

NATURAL FEATURES SUMMARY OF COMPARTMENT 20 ALLEGAN STATE GAME AREA



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Cover Photo: Crooked Lake in Compartment 20 is one of the region's most significant coastal plain marshes with documented populations of several rare plant species. October 2017. Photos throughout the document by Jesse M. Lincoln unless stated.

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INTRODUCTION

Allegan State Game Area (ASGA, Figure 1) is one of the largest continuous blocks of public land in southern Michigan, consisting of 50,656 acres. Because the landscape surrounding ASGA is dominated by agriculture and rural development, the large area of natural cover within the game area serves as an important island of biodiversity for the local region.

Ongoing survey efforts of state game areas have improved knowledge about the location and integrity of a variety of important natural areas. High-quality ecosystems provide myriad benefits to wildlife and protecting existing systems is more feasible than intensive restoration of degraded systems or the creation of a new ecosystem. During 2011 and 2012, the Department of Natural Resources (DNR) and Michigan Natural Features Inventory (MNFI) conducted the Stage 1 survey of ASGA as part of the DNR's Michigan Forest Inventory (MiFI). This project is part of a long-term effort by the DNR Wildlife Division (WLD) to document and sustainably manage areas of high conservation significance on state lands. The survey collected information on basic stand data and also helped target the locations of previously undocumented exemplary natural community Element Occurrences (EOs).

This game area is in the central portion of Allegan County. There are 25 compartments in ASGA (Figure 1). Compartment 20 consists of 2772 acres in the southwest portion of the game area. This review of Compartment 20 is intended to complement the management plans already underway by WLD. This report will provide an overview of the historical and ecoregional context of ASGA and Compartment 20, an overview of the known EOs and significant natural communities in Compartment 20, and management recommendations for the significant natural features therein. Much of the information in this report was synthesized from MNFI's Biotics database and the MNFI website, which provides descriptions of natural communities and rare plants and animals.

The focus of this project and this report is on native biodiversity with an emphasis on high-quality ecosystems. Biodiversity stewardship considerations are included in the report and we acknowledge that the DNR manages for multiple values including wildlife management, hunting and other wildlife related recreation, as well as biodiversity, and that the report does not necessarily reflect the planned management actions of the DNR.

