas, pine barrens, sand prairies, sand dunes, and open sand barrens in the midwest. Prefers areas with abundant sunlight, scattered trees, and acidic soils. Associated with black oak, northern pin oak, bur oak, and occasionally white pine. Herbaceous plants include little bluestem, horsemint, wild lupine, and spiderwort species.

**SURVEY PERIOD:** Leaves are visible May through September. Blooms from mid-June through July.

**IDENTIFICATION:** A perennial legume with one to several stems that branch from the base of the plant. It’s 7.9-27.6” (20-70 cm) tall with soft, gray-green tones due to the presence of many silky hairs on leaves and stems. Pink and cream flowers that are 0.6-0.75” (1.5-2.0 cm) wide and arrange themselves in dense clusters at the tips of the stems. Fruits found in long, narrow hair pods up to 2” (5 cm) in length. Each leaf is pinnately divided into 15–31 narrowly oval-shaped leaflets.

**MANAGEMENT:** Maintain patches of open ground and prevent canopy closure to ensure enough sunlight reaches the species; it does not grow well in shade. Its specific need for acidic soils makes this plant difficult to propagate. Since this species is drought tolerant and fire adapted (strong, woody roots that can grow deep within the soil), prescribed burns may be an appropriate management tool depending on specific site characteristics and location.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 5/1 and 10/1. Manual herbicide application and manual tree removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
**GREAT PLAINS LADIES’-TRESSES**

*Spiranthes magnicamporum*

**T&E STATUS:** IA Special Concern.

**HABITAT:** Woods, fens pastures, dry bluffs, hill prairies. Associated with white oak, black oak, little bluestem, big bluestem, Pennsylvania sedge, milkweed spp., aster spp., northern blazing star, hoary puccoon.

**SURVEY PERIOD:** Blooms September - October.

**IDENTIFICATION:** An erect, 6-12” tall, perennial forb with stems that have 3-4 scale-like leaves between the main leaves and the inflorescence. Almond scented white flowers are six-parted and have unconnected sepals that curl over the top of the flower like horns. The lip of each flower is smooth, pale yellow, and about 0.5” long. The dense, spike-like flowerhead of 20-40 flowers is a raceme of 3-4 stalks. The 2 or 3 basal leaves have hairy leaf axils and generally wilt when the plant is in bloom.

**MANAGEMENT:** Prescribed fire is important for maintaining the ecosystems in which the plant is found. Additionally, cutting and herbicide may be required to control woody invasives. Monitoring erosion on hillsides and preventing foot and vehicle traffic will help to minimize soil disturbance. Before beginning treatment, all rare species should be identified and restoration/maintenance plan should carefully consider potential impacts.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 6/1 through 11/15. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
**JACK PINE**  
*Pinus banksiana*

**T&E STATUS:** IL Endangered.

**HABITAT:** Dry, acidic mineral-rich sandy or rocky soil, full sunlight. Sandy woodlands, sandy savannas, sand prairies, rocky sandstone cliffs, and stabilized sand dunes along Lake Michigan. Thrives in barren dry areas with a history of fire and found in the northeastern U.S. and Canada. Seeds are eaten by a variety of gamebirds, songbirds, squirrels, mice, etc. In Michigan, Kirtland’s Warbler - an endangered species - nests at the base of Jack pine trees in sandy savannas.

**SURVEY PERIOD:** Year round.

**IDENTIFICATION:** A small to medium-sized (30-70’) coniferous tree with crooked crown branches that are ascending-spreading to drooping and gray, scaly trunk bark with reddish-brown patches. In open conditions, canopy is globose-ovoid in shape and the trunk is crooked and branched. In dense forest, the canopy is small and oblong and the trunk is straight. Needles 0.75-1.5” long clustered in groups of two, pale green, divergent, and slightly twisted. Cones in small clusters near the tips of the branchlets.

**MANAGEMENT:** Colonizes areas with exposed soil due to a disturbance, such as fire. It is well adapted to fire and benefits from a moderate- or high-severity fire regime with an estimated interval of 5-30 years to maintain open areas and spur seed dispersal. Not native to Iowa, but occasionally found planted throughout the state.49, 59, 142, 8

**PRESCRIPTION:** Please contact and obtain approval from Regional Forester/ITC Environmental if planning work in this area--must confirm identification of trees before removal or treatment. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
NORTHERN ADDER’S-TONGUE

*Ophioglossum pusillum*, aka *O. vulgatum*

**T&E STATUS:** IA Special Concern.

**HABITAT:** Sandy woods, sedge meadows, and calcareous seeps. Found primarily along the Cedar River in Iowa. Associated with sedges.

**SURVEY PERIOD:** Becomes fertile in late June and withers by mid-summer.

**IDENTIFICATION:** A small, shade tolerant atypical-looking fern. The undivided and tongue-shaped leaves, approximately 4” long and less than 1” wide, are more akin to those of a plantain than a fern and have distinctive roughly circular venation (areolae). A single, leathery leaf attaches halfway up the smooth, delicate stalk, which bears a fertile spike originating near the leaf base. The spike, which has bead-like spores in two rows, somewhat resembles a snake tongue and inspired the plant’s common name.

**MANAGEMENT:** Maintain habitats by preventing woody encroachment and preventing/managing invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants. 67, 25, 145

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 9/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
NORTHERN PANIC GRASS
*Dichanthelium boreale*

**T&E STATUS:** IA & IL Endangered.

**HABITAT:** Prairies and meadows, generally drier, sandy soils. Associated with sedges, clasping or sand milkweed, silky prairie clover, whitlow grass, buttonweed, and dwarf dandelion.

**SURVEY PERIOD:** Two distinct blooming periods: primary flowering heads (spikelets) bloom May into June, small secondary spikelets bloom late June into October.

