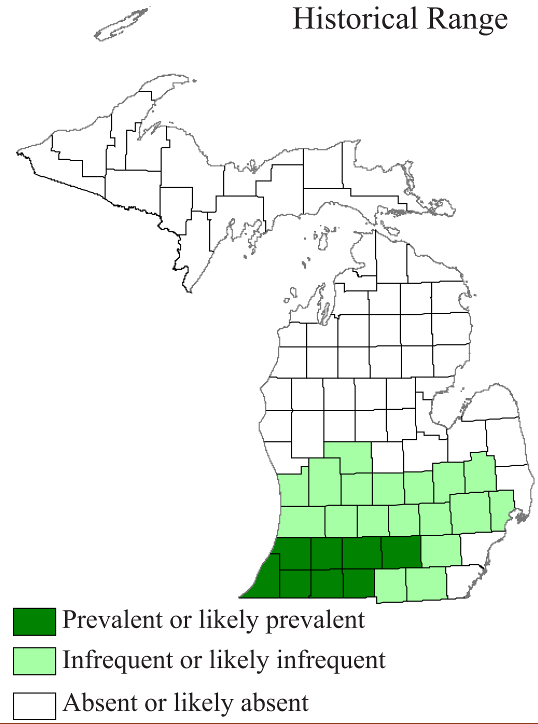
Dry-mesic Prairie — Community Abstract

Photo by Bradford S. Slaughter



Overview: Dry-mesic prairie is a native grassland community dominated by big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), and Indian grass (*Sorghastrum nutans*) that occurs on sandy loam or loamy sand on level to slightly sloping sites of glacial outwash, coarse-textured end moraines, and glacial till plain. The community represents the stands of open grassland that occurred within the historic oak openings. Areas dominated by native grasses with less than one mature tree per acre (0.4 ha) are considered prairie (Curtis 1959). This natural community type was known as woodland prairie in previous versions of the natural community classification (see Kost et al. 2007).

Global and State Rank: G3/S1

Range: In the 1800s, dry-mesic prairie occurred in association with oak openings throughout much of southern Lower Michigan. Based on interpretations of General Land Office surveyor notes from the early to mid 1800s, pockets of dry-mesic prairie occurred in Barry, Berrien, Branch, Calhoun, Cass, Ionia, Kalamazoo, Livingston, Lapeer, St. Joseph, Van Buren, and Washtenaw counties (Comer et al. 1995). Oak openings, which likely included pockets of dry-mesic prairie, occurred throughout the upper Midwest and stretched into western New York and southern Ontario, Canada (Faber-Langendoen 2001).

Rank Justification: In the early to mid 1800s, the southern Lower Peninsula supported approximately 60,500 acres (24,500 ha) (Comer et al. 1995) of upland prairie, which included pockets of dry-mesic prairie, mesic prairie, mesic sand prairie, dry sand prairie, and hillside prairie. Because of its close association with oak openings, dry-mesic prairie represented the most widespread type of prairie community in southern Michigan. The Michigan Natural Features Inventory database currently includes 11 occurrences of dry-mesic prairie, which range in size from 2 to 15 acres (ave. 5.6 acres, or 2.3 ha) and total 62 acres (25 ha). It is difficult to reliably determine the total acreage of dry-mesic prairie in Michigan in the 1800s. However, based on comparisons of the total acreage of all upland prairie element occurrences in southern Lower Michigan today (480 acres, 194 ha) with that found in the early to mid 1800s (provided above), it appears that less than 1% of the original upland prairie remains intact.

Landscape and Abiotic Context: Dry-mesic prairie occurs primarily on level to slightly sloping sites of glacial outwash or coarse-textured end moraines on glacial outwash (Chapman 1984). Soils are typically sandy loam or occasionally loamy sand with pH ranging from 5.2 to 6.7 (ave. pH 5.8) and water retaining capacity of 43 to 94% (ave. 55%) (Chapman 1984). The majority of historical dry-mesic prairies occur within the Kalamazoo