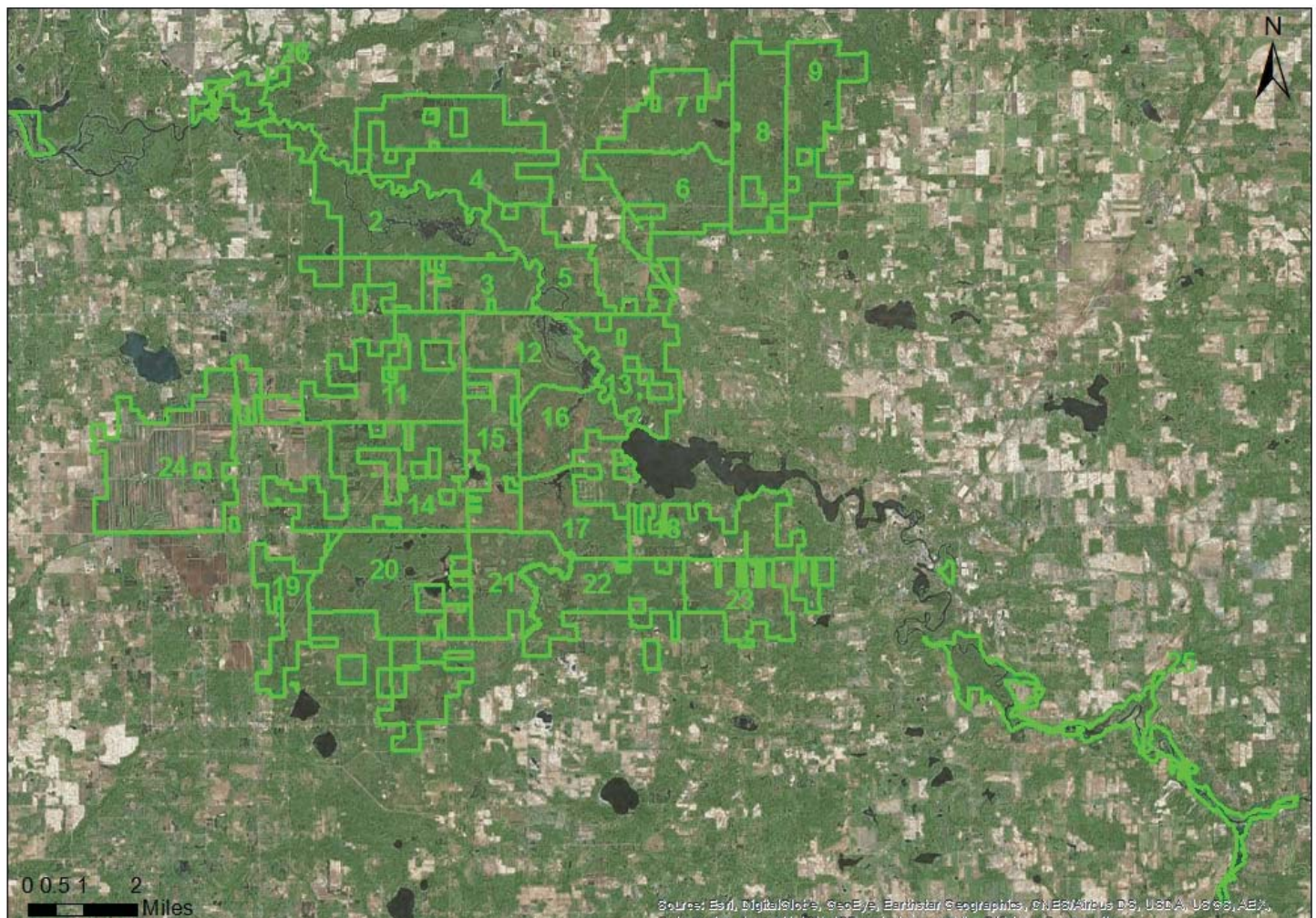


Figure 1. Compartment boundaries and land cover and in and around Allegan State Game Area.

Ecoregional Context

The regional landscape ecosystems of Michigan have been classified and mapped based on an integration of climate, physiography, soils, and natural vegetation (Albert 1995, Figure 2). This classification system can be useful for conservation planning and integrated resource management because it provides a framework for understanding the distribution patterns of species, natural communities, anthropogenic activities, and natural disturbance regimes. The classification is hierarchically structured with three levels in a nested series, from broad landscape regions called sections, down to smaller subsections and sub-subsections.

ASGA lays within the Allegan subsection (Subsection VI.3), and within two sub-subsections, the Southern Lake Michigan Lake Plain (Sub-subsection VI.3.2) and the Berrien Springs (Sub-subsection VI.3.1). The Allegan subsection is bounded by Lake Michigan to the west and the typical land forms are flat lake plain, coastal sand dunes, gently rolling till plain, and rolling to steep end moraines. Several of the state's major rivers cross the subsection, including the Kalamazoo, St. Joseph, Grand and Muskegon. The majority of the game area occurs in the Southern Lake Michigan Lake Plain sub-subsection and small portions of the eastern game area occur in the Berrien Springs (Albert 1995, Figure 2).