**IDENTIFICATION:** A small, erect to ascending grass that forms dense clumps. The leaf blades, 0.2-0.5” (5-13 mm) in width, cut in abruptly at the narrow base and prominent tufts of leaves are found at the base of the flowering stem. The ligule, a collar on the leaf sheath, is characterized by fine hairs. This species is distinguished from close relatives by delicate stems (culms) that are no more than 1 mm thick and have smooth nodes and relatively small, hairy spikelets 0.07-0.08” (1.7-2.1 mm) long. The egg-shaped primary spikelets differ from the ellipsoid secondary spikelets, which are often pointed with a red hue. The glumes, bracts at the base of the spikelet, are not as long as the florets (flowers) and are not awned (a bristle-like appendage).

**MANAGEMENT:** Maintain habitats by preventing woody encroachment, maintaining natural hydrology, and preventing/managing invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 12/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
PRAIRIE MOONWORT  
*Botrychium campestre*

**T&E STATUS:** IA & MN Special Concern, MI Threatened, IL Endangered.

**HABITAT:** Open areas on steep loess hills and gravel prairies. Associated with little bluestem, Big bluestem, Side-oats grama grass.

**SURVEY PERIOD:** Mid-May to mid-July.

**IDENTIFICATION:** A small, inconspicuous fern manifesting as a single leaf, which is divided into a sterile photosynthetic portion and a fertile spore-bearing portion. The sterile portion is sessile, oblong, longitudinally folded, has a fleshy texture, and a maximum size of about 1.5” (4 cm) in length and 0.5” (1.3 cm) in width. The sterile portion generally has five pairs of linear or linear-spatulate segments that are notched or cleft into additional secondary segments, all with crenate or dentate margins. These characteristics are key to identifying the species; however, this species often requires examination by a specialist (photographs are not adequate) to ensure proper identification.

**MANAGEMENT:** This species is susceptible to fire so prescribed burns should be performed in early spring prior to plant emergence. Encroachment by woody vegetation also threatens prairie habitat. 67, 109, 92, 49, 26, 27, 108.

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 10/1. Manual herbicide application & manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
**SOFT RUSH**  
*Juncus effusus*

**T&E STATUS:** IA Special Concern.

**HABITAT:** In Iowa, generally found in marsh edges and alluvial woods. Associated with sedges, spike-rushes, smartweeds, manna grasses, and common arrowhead.

**SURVEY PERIOD:** Blooms June - August.

**IDENTIFICATION:** A 2-4’ tall perennial rush with erect to ascending stems that forms vegetative clumps. The soft, hairless, medium green stems are round in cross-section and taper from approximately 0.2” (4 mm) across at the base to about 0.1” (2 mm) across at the inflorescence, a compound umbel of florets that hangs from one side. A stem-like bract continues up from the inflorescence, giving the impression that the stem continues beyond the flower for about 4-12". A single floret, 0.1-0.2” (2-3.5 mm) in length, is at the end of each terminal ray in the umbel. Each floret consists of 3 lanceolate sepals, 3 inconspicuous petals (look like more sepals), a central ovary with a tiny beak at the apex, 3 stamens, and one style.

**MANAGEMENT:** Maintain habitats by preventing woody encroachment and preventing/managing invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants.67, 20, 83, 127, 56

**PRESCRIPTION:** No manual or vehicular mowing/brush removal, vehicular tree removal/trimming, or vehicular herbicide application between 5/1 and 10/1. Manual herbicide application and manual tree removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
WOODLAND HORSETAIL  
Equisetum sylvaticum

T&E STATUS: IA Threatened, IL Endangered.

HABITAT: Seeps, wooded areas, sandy places and prairie swales. An indicator of cool-temperate climates and very moist to wet, nitrogen-poor soils. In the Midwest, associated plants include jack pine, white spruce, black spruce, willow spp., highbush cranberry, gooseberry spp., sedge spp., and prickly rose.

SURVEY PERIOD: Throughout the growing season. Fruits in mid- to late spring.

IDENTIFICATION: A perennial, deciduous, vascular plant that reproduces and disperses via spores and rhizomes. The sterile stems grow to about 18” in height and are straight, ridged, green, and hollow with distinctively lacy, whorled compound-branches densely populated at the nodes. The main stem sheaths are 0.2-0.4” (5-10mm) long with 3-5 reddish-brown, broad lobes. Fertile stems initially lack chlorophyll and are unbranched until spores are released. Strobili (spore cones) are generally 1” long and located at the top of the fertile stems. Extensive rhizome systems means the plant often forms dense colonies.

MANAGEMENT: Maintain habitats by preventing woody encroachment and preventing/managing invasive species. Limit herbicide and pesticide use and apply directly to the target species to avoid unintended damage to desirable plants. 67, 49, 32, 90, 89

PRESCRIPTION: No manual or vehicular mowing/brush removal, vehicular herbicide application, or vehicular tree trimming/removal from 4/1 through 10/1. Manual herbicide application and manual tree trimming/removal have no seasonal restrictions. Preserve existing native vegetation by minimizing herbicide use and applying herbicide directly to target woody vegetation only.
AMUR HONEYSUCKLE

**Lonicer maackii**

**Nativity:** Asia.

**Habitat:** Relatively shade tolerant; occurs in a variety of soil and moisture conditions; invades open forests, savannas and prairies; disturbed areas are particularly vulnerable to invasion.