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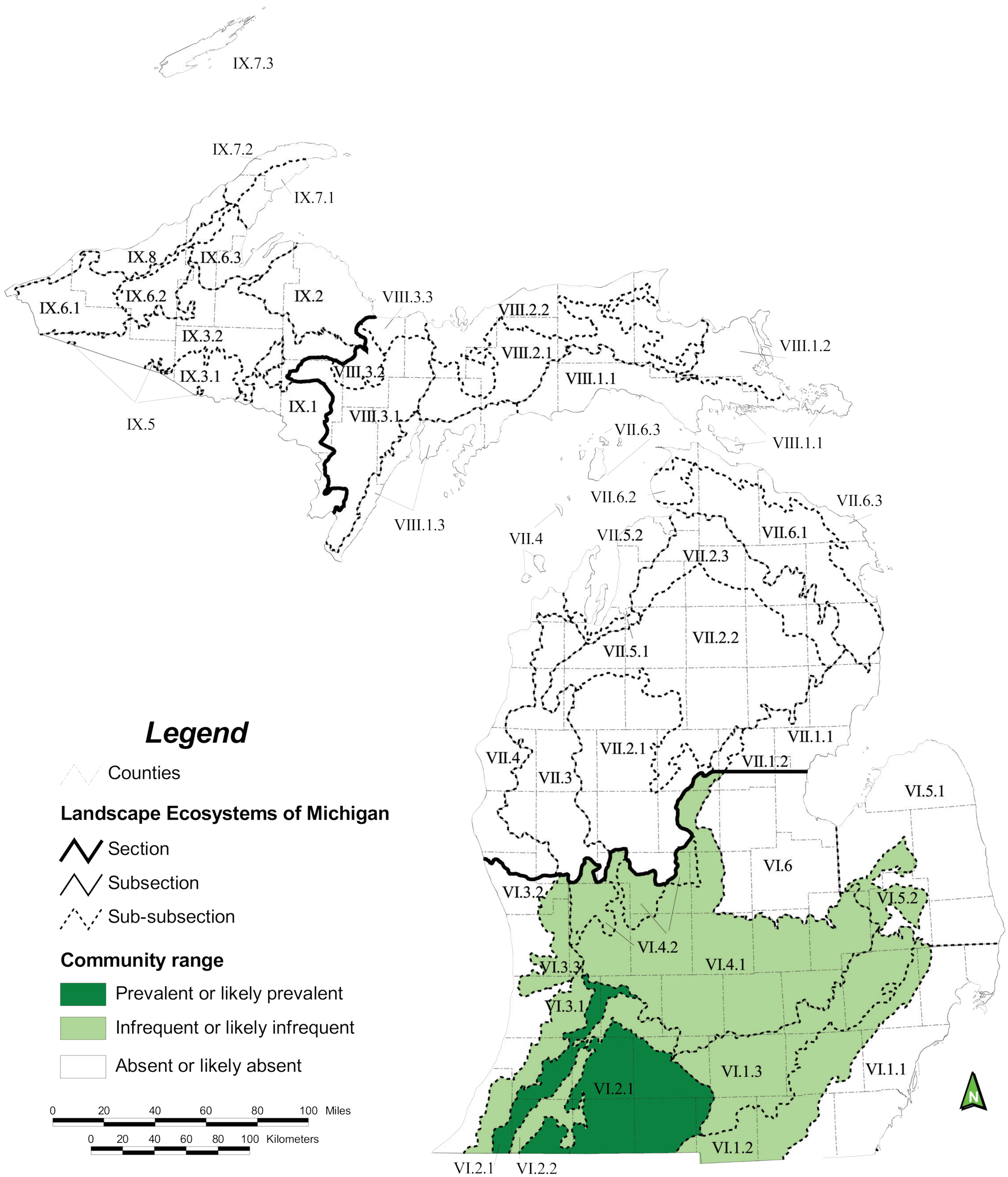
P.O. Box 30444 - Lansing, MI 48909-7944
Phone: 517-373-1552



Ecoregional map of Michigan (Albert 1995) depicting historical distribution of dry-mesic prairie (Albert et al. 2008)

Interlobate Subsection (Albert 1995), which represents the northernmost portion of the "Prairie Peninsula" described by Transeau (1935).

Dry-mesic prairie occurred historically within oak openings and may have graded into mesic prairie and bur oak plains on level outwash plains like the Battlecreek Outwash Plain (Albert 1995). Today the community is almost entirely restricted to railroad right-of-ways, which often border agricultural fields.