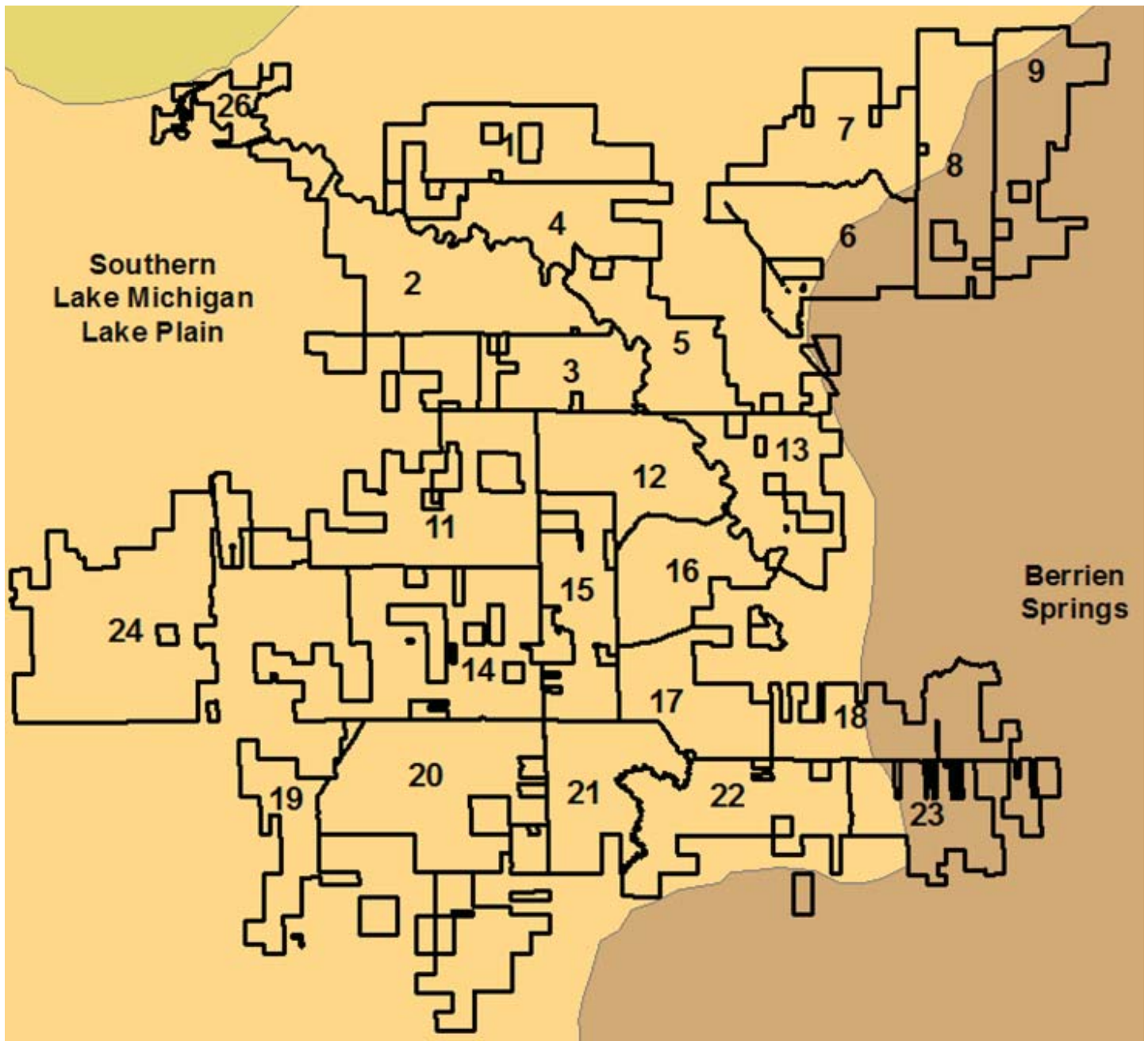


Figure 2. Ecoregions of Allegan State Game Area (Albert 1995).

Compartment 20 falls entirely within the Southern Lake Michigan Lake Plain (Figure 2). The sub-subsection is characterized by extensive lake plain features associated with historic levels of Lake Michigan that were much higher during periods of glacial recession. Sand dunes inland from present-day Lake Michigan shoreline are associated with historic shoreline. Deep sands were deposited over the lake plain during outwash events that formed the Kalamazoo, Grand, and Muskegon River channels. Coastal sand dunes are concentrated at the mouths of these and other river systems along the extent of the sub-subsection. There are a few small kettle lakes on the sand lake plain. The water level of many of these lakes fluctuates greatly, leaving them almost dry in some summers and totally inundated in spring. These fluctuations, the fluctuations of the Great Lakes historically, and the abundance of migrating waterfowl result in a distinctive disjunct flora from the Atlantic and Gulf Coastal Plains along the margins of many lakes. Throughout the lake plain, sandy soils are excessively drained and fire prone, while other areas have lenses that restrict drainage and allow for periodic inundation. (Albert 1995).

Interpretations of the General Land Office surveyor notes by MNFI ecologists indicated that the ASGA contained several distinct vegetation assemblages circa 1800 (Comer et al. 1995, Figure 3). Surveyors recorded tree species composition, tree size, and general condition of the region. Historically, much of the game area was a mosaic of oak-pine forest and barrens (savanna) ecosystems characterized by large open-grown oaks and pines with an herbaceous layer consisting of both prairie and forest species. Forests consisted largely of white pine and mixed oak with the white pine forming a supercanopy. Wetlands occurred in kettle depressions, outwash channels, and extensive tracts of floodplain forests associated with the Kalamazoo River. Lakes, marshes, bogs, inundated shrub swamps, intermittent wetlands, coastal plain marshes, and vernal pools would have occupied the low areas influenced by fluctuating ground-water levels or depressions created by blocks of ice left by the retreating glaciers. Outwash channels formed from glacial melt-waters were occupied by wet prairies, shrub swamps, and forested swamps (Cohen et al. 2015).