**Active Season:** Leaf out mid-March, bloom May through June, fruit ripen July to August. Identifiable year round.

**Identification:** Deciduous upright to spreading shrub up to 12-16’ tall. Leaves simple, opposite, slightly hairy, elliptical, 1.6-3.5” (4-9cm) long, smooth margins and a long distinctive apex or drip tip, long growing season. Multiple stems; numerous arching branches; thick non-exfoliating gray to tan bark with noticeable interlacing ridges; older branches often hollow. Flowers small, white to pink in color, tubular, paired on short 0.2” (0.5 cm) stalks arising from the leaf axils; fragrant. Fruits are red and paired, borne on very short stalks; abundant; persistent; dispersed by birds.

**Threat:** Common in urban areas and also occurs in rural areas where it was recommended for wildlife until its invasive traits became apparent; forms dense thickets; reduces tree and shrub regeneration, decreases overall plant diversity. Reproduce by seeds dispersed by birds.

**Management:** Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leaves out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide; basal bark treatment is also effective, spray bottom 18 inches of all stems. Where fuel is present, prescribed fire may provide effective control of seedlings in fire adapted communities.
AUTUMN-OLIVE
Elaeagnus umbellata

Nativity: Eurasia.

Habitat: Shade tolerant; occurs in a variety of soil types (pH range of 4.8-6.5), thrives on infertile soils because of nitrogen-fixing root nodules; found in open woods, forest edges, roadsides, fence rows, meadows, sand dunes, and other disturbed areas.

Active Season: Leaf out mid-March, bloom April through June, fruit ripen September to October. Identifiable year round.

Identification: Deciduous shrub or small tree growing up to 20' in height and 30' wide. Leaves simple, alternate, oval, 2-4" long, margins entire and wavy, gray-green above, silvery scaly below. Stems often thorny; silvery or golden brown; brownish scales give stems a speckled appearance. Flowers fragrant, tubular, 4 petals and stamens, cream to light yellow in color, borne in clusters of 1-8. Fruit a drupe, 0.25", silvery with brown scales when immature, speckled red or yellow when mature; begin to bear fruit at 3-5 years, each tree can produce 2-8 lbs. of seed per year.

Threat: Invades disturbed areas, can out-compete native species; increases nitrogen levels to the detriment of native communities; had been widely recommended for conservation planting until invasive traits became apparent. Reproduce by prolific fruit and seed production, seeds widely dispersed by birds.

Management: Hand pull seedlings; focus on newest infestations and highest quality areas first; cutting, girdling and burning are ineffective without herbicide as they stimulate sprouting; basal bark/stem sprays effective in late spring, possibly in fall; basal stem injection of herbicide on dormant plants provides excellent control with low concentrations of herbicide. Difficult to control.
| BIRD’S-FOOT TREFOIL |

*Lotus corniculatus*

**Nativity:** Eurasia.

**Habitat:** Roadsides, fields, eroded hill sides, clearings, grassy turf.

**Active Season:** Blooms midsummer.

**Identification:** A perennial, 0.5-2’ tall forb with round, slightly pubescent or hairless stems. Leaves are alternate, compound, and have long petioles. Leaves appear trifoliate, but an additional pair of leaflets occur where the petiole joins the stem. The lanceolate or ovate leaflets are up to 0.75” long with smooth margins and faint, irregular veins. The umbels of 3-12 pea-like, 0.5” long, yellow flowers can be found in the upper part of the plant on long peduncles. Each flower has five petals arranged into a standard, wings, and keel. Following flowering, the 1” long seedpods are arranged in clusters of five and resemble a bird’s foot.

**Threat:** As part of the pea family (Fabaceae), the root system adds nitrogen to the soil, which can alter nutrient cycling and disrupt the competitive dynamics of vegetative community. Can aggressively outcompete native vegetation by forming thick, shade-producing mats.

**Management:** Prescribed burns can increase seed germination, so mechanical or chemical control methods are recommended. Frequent mowing at a height of less than 2” for several years has been successful; however, it also stresses native plants. Spot spraying, especially after resumed growth following a burn or mowing, is generally recommended.

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**Credit:** Cornell University

**Credit:** Ed Ogle

**Credit:** USDA

**Credit:** Matt Lavin

**Credit:** Christine Cimala

**Credit:** Jerzy Opiola

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65
**BLACK LOCUST**

*Robinia pseudoacacia*

**NATIVITY:** Southern Appalachians, the Ozarks, and other portions of the Midsouth; naturalized throughout eastern North America and parts of the west.

**HABITAT:** A variety of soils, except excessively dry or compact; moist to dry conditions; occurs in woods, along fence rows, ornamental and erosion control plantings.

**ACTIVE SEASON:** Year-round; blooms late April through June.

**IDENTIFICATION:** Deciduous, 40-100’ tall tree with rough, light brown bark that becomes deeply furrowed with age. Pinnately compound leaves, with a pair of long stipular spines at the base, have 7-21 small round leaflets that are each 1.5” long. The showy, fragrant, white to yellow flowers develop in 8” long clusters. A thin seed pod, 2.4” (5-10 cm) in length, develop after flowering.

**THREAT:** In the prairie and savanna regions of the Midwest, black locust is considered an invasive species because it can dominate and shade desirable species occurring in the naturally open habitats. Additionally, as a legume species, nitrogen-fixing bacteria associated with the tree’s root nodules can, over time, alter the nutrient cycle of the system.

**MANAGEMENT:** Since black locust can vigorously resprout, cutting and burning (which can encourage resprouting) are not advised. Chemical treatment has had variable success because plants that appear dead can resprout several years later. Preventing establishment through early detection and prevention is recommended, since established trees are very difficult to eradicate.
**BOUNCING BET**

_Saponaria officinalis_

**NATIVITY:** Eurasia.

**HABITAT:** Old fields, pastures, fencerows, gardens, roadsides as well as along river and stream banks.

**ACTIVE SEASON:** Blooms June to October.

**IDENTIFICATION:** Perennial, 1-3’ tall forb with simple or branched stems and hairless, opposite, elliptical to lance-shaped, 8” long leaves. Often forms large colonies through vigorous rhizomes. Bracts support a long, slender tube-like flower that has five petals, each with one rounded notch. The white or pink colored flowers are arranged in terminal clusters on the main stem and are each 0.75-1” wide with a pleasant fragrance.

