

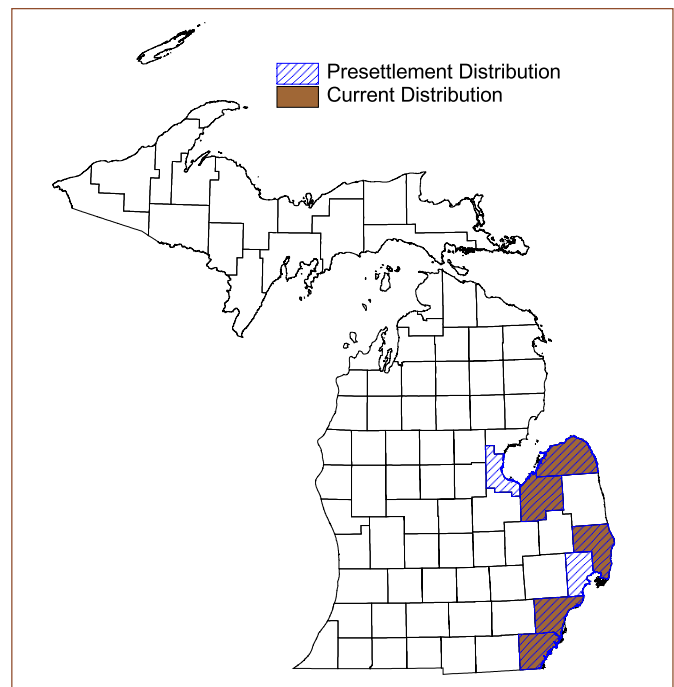


Photo by Kim Herman

Overview: Lakeplain oak openings occur within glacial lakeplains on sand ridges, level sandplains, or adjacent depressions. This fire-dependent savanna type is dominated by oaks and has a graminoid-dominated ground layer of species associated with both lakeplain prairie and forest communities.

Global and State Rank: G2?/S1

Range: Barrens and prairie plant communities reached their maximum coverage in Michigan approximately 4,000-6,000 years before present, when postglacial climatic conditions were warmer and drier than now. At this time, xerothermic conditions allowed for the invasion of fire-dependent, xeric vegetation types into large portions of the Lower Peninsula and some sections of the Upper Peninsula. With the subsequent shift of more mesic climatic conditions southward, there has been a recolonization of mesic vegetation throughout Michigan. The distribution of fire-dominated communities, such as lakeplain oak openings, has been reduced typically to isolated patches concentrated south of the climatic tension zone. Lakeplain oak openings occur on the lakeplain of the southern Great Lakes, in southeastern Michigan, southwestern Ontario, Canada, and possibly in southeastern Wisconsin (Faber-Langendoen 2001, Kost et al. 2007, NatureServe 2007). In the 1800s, Michigan's lakeplain oak openings were located on the glacial lakeplain along the shoreline of Lake



Huron in Saginaw Bay, within the St. Clair River Delta, and near Lake Erie (Comer et al. 1995). Presently the distribution of this community has been reduced to degraded remnants throughout the original range.

Rank Justification: At the time of European settlement, oak savanna communities covered some 27-32 million



acres of the Midwest. Presently oak savanna remnants occur on just 0.02% of their presettlement extent (Nuzzo 1986). The notes of the original land surveyors of Michigan reveal that prior to European settlement in the 1800s, lakeplain oak openings covered approximately 76,411 acres or 0.20% of the state. This acreage was distributed patchily across the thumb region (Huron, Bay, and Tuscola Counties) and in several lakeplain counties (Macomb, Monroe, Oakland, St. Clair, and Wayne). Surveyors' notes indicate that high concentrations of lakeplain oak openings occurred in Monroe County (63% or 47,766 acres) and Wayne County (26% or 19,707 acres). Today just over a thousand acres of lakeplain oak openings remain in Michigan, with sizable, restorable remnants in Monroe, St. Clair, and Wayne Counties. A total of 11 lakeplain oak openings have been identified in Michigan, ranging in size from 3 to 500 acres and totaling 1,550 acres or less than 0.004% of the surface area of Michigan. The largest concentration of lakeplain oak opening remnants occur in southwest Wayne County and on and near the St. Clair River Delta in St. Clair County. Because of their proximity to the Detroit metropolitan area, these lakeplain oak openings and associated lakeplain prairie remnants are experiencing extreme development pressure.