Natural Processes: Fire played a critical role in maintaining open conditions in Michigan prairie and oak savanna ecosystems. In the absence of frequent fires, which retarded woody growth prior to Euro-American settlement, Michigan's prairies and open oak ecosystems (e.g., oak openings, bur oak plains, oak barrens, oak woodlands) were quickly colonized by trees and shrubs and converted to oak forests.

In 1835 Hoffman recounts his impression of a fire in December "To-day, for the first time, I saw the meadows on fire. They are of vast extent, running far into the woods like the friths of a lake; and as wild grass, which they supply in the greatest profusion, furnishes the new settler with all the hay he uses for his stock, they are burnt over thus annually to make it tender. These fires traveling far over the country seize upon the largest prairies, and consuming every tree in the woods, except the hardiest, cause the often-mentioned oak openings, so characteristic of Michigan scenery. It is a beautiful sight to see the fire shooting in every direction over these broad expanses of land…" (Hoffman 1385 in Chapman 1984).

Van Buren in 1884 on describing the oak openings of Calhoun County writes "The annual fires burnt up the underwood, decayed trees, vegetation, and debris, in the oak openings, leaving them clear of obstructions. You could see through the trees in any direction, save where the irregularity of the surface intervened, for miles around you, and you could walk, ride on horse-back, or drive in a wagon wherever you pleased in this woods, as freely as you could in a neat and beautiful park." (Van Buren 1884 in Chapman 1984).

Many early accounts have been written of the rapid conversion of prairie and oak savanna (oak barrens and oak openings) to forest. Glidden in 1892 describes the origin of many of the oak forests now occurring in southern Michigan in the following passage. "After the very best job of breaking [plowing], a live [oak] grub would be left upon every square rod of ground. There is nothing now to compare with this pioneer grub. For fifty years or more its yearly growth had been burned off, and had sprouted again in the spring… The enlargement at the surface about the tap root increased with each year's growth of sprouts, until the cap was formed, a foot or more in with, like an underground toad stool, although not so regular in shape. The whole under–surface of this cap was filled with dormant buds, that awoke in activity at once when the standing ones were cut or were burned away. Nature reasserted itself when the annual burnings had ceased, and the fittest stem survived and became the tree or young oak, as we see them today, while the cap has rotted away" (Glidden in Chapman 1984).

The conversion of open prairie and oak opening to forest was well underway by 1872 when Hubbard described the landscape near Pontiac as it appeared during his 1837 expedition with Douglas Houghton through Michigan's "new territory". Hubbard writes "I speak in the past tense, because, though the rural beauty of the country is still unrivaled, little remains of the original character of the [oak] openings. This is a result partly of the progress of cultivation, and partly of the thick growth of small timber that has covered all the uncultivated portions since the annual fires have ceased, which kept down the underbrush" (Hubbard 1872 in Chapman 1984).

Fire frequency depended on a variety of factors including type and volume of fuel, topography, natural firebreaks, and density of Native Americans (Chapman 1984). In general, the probability for a wide-ranging fire increases in level topography like large outwash plains (Chapman 1984). While occasional lightning strikes resulted in fires that spread across the landscape, Native Americans were the main sources of ignition.

There are many early accounts of Native Americans intentionally setting fires to accomplish specific objectives (see Day 1953, Curtis 1959, Thompson and Smith 1970, Chapman 1984, Denevan 1992, Kay 1995). Native Americans intentionally set fires in the fall to clear briars and brush and make the land more easily passable. Frequent fires kept the land open, increasing both short- and long-range visibility, which facilitated large game hunting and provided a measure of safety from surprise attacks by neighboring tribes. Fire was used to increase productivity of berry crops and agricultural fields. As a habitat management tool, fires were used to maintain high quality forage for deer, elk, woodland caribou, bison and other game species. It was also used as a hunting tool to both drive and encircle game. During warfare, fire was strategically employed to drive away advancing enemies, create cover for escape, and for waging attacks.