**THREAT:** Very competitive, can out-compete native species, reducing species diversity. Due to saponin content, can be toxic if ingested.

**MANAGEMENT:** Prescribed burning as well as mowing and cutting treatments have shown little success. Hand pulling and tillage have demonstrated moderate levels of success when infestations are small but are generally not recommended since reproduction is clonal. Chemical treatment has generally proven to be more successful, especially when applied during the bolting to bud growth stage (late spring to mid-summer).  

Credit: Joan Simon  Credit: A.A. Reznicek  Credit: Andrew Zharkikh  Credit: R.W. Smith  Credit: USDA  Credit: Frank Mayfield
COMMON BUCKTHORN

*Rhamnus cathartica*

**NATIVITY:** Eurasia.

**HABITAT:** Widely planted as an ornamental shrub in hedge rows; now found along roadsides, woodland edges, prairies, old fields.

**ACTIVE SEASON:** Leaf out mid-March, bloom May to June, fruit ripen August to October. Identifiable year round.

**IDENTIFICATION:** Deciduous woody shrub to small tree ranging from 10-25' in height and reaching 10” in diameter. Leaves simple, opposite to sub-opposite, oval, dark green in color, smooth and shiny, small teeth along margins, veins that curve from base towards leaf tip, leaf out early, long growing season. One to several stems from the base; twigs with thorns often found near the tips; bark brown to gray, peeling with age, dotted with vertical light-colored lenticels. Flowers small, green-yellow, four-petaled, clustered in leaf axils, fragrant. Fruit is a round, pea-size, blackberry (on female plants only), persistent through the winter.

**THREAT:** Produces a dense shade that suppresses growth of tree and shrub seedlings, and native herbaceous groundcover, reduces overall plant diversity; changes nutrient cycling by increasing nitrogen and carbon; had been widely recommended for conservation planting until invasive characteristics became apparent. Reproduce by prolific fruit and seed production, seeds widely dispersed by birds.

**MANAGEMENT:** Monitor woodland edges and paths. Buckthorn leafs out early and retains its leaves late into fall. Begin control efforts in highest quality areas; hand pull or dig seedlings or small plants; target large, fruit-bearing plants for removal; foliar spraying may be effective for large populations where there are few natives present; treat cut stumps with herbicide as stumps sprout; basal bark treatment also effective. Where fuel is present, prescribed fire may provide effective control of seedlings.
COMMON MULLEIN

Verbascum thapsus

NATIVITY: Eurasia.

HABITAT: Limestone glades, rocky slopes and clay banks, pastures and fallow fields, areas along railroads and roadsides, vacant lots, and dry waste areas. Disturbed areas preferred.

ACTIVE SEASON: Bloom in summer for 1.5 months, length of bloom a function of stalk height. Longer stalks may flower into early October.

IDENTIFICATION: Biennial. 1st year is a rosette of basal leaves 1-2’ across. 2nd year becomes 3-7’ tall; usually unbranched. Alternate leaves up to 12” long and 4” across, becoming progressively smaller and more narrow as they ascend the central stem, obovate to oblong-ovate, smooth or slightly crenate along the margins; covered with fine downy hairs. Lower leaves taper gradually to a narrow winged base, while upper leaves partially decurrent against stem. Dense branched hairs make foliage look whitish or greyish green. Central stem terminates in a dense spike of 5-petaled pale yellow flowers about 0.5–2’ long. Central stalk and its seed capsules turn brown and persist through the winter.

THREAT: Tiny wind-dispersed seeds. Root system consists of a stout taproot that runs deep underground. Spreads by prolific seeding. Foliage is little bothered by pests and disease, although some of the lower leaves may wither away during drought. Seeds can lie dormant in the soil for several decades and remain capable of germination. A single plant can produce 100,000-180,000 seeds which remain viable for over 100 years.

MANAGEMENT: Germination is dependant on the presence of bare ground; sow sites with early successional native grasses. Hand pull plants in small areas, minimizing soil disturbance. Herbicide is effective; apply during early spring to avoid native plants. Two biological control organisms specifically target mullein, a European curculinoid weevil, and the mullein moth.183
| CROWN VETCH | Securigera varia |

**NATIVITY:** Europe.

**HABITAT:** Prefers disturbed, open areas with mesic conditions and fertile loamy soil, such as savannas, roadsides, cemeteries, weedy meadows along rivers, highway rights-of-way, and pastures.

**ACTIVE SEASON:** Blooms July through September.

**IDENTIFICATION:** Herbaceous vine forming sprawling mats and thickets up to three feet tall. Pinnately compound leaves, with 15-25 pairs of leaflets, in an alternate arrangement. The 0.5" long, pea-like flowers can be white, pink, or purple. Each fertile flower produces a seedpod, which consists of 1-7 segments, with constrictions between segments, and tapering ends.

**THREAT:** Outcompetes and displaces native plants, often creating a monoculture, which does not support native fauna.

**MANAGEMENT:** For small populations, manual controls, such as: pulling entire plants, mowing in late spring and multiple times throughout the growing season for several consecutive years, and prescribed burning conducted in late spring for several consecutive years, can be effective. For larger or more established populations, chemical control will also likely be necessary and may be most effective if applied to remaining foliage following mechanical removal.\(^{134}, 51\)
CUT-LEAVED TEASEL

**Dipsacus laciniatus**

**NATIVITY:** Europe.

**HABITAT:** Prefers disturbed, open areas with mesic conditions and fertile loamy soil, such as savannas, roadsides, cemeteries, weedy meadows along rivers, highway rights-of-way, and pastures.