Remaining occurrences have been degraded by alterations of the groundwater hydrology and fire suppression, both resulting in increased encroachment by woody species and succession to shrub and forest communities. Most lakeplain oak openings were cleared for agriculture, and either residential or industrial development (Chapman et al. 1995). Lakeplain oak openings occurring in wet depressions were frequently drained along with surrounding lakeplain prairie. The construction of extensive drainage networks to promote agriculture and residential development has lowered the water table in most of the historical range of lakeplain prairies and lakeplain oak openings. Wildfire suppression policies instituted in the 1920s in concert with hydrologic manipulation, road construction, expansion of towns, and increased agriculture caused a dramatic decrease in fire frequency and intensity (Abrams 1992). Alteration of the historical fire and hydrologic regime has shifted much of the lakeplain oak openings into woodlands and forest (Faber-Langendoen 1993), characterized by increased shrub dominance, scant oak advanced regeneration, and a vanishing graminoid component (Chapman et al. 1995, Michigan Natural Features Inventory 1995). In addition, timber exploitation of oaks in the 1920s further destroyed or degraded lakeplain

oak openings across Michigan. In addition to simplified overstory structure, these communities are often depauperate in floristic diversity as the result of fire suppression and hydrologic alteration and subsequent woody encroachment, livestock grazing, off-road vehicle activity, and the invasion of exotic species (Michigan Natural Features Inventory 1995).

Landscape and Abiotic Context: Michigan's glacial lakeplains formed at the margins of melting lobes of the Wisconsin ice sheet. In southeast Lower Michigan, glacial lake deposits of clay are up to 100 meters thick over Paleozoic bedrock, with deposits thickest at their inland extremes and thinnest along the Lake St. Clair and Lake Erie shorelines (Albert 1995). Poorly drained mineral soils characterize most of the clay plain. These clay plains extend inland 30 to 40 miles (50 to 66 km) along the margins of Lake Erie, Lake Michigan, Lake St. Clair, and Lake Huron's Saginaw Bay. Within the clay lakeplains, several broad sand channels formed where glacial meltwater streams carried sand into the shallow proglacial lakes. These sand channels can be several miles wide but the sand in them is typically only one to three meters thick. A series of excessively drained sand beach ridges and dunes are found throughout these lakeplains. Adjacent swales have poorly drained soils. A large delta with both clay and sand deposits is located at the mouth of the St. Clair River.

Lakeplain oak openings typically occur on these dune features, with a wet variant occurring in the swales. Soils are typically mildly alkaline (pH 7.4-7.8), very fine sandy loams, loamy sands, or sands with moderate water-retaining capacity. Lakeplain oak openings occur less commonly on silty/clayey glacial lakeplains with seasonally high water tables. Historically, lakeplain oak openings occurred in complex mosaics with sand flatwoods (pin oak-swamp white oak), elm-ash-maple swamps, lakeplain wet prairie, lakeplain wet-mesic prairie, and lakeplain mesic prairie, all typical plant communities of poorly drained lakeplain.

Lakeplain oak openings are distributed in Michigan's Region I, Southern Lower Michigan (Albert et al. 1986). This region has a warm, temperate, rainy to cool, snow-forest climate with hot summers and no dry season. The daily maximum temperature in July ranges from 29° to 32° C (85° to 90° F), and the daily minimum temperature in January ranges from -9° to -4° C (15° to 25° F). The number of freeze-free days is between 120 and 220, and the average number of days per year with snow cover of 2.5 cm or more is between 10



and 60. The mean annual total precipitation for Region I is 820 mm (Albert et al. 1986, Barnes 1991).