In addition to maintaining open conditions, fire also plays a critical role in maintaining species diversity. A recensus of 54 prairie remnants in Wisconsin found that 8 to 60% of the original plant species recorded at the sites had been lost over time (32 to 52 years) even though the sites appeared relatively undisturbed (Leach and Givnish 1996). The authors suggest that taller vegetation outcompeted species with small statures, small seeds (e.g., orchids), and nitrogen-fixing symbioses such as members of the legume family (Fabaceae) like lupine (*Lupinus perennis*), wild indigo (*Baptisia* spp.), bush clover (*Lespedeza* spp.), and tick-trefoil (*Desmodium* spp.). Because fire maintains open conditions and burns off standing and accumulated litter, small species and those with small seeds that require open microsites are able to garner enough space and light to remain viable. In the absence of frequent fires, small species are outcompeted by taller and denser types of vegetation. As fire volatilizes much of the nitrogen stored in combustible vegetation, frequent burning also favors species that form nitrogen-fixing symbioses (e.g., legumes and rhizobium bacteria) and thus provides these plants with a competitive edge not found in unburned sites (Leach and Givnish 1996).

Fire also helps maintain species diversity by facilitating expression of the soil seed bank and promoting seed germination and establishment. By consuming accumulated and standing leaf litter, fire increases light availability to the soil surface and increases diurnal temperature fluctuations, both of which trigger seed germination. In addition, the removal of litter by fire creates critical microsites for seed germination and fosters seedling establishment.

The removal of litter by fire also increases the availability of many important plant nutrients (e.g., N, P, K, Ca and Mg), which are thought to contribute to higher plant biomass, increased flowering and seed production, and greater palatability to herbivores (Vogl 1964, Daubenmire 1968, Viro 1974, Vogl 1974, Smith and Kadlec 1985, Abrams et al. 1986, Collins and Gibson 1990, Reich et al. 1990, Schmalzer and Hinkle 1992, Timmins 1992, Laubhan 1995, Warners 1997).

While this discussion has focused on plants it is important to note that these species serve as host plants for a variety of insects and the structure of open grasslands is critical to a wide variety of animal species, many of which are considered rare or declining today.

Ants, particularly the genus *Formica*, play an important role in mixing and aerating prairie soils (Curtis 1959, Trager 1998). Large ant mounds, which may measure .5 m in height and over 1 m wide and number 40 to 50 per acre are especially conspicuous following a prairie fire (Curtis 1959). Because of their abundance and frequent habit of abandoning old mounds and building new ones, ants overturn large portions of prairies in a relatively short time (Curtis 1959). Other important species contributing to soil mixing and aeration include moles, mice, skunks, and badgers (Curtis 1959).

Historically, large herbivores such as bison significantly influenced plant species diversity in Michigan prairie and oak savanna ecosystems. The diet of bison consists of 90 to 95% grasses and sedges (Steuter 1997). As bison selectively forage on grasses and sedges, they reduce the dominance of graminoids and provide a competitive advantage to forb species. The activities of bison, which includes wallowing and trampling, promotes plant species diversity by creating microsites for seed germination and seedling establishment and reducing the dominance of robust perennials (Steuter 1997).

Vegetation Description: Unfortunately, no detailed ecological study of dry-mesic prairie was completed in Michigan before the nearly total demise of the community. What information is available comes from written descriptions of oak openings by early European settlers and from studies of small prairie remnants.

Chapman (1984) completed a study of 66 prairie and savanna remnants in southern Lower Michigan, thirteen of which he classified as dry-mesic prairie. In addition, Curtis (1959) and Curtis and Green (1949) collected detailed information on 66 dry-mesic prairie stands in Wisconsin and much of their data may be applicable to dry-mesic prairie in Michigan.

Dry-mesic prairie supports a dense to moderately dense growth of low to medium vegetation with very little bare ground (Chapman 1984). The community is dominated by big bluestem, little bluestem, and Indian grass, which can occur in varying degrees of dominance to one another

(Chapman 1984). Switch grass (*Panicum virgatum*) occurred in only three of the thirteen dry-mesic prairie sites studied by Chapman and was not listed among the prevalent species for dry-mesic prairie in Wisconsin by Curtis (1959). Species that reach their greatest abundance (e.g., modal species) in dry-mesic prairie in Michigan include the following: lead plant (*Amorpha canescens*, state special concern), thimbleweed (*Anemone cylindrica*), butterfly weed (*Asclepias tuberosa*), smooth aster (*Aster laevis*), and daisy fleabane (*Erigeron strigosus*) (Chapman 1984).

Oak grubs of white oak, black oak, and bur oak, which were maintained in a shrub-like condition as a result of annual fires, were abundant in dry-mesic prairie as were widely scattered, open grown adults of these same species, especially white oak.