**ACTIVE SEASON:** Blooms July through September.

**IDENTIFICATION:** Grows as a basal rosette for at least one year, sends up tall flowering stalk, then dies after flowering. During the rosette stage, leaves range from ovoid to oblong and hairy and a large (2’ long) taproot develops. The leaves of flowering plants are form cups to hold water and are large, oblong, sessile, and prickly, especially along the midrib.

**THREAT:** Outcompetes and displaces native plants, often creating a monoculture, which does not support native fauna.

**MANAGEMENT:** In high quality natural communities with small populations, mechanical methods (i.e. digging and pulling) provided by volunteers is often effective and least costly. Young rosettes of cut-leaved teasel can be removed using a dandelion digger or trowel and small seedlings can be hand pulled when soil is moist. For more mature plants, flowering heads should be cut and removed at flowering time to reduce the likelihood of re-sprouting. For larger or more mature populations, foliar herbicide application is likely the most cost effective method of control. Spot treatment should be employed to prevent damage to native species. For lower quality natural communities that are heavily infested, a foliar applied herbicide, such as Glyphosate, 2,4-Damine, and Triclopyr, is generally the preferred option. The herbicide should be applied during the growing season and preferably before the flowering stalk appears.52, 117
**GARLIC MUSTARD**

**Alliaria petiolata**

**Nativity:** Europe.

**Habitat:** Upland and floodplain forests, savannas, open wetlands, parking lots, campgrounds, paths, and roadsides.

**Active Season:** Leaves out in spring before natives. Identifiable throughout the growing season.

**Identification:** Herbaceous biennial, up to 4’ tall. Stem leaves simple, alternate, triangular with toothed margins. Basal leaves rounded with heart-shaped bases, scalloped edges, and palmate venation arranged in a basal rosette. Small, white, 4-petaled flowers. Forms round basal rosette the first year, flowers the second year and dies. Fruit a long, narrow capsule with tiny dark seeds. Crushed leaves smell like garlic.

**Threat:** Produces abundant seed; spread by floodwaters, dispersed in soil on boots, vehicles, and equipment. Also spread by animals such as deer. Dominates the ground layer of forests to the exclusion of almost all other herbaceous species. Destroys mycorrhizal fungi needed by woody plants for regeneration.

**Management:** Monitor forest edges, paths and floodplains. Begin control efforts in highest quality areas; pull seedlings when there only a few - otherwise, focus on second year plants. Pull plants before seed is produced. Remove upper half of root or it may resprout. Tamp soil thoroughly to minimize recolonization and germination. Flower/seed heads must burned or placed in a landfill to prevent seed development. Herbicide can be used in early spring and fall while native plants are dormant. Continue control efforts until the seed bank is depleted. This species is difficult to control, research control options thoroughly.
| JAPANESE BARBERRY |

Berberis thunbergii

NATIVITY: Asia.

HABITAT: Commonly found in upland and riparian environments, including wetlands, pastures, and meadows. It’s most abundant in post-agricultural forests and less common in undisturbed wooded areas. It can tolerate full sun or dense shade.¹⁹²

ACTIVE SEASON: Year round: conspicuous red fruits mature July through October and persist through the winter.

IDENTIFICATION: This deciduous shrub grows is typically 3’ tall, but can grow up to 6’. It carries small, sharp, simple spines along brown, deeply grooved branches. Its oval-shaped leaves are between 0.5”–1.5” long and vary in color, ranging from green to a reddish purple. Japanese barberry has pale yellow flowers that bloom in spring and produces bright red berries about 0.3” long that mature from summer through October, and sometimes persisting through winter.

THREAT: The shrub has the ability to displace many native plants through its ability to tolerate deep shade, outcompete other vegetation, and change the chemistry of the local soil to become more basic through its leaf litter. It is easily spread by birds that eat the berries and widely disperse the seeds.

MANAGEMENT: There are very few methods for managing Japanese barberry. Older shrubs can be uprooted when soil is moist or synthetic herbicides like glyphosate and triclopyr can be very effective when applied to mowed or cut stumps. There is no known biological control available.²⁰¹, ¹⁸¹
JAPANESE KNOTWEED
Fallopia japonica

NATIVITY: Asia.

HABITAT: Prefers full sun and can tolerate a wide range of soil and moisture conditions. Generally found along roadsides, wetlands, wet depressions, woodland edges, and along stream and river banks.

ACTIVE SEASON: Blooms August through September.

IDENTIFICATION: This large, non-native, invasive perennial is an herbaceous shrub originally introduced in the US as an ornamental. It has a deep tap root, extensive lateral network of rhizomes, and can reach heights 3-10’. The hollow stalks are round and have a whitish coating that can be rubbed-off. The simple, alternate leaves can be 6” long and 5” wide with an abruptly pointed tip and a flat or tapering base. The numerous, small, ivory colored flowers are arranged in spikes and bloom in late summer.

THREAT: Out-competes native plant species through the formation of thickets that create light limitations, alteration of nutrient cycling, and the suppression of potential plant competitors through allelopathy (releasing toxic or inhibiting chemicals).