Natural Processes: Lakeplain oak openings persist when fire, hydrology, and/or drought prevent canopy closure. The character of lakeplain oak openings can differ dramatically, primarily as the result of varying fire intensity and frequency, which are influenced by climatic conditions, soil texture, topography, and landscape context (i.e., proximity to water bodies and fire-resistant and fire-conducting plant communities) (Bowles et al. 1994, Chapman et al. 1995). Infrequent, high-intensity fires kill mature oaks and produce barrens with abundant scrubby oak sprouts. Park-like barrens, with widely spaced trees and an open grass understory, are maintained by frequent, low-intensity fires, which occur often enough to restrict maturation of oak seedlings (Chapman et al. 1995, Faber-Langendoen and Davis 1995, Peterson and Reich 2001). Frequent, low-intensity fires also maintain high grass and forb diversity by deterring the encroachment of woody vegetation and limiting single species dominance. Absence of fire in lakeplain oak openings causes increased litter layer and fuel loads, decreased herb diversity, increased canopy and subcanopy cover, invasion of fire-intolerant species, and ultimately the formation of a closed-canopy oak community, often within 20-40 years (Curtis 1959, Chapman et al. 1995, Faber-Langendoen and Davis 1995). Presently, the prevalent catalyst of fires is lightning strike, but historically Native Americans played an integral role in the fire regime, accidentally and/or intentionally setting fire to prairie ecosystems (Day 1953, Chapman 1984). It remains unclear whether lightning strikes or Native American activities had a more significant role in the historical maintenance of lakeplain oak openings (Hayes 1964, Faber-Langendoen and Maycock 1987). Native Americans utilized dune ridges on the lakeplain for settlements and trails (Jones and Knapp 1972, Comer et al. 1995), and it is quite likely that fires periodically resulted from this use, spreading to adjacent oak openings and grassland. One indication of the significance of fire on the lakeplain is the fact that many of the historical oak openings located along the beach ridges have become closed-canopy oak forests during the last century of fire suppression; large-diameter, open-grown oaks persist in these forests, surrounded by smaller, younger trees.

While the hydrological interactions of lakeplain oak openings and surrounding lakeplain prairie are not well understood, seasonally high water plays an important role in maintaining those lakeplain oak openings growing in lower areas

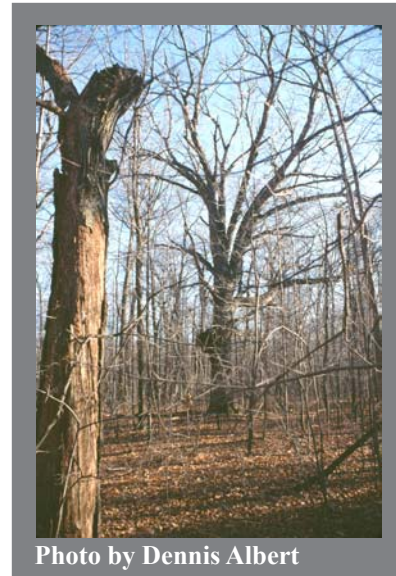


Photo by Dennis Albert

Suppression of fire and flooding in lakeplain oak openings results in woody species encroachment and eventually canopy closure.

(Chapman et al. 1995). High seasonal water table of lakeplains was a significant factor on the presettlement landscape. However, the hydrologic regime of the Michigan lakeplain has been drastically altered. Many lakeplain landscapes are artificially ditched and drained. In addition, beaver activity has been eliminated for well over 100 years. Before settlement, beaver were abundant on first through fourth order streams where they could impound flowing water (Naiman et al. 1988). The fur trade had decimated beaver populations in the Midwest by the mid-1800s. Hubbard (1888) was told by Indians that beaver, formerly abundant in the southeast Michigan lakeplain, created wet prairies by damming streams. On lakeplains and outwash plains with streams, beaver would have dramatically influenced the landscape by expanding wetland area, preventing the encroachment of woody species in seasonally flooded areas, and creating barriers to fire.