The following table of dry-mesic prairie plants was compiled from Chapman's (1984) study of thirteen dry-mesic prairie remnants in southern Lower Michigan and includes only species occurring in more than half the sites he studied.

SCIENTIFIC NAME	**COMMON NAME**
Grasses and Sedges	
Andropogon gerardii	big bluestem
Andropogon scoparius	little bluestem grass
Carex pensylvanica	Pennsylvania sedge
Sorghastrum nutans	Indian grass
Forbs	
Achillea millefolium	yarrow
Anemone cylindrica	thimbleweed
Antennaria parlinii	smooth pussytoes
Asclepias syriaca	common milkweed
Asclepias tuberosa	butterfly weed
Aster laevis	smooth aster
Aster oolentangiensis	prairie heart-leaved aster
Aster pilosus	hairy aster
Comandra umbellata	bastard toadflax
Desmodium canadense	showy tick-trefoil
Desmodium illinoense	prairie tick-trefoil
Desmodium marilandicum	small-leaved tick-trefoil
Erigeron strigosus	daisy fleabane
Euphorbia corollata	flowering spurge
Fragaria virginiana	wild strawberry
Helianthus occidentalis	western sunflower
Hieracium longipilum	long-bearded hawkweed
Lactuca canadensis	tall lettuce
Lespedeza capitata	round-headed bush-clover
Lithospermum canescens	hoary puccoon
Monarda fistulosa	wild bergamot
Potentilla simplex	old field cinquefoil
Ratibida pinnata	yellow coneflower
Rudbeckia hirta	black-eyed susan
Smilacina racemosa	false spikenard
Solidago juncea	early goldenrod
Solidago nemoralis	old field goldenrod
Solidago rigida	stiff goldenrod
Solidago speciosa	showy goldenrod
Tradescantia ohiensis	common spiderwort
Shrubs	
Ceanothus americanus	New Jersey tea
Rosa carolina	pasture rose
Rubus flagellaris	northern dewberry
Salix humilis	prairie willow

Michigan Indicator Species: Chapman lists only one species, hairy aster (*Aster pilosus*), as an indicator for dry-mesic prairie in Michigan. Thimbleweed (*Anemone cylindrica*) and western sunflower (*Helianthus occidentalis*), which are listed as indicators of dry-mesic prairie in Wisconsin by Curtis (1959) and are common in Michigan dry-mesic prairies, may be suitable indicator species for dry-mesic prairie in Michigan.

Other Noteworthy Species: Rare plant species associated with dry-mesic prairie are listed below along with their status, which is indicated by the following abbreviations: X, extirpated from state; E, State Endangered; T, State Threatened; SC, State Species of Special Concern; LE, Federally Endangered.

Scientific Name	**Common Name**	**Status**
Amorpha canescens	lead-plant	SC
Baptisia lactea	white false indigo	SC
Carex inops ssp. *heliophila*	sun sedge	SC
Cirsium hillii	Hill's thistle	SC
Coreopsis palmata	prairie coreopsis	T
Echinacea purpurea	purple coneflower	X
Gentiana flavida	white gentian	E
Panicum leibergii	Leiberg's panic grass	T
Scleria triglomerata	tall nut-rush	SC
Viola pedatifida	prairie birdfoot violet	T

Rare animal species associated with dry-mesic prairie include the following:

Grassland Birds: Henslow's sparrow (*Ammodramus henslowii*) (E), grasshopper sparrow (*Ammodramus savannarum*) (SC), short-eared owl (*Asio flammeus*) (E), long-eared owl (*Asio otus*) (T), northern harrier (*Circus cyaneus*) (SC), migrant loggerhead shrike (*Lanius ludovicianus migrans*) (E), dickcissel (*Spiza americana*) (SC), western meadowlark (*Sturnella neglecta*) (SC), and barn owl (*Tyto alba*) (E).

Insects: blazing star borer (*Papaipema beeriana*) (SC), phlox moth (*Schinia indiana*) (E), leadplant flower moth (*Schinia lucens*) (E), red-legged spittlebug (*Prosapia ignipectus*) (SC), Sprague's pygarctia (*Pygarctia spraguei*) (SC), American burying beetle (*Nicrophorus americanus*) (X/LE), pinetree cricket (*Oecanthus pini*) (SC), and regal fritillary (*Speyeria idalia*) (E).

Mammals: prairie vole (*Microtus ochrogaster*) (E).