MANAGEMENT: Mechanical methods alone are generally NOT successful and may exacerbate the problem since the plant vigorously re-sprouts. To be effective, efforts MUST target the underground system of rhizomes. Therefore, cutting in combination with an herbicide application can be effective, since the plant has to expend energy to regrow its canopy rather than expanding its network of rhizomes. However, the plant can also re-sprout from root and stem fragments, so it is essential to remove ALL cuttings (large and small) from the site and dispose of them properly. Monitoring and follow-up treatment, although dependent on the size and age of the population, is typically required for 4-10 years before removal can be determined a success.42,76
| KENTUCKY BLUEGRASS |

*Poa pratensis*

**NATIVITY:** Europe.

**HABITAT:** Full to partial sun, mesic conditions, slightly acid to alkaline pH. Found in lawns, parks, pastures, roadsides, degraded prairies, weedy meadows, vacant lots, waste areas, open woodlands, savannas, limestone glades, gravelly seeps and historically disturbed areas.

**ACTIVE SEASON:** Growth starts late winter or early spring, flowers in May, seed matures in June.

**IDENTIFICATION:** Perennial grass 1-2.5' tall, stems light green and cylindrical to slightly flattened, glabrous, unbranched and erect with 2-5 alternate leaves. Leaves on stem are 2-5" long, medium green, mostly hairless and hull shaped. Basil leaves are similar to stem leaves though are usually longer and more floppy. Leaf sheaths are medium green and mostly hairless. The stems end in a loose, branching cluster of reduced flower clusters, or spikelets, which are 2-6" long. The flowering stalks appear oblong or narrowly pyramidal in shape. The central axis of the flowering stem has 2-5 lateral, whorled branches which are ascending to widely spreading. Each lateral branch divides and subdivides into 0.125-0.25” (4-6 mm) stalked spikelets. Each spikelet is light green to purplish-green and has a pair of scales at the bottom (glumes) and 2-5 scales above (lemmas), arranged in 2 overlapping ranks. Spikelets mature to a light tan or light brown color. Plants often form clonal colonies from rhizomes.

**THREAT:** Very competitive, tends to invade native grasslands, reducing species diversity.

**MANAGEMENT:** Repeated spring burns have been shown to control Kentucky bluegrass. Repeated early season grazing or mowing has been shown to reduce productivity in the following year. Herbicide in spring. 156, 163, 55
**MULTIFLORA ROSE**

**Rosa multiflora**

**NATIVITY:** Japan & Korea.

**HABITAT:** Forests, streambanks, pastures, roadsides.

**ACTIVE SEASON:** Bloom May-June, distinctive fringed stipules visible throughout the growing season and distinguish it from native roses.

**IDENTIFICATION:** Deciduous, dense, perennial shrub growing up to 10’ tall and 10-13’ wide, with long, slender, arching branches and stout, recurved thorns. Alternate, finely toothed, pinnately compound leaves with 5-11 leaflets and a finely fringed stipule at the leaf base. White or slightly pink five-petaled flowers; up to 1” wide; arranged in a panicle. Fruit a hard, smooth red rose hip.

**THREAT:** Reproduces by horizontal stems that root at the node and shoots that root at the tips; hips and seeds dispersed by birds and mammals.

**MANAGEMENT:** A long-term management program of mowing or cutting and treating stems with systemic herbicide several times during the growing season is recommended. Digging or hand-pulling small shrubs may also be effective. Monitor paths, edges, and open areas in late spring while flowering. Dig out small plants and remove all roots; cutting or mowing several times throughout the growing season for several years may reduce populations; treat cut stems with herbicide to prevent resprouting. Basal bark treatment effective. Foliar herbicide treatment effective where few natives are present. In fire adapted communities where good fuel is present, prescribed fire top kills well and facilitates follow-up with foliar herbicide treatment; repeated late spring fires reduce population if sufficient fuel is present.
| REED CANARYGRASS |

_Phaloaris arundinacea_

**Nativity:** Europe.

**Habitat:** Wetlands, lake, stream, and pond banks, wet meadows, and ditches.

**Active Season:** Seed heads mature June to August, spreading open as they mature.

**Identification:** Cool-season, colonial, perennial grass ranging from 2.5-8' tall. Forms dense stands with thick, fibrous rhizomes. Flat, rough leaf blades; 0.75-1” wide and up to 1.5’ long, large, clearish membrane attaches leaf blades to the stalk; prominent transparent ligule (large, clearish membrane attaches leaf blades to the stalk). Stems bluish green. Inflorescence a panicle that opens in spring for pollination and then closes tightly.

**Threat:** Spread primarily by dense, mat-forming rhizomes, also by seed, which is dispersed by water, animals, humans, and machinery.

**Management:** A combination of burning or mowing with systemic herbicides is the best method of control; grass-specific herbicides applied with wick applicators are recommended in areas where native plants occur. Monitor moist, fertile sites and wetlands; most visible in spring when inflorescences expand to facilitate pollination. Herbicide application in late summer or fall provides the most effective control, particularly for large populations; reseeding with desired plant species beneficial; burning, mowing, disking and plowing must be ongoing as root fragments resprout. One-time efforts may increase population. Monitoring and follow-up required for 5-10 years until seed bank is exhausted. Extremely difficult to eradicate.\(^{106, 129}\)
**SIBERIAN ELM**
*Ulmus pumila*

**NATIVITY:** Eurasia.

**HABITAT:** Tolerates poor soils (except highly acidic) and low moisture. Often found on disturbed sites, including: abandoned fields, rights-of-way, river banks, roadsides, railroad embankments, fencerows, disturbed woodlands, weedy meadows, and disturbed prairie sites.

**ACTIVE SEASON:** After leaves appear in March/April until senescence in September/October.

**IDENTIFICATION:** When mature, this species is a large (30-60’ tall), deciduous tree with dark gray, shallowly furrowed bark and a rounded, open crown. The slender and spreading branches have silver-gray, zig-zag twigs with a leaf bud at each junction. The alternate, small (1-3”) leaves are elliptic, toothed with a mildly asymmetrical base and a short-pointed tip. The compact greenish flowers, occurring in clusters of 2-5, lack petals and appear before leaves develop. The oval-orbicular samaras, each containing a single seed, ripen from April to May and are wind distributed.