Vegetation Description: Within glacial lakeplains there are two prominent forms of lakeplain oak openings that occur interspersed through ridge and swale topography. In both types, *Quercus* spp. dominate the tree canopy layer, and grasses and sedges make up the majority of the ground layer. The dry-mesic type occurs on droughty beach ridges and is typically dominated by *Quercus velutina* (black oak) and *Quercus alba* (white oak). The wet-mesic type, found on flat, poorly drained areas, is dominated by *Quercus macrocarpa* (bur oak), *Quercus palustris* (pin oak), and *Quercus bicolor* (swamp white oak) with a ground layer



similar to lakeplain wet prairie and lakeplain wet-mesic prairie. The canopy often contains *Acer rubrum* (red maple), *Acer saccharinum* (silver maple), *Fraxinus pennsylvanica* (green ash), and/or *Populus deltoides* (cottonwood). The canopy of this community can be very open. In southwestern Ontario, Bakowsky (1988) described the average canopy as 33% cover and average density of trees greater than 6 cm dbh as 92 trees/ha (Faber-Langendoen 2001, NatureServe 2007). Prevalent species of the subcanopy include: *Carya* spp. (hickory species), *Cornus* spp. (dogwood species), *Corylus americana* (American hazelnut), *Fraxinus pennsylvanica* (especially where fire is suppressed), *Prunus* spp. (cherry species), and *Sassafras albidum* (sassafras). Characteristic shrubs of the sandy ridges include: *Amelanchier* spp. (serviceberry), *Arctostaphylos uva-ursi* (bearberry), *Ceanothus americanus* (New Jersey tea), *Comptonia peregrina* (sweetfern), *Cornus foemina* (gray dogwood), *Corylus americana*, *Corylus cornuta* (beaked hazelnut), *Crataegus* spp. (hawthorn species), *Gaultheria procumbens* (wintergreen), *Gaylussacia baccata* (huckleberry), *Prunus americana* (wild plum), *Prunus virginiana* (choke cherry), *Prunus pumila* (sand cherry), *Rhus copallina* (shining sumac), *Rhus typhina* (staghorn sumac), *Rosa carolina* (pasture rose), *Rubus flagellaris* (northern dewberry), *Salix humilis* (prairie or upland willow), *Vaccinium angustifolium* (low sweet blueberry),



Photo by Kim Herman

and *Vaccinium myrtilloides* (Canada blueberry). Prevalent shrubs in moist swale lakeplain oak openings include: *Aronia melanocarpa* (chokeberry), *Cephalanthus occidentalis* (buttonbush), *Cornus amomum* (pale dogwood), *Cornus stolonifera* (red-osier dogwood), *Ilex verticillata* (Michigan holly), *Salix eriocephala* (willow), and *Salix myricoides* (blueleaf willow).