Reptiles: eastern massasauga (*Sistrurus c. catenatus*) (SC and Federal Candidate Species), gray ratsnake (*Pantherophis spiloides*) (SC), and eastern box turtle (*Terrapene c. carolina*) (SC). Spotted turtle (*Clemmys guttata*) (T) and Blanding's turtle (*Emydoidea blandingii*) (SC) may nest in dry-mesic prairie when it occurs adjacent to wetlands.

Conservation and Biodiversity Management: Efforts should be made to identify, protect, and manage remnants of dry-mesic prairie where they occur. Several studies to identify prairie remnants in Michigan have been undertaken and most remnants are very small and/or occur as narrow strips adjacent to railroads (Scharrer 1972, Thompson 1970, 1975 and 1983, Chapman 1984). The small size and poor landscape context of most remnant dry-mesic prairies makes large-scale restoration of existing prairies nearly impossible. Prairie plantings located in areas of former dry-mesic prairie in southwestern Lower Michigan are particularly needed.

Managing dry-mesic prairie requires frequent burning, from annual to every two to three years. Longer burn intervals will result in tree and tall shrub encroachment. Prescribed burning is required to protect and enhance plant species diversity and prevent encroachment of trees and tall shrubs, which outcompete light-demanding prairie plants. In prairie remnants where fire has been excluded for long periods (e.g., decades), local extinctions of plant species are common (Leach and Givnish 1996).

Photo by Michael A. Kost

Dry-mesic prairie remnants in Michigan are largely restricted to railroad rights-of-way.

In addition to prescribed fire, brush cutting accompanied by herbicide application to cut stumps is an important component of prairie restoration. While fires frequently kill woody seedlings, long established trees and tall shrubs like black cherry (*Prunus serotina*) and dogwoods (*Cornus* spp.) typically resprout and can reach former levels of dominance within two to three years. Herbicide application to cut stumps will prevent resprouting.

To reduce the impacts of management on fire-intolerant species it will be important to consider a rotating schedule of prescribed burning in which adjacent management units are burned in alternate years. This is especially important when planning burns in open grasslands such as dry-mesic prairie. Insect species that are restricted to these habitats have already experienced severe losses in the amount of available habitat due to forest succession brought on by years of fire suppression. By burning adjacent management units in alternate years, insect species from unburned units may be able to recolonize burned areas (Panzer et al. 1995). Avian species diversity is also thought to be enhanced by managing large areas as a mosaic of burned and unburned patches (Herkert et al. 1993).

Prairie ants (*Formica*) are an extremely important component of grassland communities and research indicates that they respond with population increases to restoration activities, especially prescribed fire (Trager 1998). Prescribed burning precipitates changes in the dominance of ant species from carpenter and woodland ants (*Camponotus* and *Aphaenogaster*) to prairie ants because it reduces woody vegetation and detritus used by the arboreal and litter- and twig-nesting species in favor of species restricted to grassland habitats (Trager 1998). Restorations involving prairie plantings near old fields or remnant prairies are typically colonized by several species of prairie ants within a few years (Trager 1990).

Controlling invasive species is a critical step in restoring and managing dry-mesic prairie. By outcompeting native species, invasives alter vegetation structure, reduce species diversity, and upset delicately balanced ecological processes such as trophic relationships, interspecific competition, nutrient cycling, soil erosion, hydrologic balance, and solar insolation (Bratton 1982, Harty 1986). At present some of the most aggressive invasive species that threaten biodiversity of grassland communities include reed canary grass (*Phalaris arundinacea*), spotted knapweed (*Centaurea maculosa*), white and yellow sweet clover (*Melilotus alba* and *M. officinalis*), autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), common buckthorn (*Rhamnus cathartica*), Eurasian honeysuckles (*Lonicera maackii*, *L. morrowii*, *L. tatarica*, *L.* x *bella*.), and black locust (*Robinia pseudoacacia*).

In addition to reestablishing ecological processes such as prescribed fire, most restoration sites will require the reintroduction of appropriate native species and genotypes. Plants can be reintroduced through both seeding and seedling transplants. Small, isolated prairie remnants may harbor plant populations that have suffered from reduced gene flow. Restoration efforts at isolated prairie remnants should consider introducing seeds collected from nearby stocks to augment and maintain genetic diversity of remnant plant populations. The Michigan Native Plant Producers Association may be a helpful resource for locating sources of Michigan genotypes (http://www.nohlc.org/MNPPA.htm).