**THREAT:** In urban areas, this species can cause infrastructure damage due to its susceptibility to wind, snow, and ice injury. In addition, it can clog underground water and sewer lines due to its strong, water-seeking roots. In native ecosystems, Siberian elm is a very-tolerant pioneer species and can out-compete native flora on disturbed sites. Dry to mesic prairies and stream banks are often most vulnerable to invasion. Thickets of seedlings form around trees and new colonies can form from wind-dispersed seeds. It is resistant to Dutch elm disease.

**MANAGEMENT:** To avoid re-sprouts, older specimens can be either cut or girdled and painted with a systemic herbicide, such as glyphosate or triclopyr. Small seedlings can be hand pulled and small trees can be carefully removed with a grub hoe or weed wench. 50, 120, 113, 192
SMOOTH BROME
*Bromus inermis*

**NATIVITY:** Eurasia.

**HABITAT:** Railroad prairies, woodland edges, savannas, pastures, fallow fields, grassy areas along roads, weedy meadows, little-mowed areas of city parks, and waste areas.

**SURVEY PERIOD:** Leaf out mid-March, bloom early April to early June, fruit ripen July.

**IDENTIFICATION:** Perennial grass 2.25–3.5’ tall; usually unbranched. The blades of alternate leaves are up to 12” long and 16 mm (0.67”) across; greyish blue on the upper side, green on the lower side, hairless, and flat. The leaf blades are ascending to spreading and rather floppy. The leaf sheaths are greyish blue, hairless, and closed, although they usually split open near the ligules. Each culm terminates in a panicle of floral spikelets about 4-8” long; the entire panicle has a tendency to lean sideways or droop from the weight of the spikelets. The branchlets of this panicle are ascending to spreading during the period of bloom, otherwise they are more erect and contracted. The branchlets occur in whorls along the central stalk of the inflorescence, and they often divide into secondary branchlets. These branchlets are green, hairless, and somewhat wiry. Each elongated spikelet is about 0.75–1.25” (2-3 cm.) in length; it consists of a pair of glumes and 5-10 fertile lemmas that are arranged in 2 overlapping ranks. Absence of awns on its spikelets distinguish it from other Brome grasses.

**THREAT:** Has the capacity to invade native prairies and savannas. Forms dense colonies that exclude other plant species.

**MANAGEMENT:** Prescribed burns in late spring will decrease density. Chemical treatment will increase efficacy by mowing and then repeated spraying with glyphosate after a flush of growth.  

88, 158, 110
**TARTARIAN HONEYSUCKLE**

*Lonicera tatarica*

**NATIVITY:** Asia.

**HABITAT:** Although this species prefers partial sun, mesic conditions, and fertile soil, it can survive in other conditions. Deciduous woodlands, disturbed woodlots, woodland borders, thickets, fence rows, and roadsides.

**ACTIVE SEASON:** Leaf occurs earlier than most other species and leaves persist until late fall. Blooms appear late spring to early summer.

**IDENTIFICATION:** A multi-branched, 5-12’ tall shrub with long, arching branches that are gray or grayish-brown in coloration and create an irregular rounded crown. With age, the bark becomes shaggy and the branches hollow out making them more fragile. Pairs of opposite, deciduous, hairless, oval-ovate shaped leaves with smooth margins occur along the branches. Each leaf is about 1.5 - 2.5” long and 0.75-1.5” in width and the base is rounded or slightly heart-shaped while the tip tapers to a blunt point. Pairs of white to pink, fragrant, asymmetrical, 5-lobed flowers emerge at the axis of the leaves. Following pollination, pairs of 0.25” red berries develop. The flowers and berries are on slender pedicels about 0.75-1” long, which is longer than most other honeysuckle species (typically 0.5” or less).

**THREAT:** Aggressively invades natural areas and outcompetes native species by leafing out earlier and forming monocultures. Seeds are spread widely by a variety of bird species that eat the berries.

**MANAGEMENT:** Monitor sunny, upland sites and open forests in spring as non-native honeysuckle leafs out before natives. Begin control efforts in highest quality areas; hand pull or dig small plants, removing all roots; target large, fruit-bearing plants for control/removal; foliar spray may be effective for large populations where few natives are present; treat cut stumps with herbicide; basal bark treatment is also effective, spray bottom 18” of all stems. Where fuel is present, prescribed fire may provide effective control of seedlings in fire adapted communities.57, 39, 36
**TREE-OF-HEAVEN**

*AILANTHUS ALTISSIMA*

**NATIVITY:** Northeastern and Central China and Taiwan.

**HABITAT:** Very adaptable to a range of conditions, but prefers full sun.

**ACTIVE SEASON:** Year-round; leafs out in spring, blooms in June.

**IDENTIFICATION:** Deciduous tree with smooth, pale bark and light chestnut brown twigs with large leaf scar. The leaves, stems, and some flowers have an unpleasant odor described as cat urine or rotting peanut butter. Large, showy clusters of yellowish-green flowers bloom in June and flat, twisted single-seeded samaras are produced by female trees.

**THREAT:** Prolific seeder and vigorous grower that uses the chemical ailanthone, which has allelopathic effects, to displace native vegetation. Also causes damage to infrastructure in urban areas.

**MANAGEMENT:** Due to vigorous resprouting, systemic herbicides with active ingredients such as glyphosate and triclopyr are generally required and could be applied to the stump following manual cutting or girdling.¹⁵⁴
WHITE MULBERRY

Morus alba

NATIVITY: China

HABITAT: Old fields, urban lots, roadsides, forest edges, floodplains, and other disturbed areas. Occasionally planted in residential areas. Is very pollution and drought tolerant and will grow in most soils except permanent wet areas.