The ground layer is dominated by graminoids and forbs. Common species include: *Andropogon gerardii* (big bluestem), *Calamagrostis canadensis* (blue joint grass), *Carex pensylvanica* (Pennsylvania sedge), *Schizachyrium scoparium* (little bluestem), and *Sorghastrum nutans* (Indian grass). Prevalent herbs of the droughty beach ridges include: *Aster oolentangiensis* (sky-blue aster), *Aureolaria* spp. (false foxglove), *Coreopsis lanceolata* (tickseed), *Cyperus filiculmis* (nut grass), *Danthonia spicata* (poverty oats), *Deschampsia flexuosa* (hair grass), *Euphorbia corollata* (flowering spurge), *Helianthus divaricatus* (tall sunflower), *Koeleria macrantha* (June grass), *Krigia biflora* (dwarf dandelion), *Lathyrus ochroleucus* (white pea), *Lespedeza hirta* (hairy lespedeza), *Liatris aspera* (blazing star), *Liatris cylindrica* (dwarf blazing star), *Lupinus perennis* (wild lupine), *Monarda fistulosa* (wild bergamot), *Panicum implicatum* (panic grass), *Pedicularis canadensis* (wood betony), and *Stipa spartea* (needle grass). Lakeplain oak openings occurring in flat, poorly drained areas can support a wide range of herbaceous species characteristic of lakeplain prairies, for example: *Andropogon gerardii*, *Calamagrostis canadensis*, *Carex stricta* (sedge), *Carex aquatilis* (sedge), *Cladium mariscoides* (twig-rush), *Juncus balticus* (rush), *Panicum virgatum* (switch grass), *Pedicularis lanceolata* (swamp-betony), *Potentilla fruticosa* (shrubby cinquefoil), *Pycnanthemum virginianum* (common mountain mint), *Schizachyrium scoparium*, *Spartina pectinata* (cordgrass), *Solidago ohioensis* (Ohio goldenrod), *Solidago riddellii* (Riddell's goldenrod), *Sorghastrum nutans*, and *Vernonia* spp. (ironweed species).

In the absence of fire and with the prevalence of anthropogenic disturbance such as logging, ditching and draining, off-road vehicle recreation, and livestock grazing, the following exotic species may be dominant components of the herbaceous layer of lakeplain oak openings: *Agropyron repens* (quack grass), *Agrostis stolonifera* (creeping bent), *Asparagus officinalis* (wild asparagus), *Centaurea maculosa* (spotted knapweed), *Hieracium* spp. (hawkweeds), *Hypericum perforatum* (St. John's-wort), *Poa compressa* (Canada bluegrass), *Poa pratensis* (Kentucky bluegrass), *Rumex acetosella* (sheep sorrel), and *Tragopogon dubius* (goat's beard).

Michigan indicator species:

Spring/Early Summer

Dry: *Comandra umbellata* (bastard toadflax), *Coreopsis*



lanceolata (lanceolate coreopsis), *Lithospermum canescens* (hoary puccon), *Lupinus perennis*, *Krigia biflora*, *Pedicularis canadensis*, *Potentilla simplex* (common cinquefoil), *Senecio plattensis* (prairie ragwort), and *Stipa spartea*.

Wet: *Carex aquatilis*, *Carex pellita* (sedge), and *Carex stricta*.

Summer

Dry: *Anemone cylindrica* (thimbleweed), *Asclepias tuberosa* (butterfly weed), *Asclepias verticillata* (whorled milkweed), *Ceanothus americanus*, *Helianthus occidentalis* (woodland sunflower), *Helianthus divaricatus*, *Linum sulcatum* (furrowed flax, state special concern), *Monarda punctata* (horsemint), *Monarda fistulosa*.

Wet: *Aletris farinosa* (colic root), *Calamagrostis canadensis*, *Cladium mariscoides*, *Juncus balticus*, and *Potentilla fruticosa*.

Fall

Dry: *Andropogon gerardii*, *Aristida purpurascens* (three awn grass), *Aster oolentangiensis*, *Aster ericoides* (many flowered aster), *Aureolaria flava* (false foxglove), *Aureolaria pedicularia* (false foxglove), *Aureolaria virginica* (false foxglove), *Coreopsis tripteris* (tall coreopsis), *Liatris aspera* (rough blazing star), *Liatris cylindracea* (dwarf blazing star), *Schizachyrium scoparium*, *Solidago speciosa* (showy goldenrod), *Solidago rigida* (stiff goldenrod), and *Sorghastrum nutans*.

Wet: *Asclepias incarnata* (swamp milkweed), *Liatris spicata* (marsh blazing star), *Silphium terebinthinaceum* (prairie dock), and *Spartina pectinata*.