Several helpful guides are available for restoring prairies and starting prairie plants from seed (Packard and Mutel 1997, Nuzzo 1976, Schulenberg 1972). See Packard and Mutel (1997) for a comprehensive treatment of the subject and additional references.

Restoration and management of grasslands such as dry-mesic prairie are critically important to grassland birds, which have suffered precipitous population declines due to habitat loss and changing agricultural practices (e.g., early mowing of hay fields). Detailed habitat management guidelines for grassland birds have been developed by Herkert et al. (1993) and Sample and Mossman (1997). Listed below are several of the recommendations suggested by Herkert et al. (1993) (see publication for complete list of management guidelines).

1. Avoid fragmentation of existing grasslands.
2. Grassland restorations aimed at supporting populations of the most area-sensitive grassland birds should be at least 125 acres and preferably more than 250 acres in size. Area sensitive species requiring large patches of grassland (>100 acres) include northern harrier (SC), bobolink (*Dolichonyx oryzivorus*), savannah sparrow (*Passerculus sandwichensis*), Henslow’s sparrow (SC), grasshopper sparrow (SC), eastern meadowlark (*Sturnella magna*), western meadowlark (SC), sedge wren (*Cistothorus platensis*), sharp-tailed grouse (*Pedioecetes phasianellus*), upland sandpiper (*Bartramia longicauda*), short-eared owl (E), and barn owl (E) (Herkert et al. 1993, Sample and Mossman 1997). Patches of grassland less than 50 acres will benefit the least area-sensitive grassland birds such as northern bobwhite (*Colinus virginianus*), red-winged black bird (*Agelaius phoeniceus*), American goldfinch (*Carduelis tristis*), Vesper sparrow (*Pooecetes gramineus*), field sparrow (*Spizella pusilla*), song sparrow (*Melospiza melodia*), dickcissel (SC), and common yellowthroat (*Geothlypis trichas*) (Herkert et al. 1993).
3. Maximize interior grassland habitat by establishing circular (best) or square grassland plantings and avoiding long, narrow plantings, which increase edge habitat.
4. Where grassland habitats border forests, strive to create a feathered edge by allowing prescribed fires to burn through adjacent forests as opposed to installing firebreaks along the forest edge. Grasslands with feathered edges experience lower rates of nest predation than those with sharply contrasting edges (Ratti and Reese 1988).

Research Needs: Remaining remnants of dry-mesic prairie need to be identified, protected, and managed. Further research on the historical plant species composition of dry-mesic prairie in Michigan would be useful for developing seed mixes for restoration. Genetic studies of the effects of small, isolated populations on plant species genetic diversity will provide information on managing remnants of dry-mesic prairie. Research on the utilization of restored and remnant prairies by grassland birds will provide useful information for understanding how dry-mesic prairies contribute to biodiversity. Studies on methods of prairie establishment and management, including controlling invasive species, will benefit both ongoing and new efforts to restore dry-mesic prairie. Conservation and management efforts will benefit from further study of how species composition is influenced by fire frequency, intensity, and periodicity.

Similar Communities: oak openings, dry sand prairie, hillside prairie, mesic sand prairie, oak barrens, bur oak plains, and mesic prairie.

Other Classifications: Michigan Natural Features Inventory Circa 1800s Vegetation (MNFI): Grassland.

Michigan Department of Natural Resources (MDNR): G

The Nature Conservancy U.S. National Vegetation Classification and International Classification of Ecological Communities (Faber-Langendoen 2001, NatureServe 2004): Michigan dry-mesic prairie is not recognized as a separate prairie type but is instead lumped with oak openings.

CODE; ALLIANCE; ASSOCIATION; COMMON NAME

V.A.6.N.c.2; *Quercus macrocarpa* – (*Quercus alba*) Wooded Herbaceous Alliance; *Quercus alba* – *Quercus macrocarpa / Andropogon gerardii* Wooded Herbaceous Vegetation; White Oak – Bur Oak Openings

Related Abstracts: oak openings, dry sand prairie, oak barrens, bur oak plains, mesic prairie, Culver's root borer, eastern box turtle, eastern massasauga, Henslow's sparrow, migrant loggerhead shrike, northern harrier, and red-legged spittlebug.

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