ACTIVE SEASON: In the Midwest, generally blooms May into June with fruits forming as early as May and continuing into late July.

IDENTIFICATION: A 30-50 ft tall, deciduous tree with distinctive polymorphic leaves that can be entire or have one or multiple lobes. All leaves are alternate, simple, toothed, and have a glossy upper surface and generally glabrous lower surface (unlike native M. rubra). The inner bark is bright orange and can sometimes be seen through bark fissures on older trees or on the roots. The fruits are composed of multiple dupes and ripen to white, pink, dark red, and purplish-black.

THREAT: This species has the potential to exclude native vegetation and research has suggested it may have allelopathic properties. It also hybridizes with red mulberry and may lead to local extinctions of the native population.

MANAGEMENT: Seedlings can be hand pulled. Older specimens can be either cut or girdled and painted with a systemic herbicide.

Credit: byrev

Credit: Jaknouse

Credit: Flora of North America

Credit: USDA

Credit: Jean PoI

Credit: Abrahami
WILD PARSNIP  

*Pastinaca sativa*

**NATIVITY:** Eurasia.

**HABITAT:** Prefers sun and moist to mesic, fertile soils, can tolerate less favorable conditions. Occurs in disturbed areas, such as rights-of-way, roadsides, and railroad embankments. Can also invade prairies and savannas with fertile soil.

**ACTIVE SEASON:** Blooms typically June to July.

**IDENTIFICATION:** Herbaceous biennial/short-lived perennial spends one or more years around 6” tall as rosette. When conditions favorable, grows into 2-5’ plant with glabrous, angular, grooved stem; branches occasionally. Alternate, compound leaves up to 18” long and 6” across, 5 to 15 leaflets each. Leaflets up to 3” long and 2” wide, often have lobes or coarse teeth along margins. The flat-topped flowerhead, a compound umbel of tiny yellow flowers, is 3-8” wide. Individual seeds spread via wind or water dispersal. The long, fleshy taproot smells like parsnips.

**THREAT:** Plant contains a chemical, furocoumarins, which can make skin sensitive to light (phytophotodermatitis) causing severe burns and blisters. Well established native habitats are most susceptible along edges, particularly where corridors, trails, roads, or railways bisect the habitat. Once a population of wild parsnip builds up, it can spread rapidly and out compete native vegetation.

**MANAGEMENT:** Due to the plant’s hazardous sap, hand pulling is not recommended, but can be effective. Small patches can be weeded with a shovel by severing the tap root 1-2” below ground and seeding the area with desired species. The site should be re-checked to ensure re-sprouting does not occur and collected plant material should be burned on-site or disposed of in a landfill. For larger populations, spot application of glyphosate in late fall may be effective. Any equipment that comes in contact with the sap should be carefully disinfected following removal. Regardless of management technique, proper protective equipment should be worn to ensure sap does not contact skin or eyes. 58, 112, 115, 79
YELLOW & WHITE SWEET-CLOVER | *Melilotus officinalis & Melilotus albus*

**Nativity:** Eurasia.

**Habitat:** Open, disturbed sites such as roadsides and old fields; invades prairies, savannas and dunes; shade intolerant; tolerates nutrient poor soils.

**Active Season:** Bloom May through September.

**Identification:** Herbaceous annual or biennial that can grow up to 3' tall; deep taproot; extensive lateral roots. Leaves compound, alternate, clover leaves with three finely toothed leaflets. Stems upright; many-branched; often hollow; leafy stems that may be somewhat spreading near the base giving the plant a bushy appearance. Flowers numerous, yellow or white in color, pea-like, fragrant, crowded onto elongated stems. Seed pod, tiny, wrinkled, contains 1-2 small seeds that may remain viable for up to thirty years, seed germination stimulated by burning.

**Threat:** This plant is capable of nitrogen fixation. Reproduce by prolific seed production, up to 350,000 seeds per plant.

**Management:** Monitor open, sunny sites; most easily identified while in bloom. For small infestations, pull first year plants in fall, after the root-crown buds have developed; pull second year plants before flowering. Flowering plants should be removed and disposed of so that seed does not develop. Poorly planned prescribed fire will increase infestations; multiple hot burns needed, timing critical, dependent on population age structure. A single burn may also be combined with herbicide application.
TAKE-HOME MESSAGES FROM THE TRIP

Threatened, endangered, and special concern species are integral parts of landscape ecosystems, so we must conserve and manage the entire system in order to save these species; this will require a movement from bio-centric conservation (species only) to eco-centric preservation (landscape ecosystems and species dependent upon them). An example is controlling herbaceous and woody invasive species in rights-of-way rather than focusing only on species that are incompatible with power line transmission. Managing landscapes for diverse native plant species automatically supports a diverse population of native pollinator species and helps maintain functioning ecosystems.

Absence of evidence is not evidence of absence. A complete survey of the state has not been conducted; therefore, not all locations/instances of rare species and their habitats are known or recorded in the state natural inventory database. Therefore, it is important to pay attention to the landscape ecosystems we are working in and learn to recognize rare species and their habitats.

The rare species prescriptions you see in the Web Mapper, ROW Keeper, or WPS are not set in stone. They've been drafted in a conservative manner to avoid adverse impacts to rare species with minimal effort or correspondence. With further consideration of management activities, field surveys, and/or consultation with agencies and local land managers, they may be modified. Please don't hesitate to reach out and ask questions as you are planning your work.

Whether or not adverse impacts can be avoided should be assessed as early in the planning and design phase of a project as possible. Securing the appropriate natural resource permits is necessary and can be time-consuming and costly.
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