Other noteworthy species: Rare plants associated with lakeplain oak openings include: *Agalinis gattingeri* (Gattinger's gerardia), *Agalinis skinneriana* (Skinner's gerardia), *Angelica venenosa* (hairy angelica), *Arabis missouriensis* var. *deamii* (Missouri rock-cress), *Aristida longispica* (three-awned grass), *Asclepias purpurascens* (purple milkweed), *Astragalus neglectus* (Cooper's milk-vetch), *Carex richardsonii* (Richardson's sedge), *Leucospora multifida* (conobea), *Eupatorium sessilifolium* (upland boneset), *Euphorbia commutata* (tinted spurge), *Gentiana puberulenta* (downy gentian), *Helianthus hirsutus* (whiskered sunflower), *Helianthus mollis* (downy sunflower), *Hieracium paniculatum* (panicled hawkweed), *Hypericum gentianoides* (gentian-leaved St. John's-wort), *Lechea minor* (least pinweed), *Linum sulcatum* (furrowed flax), *Polygala cruciata* (cross-leaved milkwort), *Scirpus*

clintonii (Clinton's bulrush), *Scleria pauciflora* (few-flowered nut-rush), *Scleria triglomerata* (tall nut-rush), *Spiranthes ochroleuca* (yellow ladies'-tresses), *Sporobolus clandestinus* (dropseed), and *Tradescantia virginiana* (Virginia spiderwort).

Lakeplain oak openings and surrounding lakeplain prairie habitat share a rich diversity of invertebrates including numerous butterflies, skippers, grasshoppers, and locusts. However, the fragmented and degraded status of midwestern oak openings/savannas and prairies has resulted in the drastic decline of numerous insect species associated with dry, open habitats or obligates of savanna and prairie host plants (Chapman et al. 1995). Rare butterflies, skippers, and moths include: *Atrytonopsis hianna* (dusted skipper), *Erynnis baptisiae* (wild indigo dusky wing), *Erynnis p. persius* (persius duskywing), *Euphyes dukesi* (Duke's skipper), *Lycaeides melissa samuelis* (Karner blue), *Papaipema maritima* (maritime sunflower borer), *Papaipema sciata* (Culver's root borer), and *Papaipema silphii* (Silphium borer moth). Other rare invertebrates include *Lepyronia gibbosa* (Great Plains spittlebug), and *Prosapia ignipectus* (red-legged spittlebug).

Numerous songbirds utilize lakeplain oak openings. Rare species include *Ammodramus savannarum* (grasshopper sparrow, state special concern) and *Dendroica discolor* (prairie warbler, state endangered). Typical songbirds include: *Melospiza lincolnii* (Lincoln's sparrow), *Passerina cyanea* (indigo bunting), *Poocetes gramineus* (vesper sparrow), *Sial sialis* (eastern bluebird), *Spizella passerina* (chipping sparrow), *Spizella pusilla* (field sparrow), *Toxostoma rufum* (brown thrasher), *Vermivora pinus* (blue-winged warbler), and *Vermivora ruficapilla* (Nashville warbler). Additional avian species that utilize this habitat include: *Accipter striatus* (sharp-shinned hawk), *Bartamia longicauda* (upland sandpiper), *Bonasa umbellus* (ruffed grouse), *Buteo jamaicensis* (red-tailed hawk), *Carduelis tristis* (American goldfinch), *Charadrius vociferus* (killdeer), *Falco sparverius* (American kestrel), *Icterus galbula* (Baltimore oriole), *Melanerpes erythrocephalus* (red-headed woodpecker), *Meleagris gallopavo* (wild turkey), *Otus asio* (Eastern screech-owl), *Tyrannus tyrannus* (Eastern kingbird), and *Zenaida macroura* (mourning dove). Savanna restoration with prescribed fire in Minnesota resulted in the increase in the abundance of open-country bird species, including many species that have been declining in central and eastern North America (Davis et al. 2000).



Cryptotis parva (least shrew, state threatened) and *Microtus ochrogaster* (prairie vole, state endangered) are rare mammals that may be found in lakeplain oak openings. Additional mammals commonly associated with this community include: *Canis latrans* (coyote), *Microtus pennsylvanicus* (meadow vole), *Odocoileus virginianus* (white-tailed deer), *Sciurus niger* (fox squirrel), *Spermophilus tridecemlineatus* (thirteen-lined ground squirrel), *Taxidea taxus* (badger), *Vulpes vulpes* (red fox), and *Zapus hudsonia* (jumping meadow mouse).

Several rare reptiles are known from this community type. They include: *Elaphe o. obsoleta* (black rat snake, state special concern), *Elaphe vulpina gloydi* (eastern fox snake, state threatened), *Sistrurus c. catenatus* (eastern massasauga, state special concern, federal candidate species), and *Terrapene c. carolina* (eastern box turtle, state special concern). Some common amphibians and reptiles include: *Bufo a. americanus* (eastern American toad), *Bufo fowleri* (Fowler's toad), *Heterodon platirhinus* (eastern hog-nosed snake), and *Opheodrys vernalis* (smooth green snake).

Conservation/management: Where remnants of lakeplain oak openings persist, the use of prescribed fire and restoration of hydrologic processes is imperative for maintaining an open canopy, promoting high levels of grass and forb diversity, and deterring the encroachment of woody vegetation and invasive exotics. In areas where seasonal flooding has been diminished by extensive drainage networks, the filling of ditches can contribute to the restoration of hydrologic processes. The hydrological interactions of lakeplain oak openings and surrounding lakeplain prairie are not well understood, so restoration management will need to be experimental. Numerous studies in oak savanna systems have indicated that fire intervals of 1-3 years bolster graminoid dominance, increase overall grass and forb diversity, and remove woody cover of saplings and shrubs (White 1983, Tester 1989). Burning at longer time intervals will allow for woody plant seedling establishment and persistence. Where rare invertebrates are a management concern, burning strategies should allow for ample refugia to facilitate effective postburn recolonization (Michigan Natural Features Inventory 1995, Siemann et al. 1997).

Though most of the historical lakeplain oak openings have been degraded, there is opportunity for restoration of this community type. Plant species of lakeplain oak openings

can persist through cycles of canopy closure and removal (Chapman et al. 1995). The occurrence of oak savanna indicator species in closed-canopy forests reveals the presence of a native seedbank and highlights that area as a target for restorative management. Also indicative of a site's potential for restoration is the prevalence of oak "wolf trees." "Wolf trees" are large open-grown trees with wide-spreading limbs that are often associated with lakeplain oak opening plants or seedbank (Michigan Natural Features Inventory 1995).

Where canopy closure has degraded the savanna character, one can restore lakeplain oak openings by selectively cutting the majority of trees (White 1986), leaving an average of 4 trees/acre. Degraded lakeplain oak openings that have been long deprived of fire often contain a heavy overstory and understory component of shade tolerant species such as *Acer rubrum* (red maple) and *Fraxinus pennsylvanica* (green ash), which can be removed by mechanical thinning, herbiciding, or girdling (Michigan Natural Heritage Program 2000, Peterson and Reich 2001). Restored sites will need to be maintained by periodic prescribed fire and may require investment in native plant seeding where seed and plant banks are inadequate (Packard 1988). Depending on the physiognomic target of the management, one can manipulate the intensity, seasonality, and frequency of the prescribed burns: low-intensity and high-frequency burns for the park-like end of the opening continuum, and low-frequency and high-intensity burns for shrubby lakeplain oak openings. Fall burns typically are slow moving, low-intensity fires due to high relative humidity and slow wind speed, while late spring and summer burns are often more intense due to higher wind speeds and lower relative humidity (King 2000). Summer burning can be employed to simulate naturally occurring lightning season burns. Early spring burns often carry irregularly through lakeplain oak openings influenced by high spring water tables. Such patchy burns can be useful for establishing refugia for fire-sensitive species and may permit oak seedling establishment (Chapman et al. 1995). Patchy burns are often the result of frequent low-intensity fires, which carry sporadically through areas with low fuel loads. In contrast, infrequent fires are often more uniform in coverage, spreading evenly through areas of high fuel accumulation (Ladd 1991).

In areas where fire is undesirable or unfeasible, mowing or selective cutting can be utilized and should be conducted in late fall or winter to minimize detrimental impact to herbaceous species and rare invertebrates (Chapman et al.



1995, Michigan Natural Features Inventory 1995, King 2000). Management of lakeplain oak openings should be orchestrated in conjunction with management of adjacent communities such as lakeplain wet prairie or lakeplain wet-mesic prairie.

Research needs: As noted by Nuzzo (1986), Minc and Albert (1990), Faber-Langendoen (1993), and Bowles and McBride (1994), no single definition of Midwest oak savanna or oak openings is universally accepted, and numerous distinct community types have been lumped under the phrase “Midwest oak savanna.” Misunderstanding and misuse of the term can be alleviated by the continued refinement of regional classifications that correlate species composition, site productivity, ecological process, and landscape context. Understanding spatial and temporal variability of lakeplain oak openings is also crucial for determining the direction of management.

Management of lakeplain oak opening remnants can be determined by site-specific research of site characteristics and presettlement composition and structure (Minc and Albert 1990, Bowles et al. 1994, Bowles and McBride 1998). Investigation into the frequency, periodicity (seasonality), and intensity of fire and flooding events in lakeplain oak openings is needed to guide restoration and management activities. In addition, because limitations imposed by safety concerns can hamper the effectiveness of prescribed fire, maintaining the ecological integrity of lakeplain oak openings requires experimentation with different disturbance combinations (King 2000). Effects of management need to be monitored to allow for assessment and refinement.

Since all of Michigan’s lakeplain oak openings are degraded, it is essential to determine what role seedbanks, vegetative reproduction, and external seed sources play in restoration of remnant barrens. Numerous rare insects have host plants occurring on lakeplain oak openings. The effects of fire, flooding, and alternative management techniques on rare faunal populations and their host vegetation need to be studied (Chapman et al. 1995, Siemann et al. 1997). In addition, because of the daunting problem of exotic species encroachment, research needs to identify strategies to minimize invasive species introduction and dominance.

Similar communities: Lakeplain wet prairie, lakeplain wet-mesic prairie, bur oak plains, dry sand prairie, dry southern forest, oak barrens, oak openings, oak-pine barrens, and pine barrens.

Other Classifications:

Michigan Natural Features Inventory Presettlement Vegetation (MNFI):

Black Oak Barren and Mixed Oak Savanna

Michigan Department of Natural Resources (MDNR): G-grass and O0(zero)-oak with <100 trees per acre.

Michigan Resource Information Systems (MIRIS): 33 (Pine or Oak Opening), 412 (Central Hardwood), 4122 (White Oak), 4123 (Black Oak), 4129 (Other Oak).

The Nature Conservancy National Classification:

CODE; ALLIANCE; ASSOCIATION; COMMON NAME

V.A.6.N.c.2.; *Quercus macrocarpa* - (*Quercus alba*)
Wooded Herbaceous Alliance; *Quercus macrocarpa*
- *Quercus palustris* – *Quercus bicolor* /
Calamagrostis canadensis Wooded Herbaceous
Vegetation; Lakeplain Wet-Mesic Oak Openings

II.B.2.N.a.12.; *Quercus alba* - (*Quercus velutina*)
Woodland Alliance; *Quercus alba* – *Quercus*
velutina - *Quercus palustris* / *Carex pennsylvanica*
Woodland; Lakeplain Mesic Oak Woodland

Related Abstracts: Culver’s root borer, Hill’s thistle, karner blue butterfly, lakeplain wet-mesic prairie, lakeplain wet prairie, bur oak plains, dry sand prairie, oak barrens, oak openings, oak-pine barrens, pine barrens, prairie smoke, and red-legged spittlebug.

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