Photo 1. Little Tom Lake is a small kettle lake in Compartment 20. The fluctuating water levels create a dynamic system and the lake has elements of bog and coastal plain marsh at the margins.

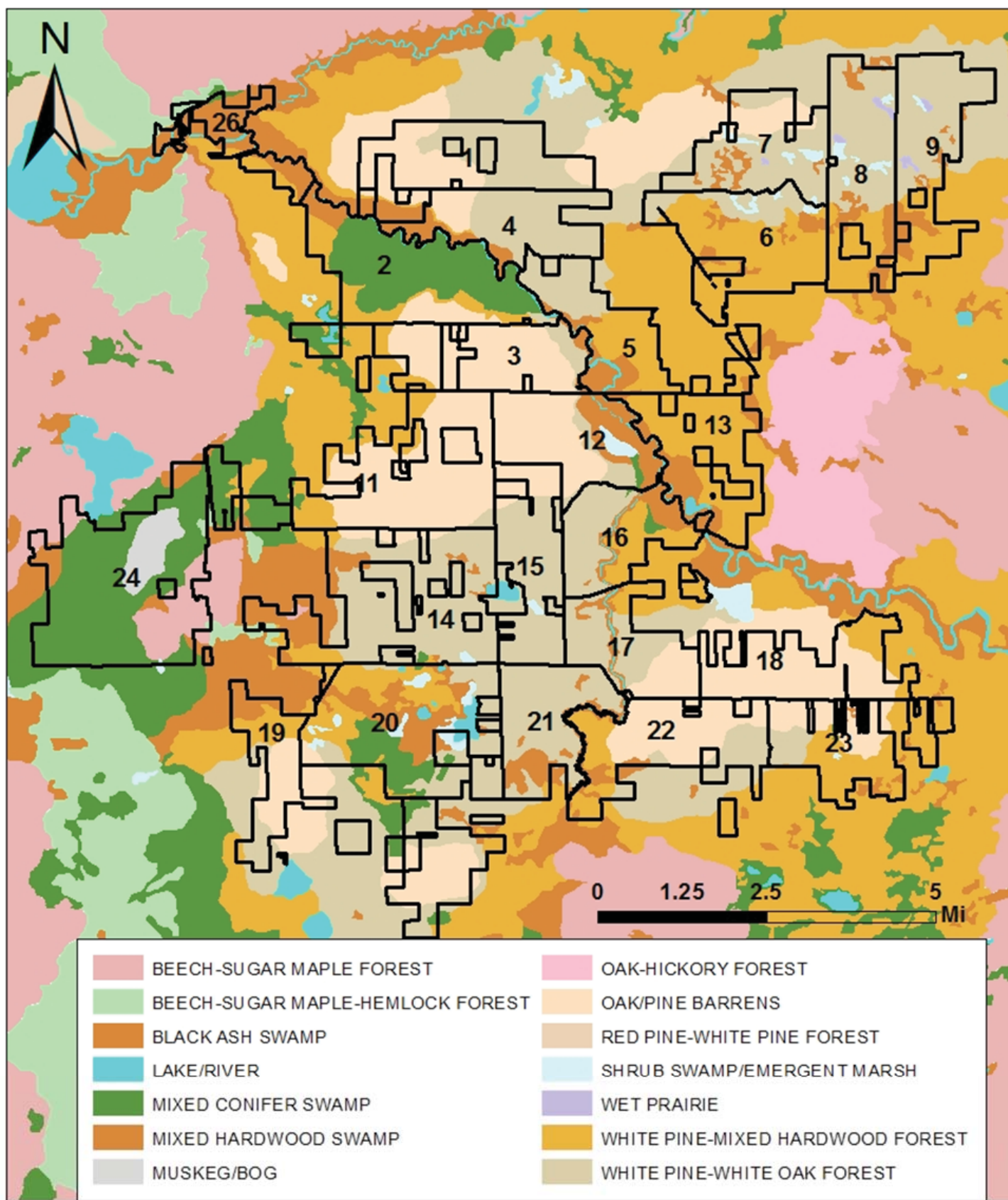


Figure 3. Circa 1800 vegetation cover of Allegan State Game Area (Comer 1997).

SUMMARY OF COMPARTMENT 20

Natural Communities

Vegetation of Compartment 20 circa 1800 was predominantly forest. The relatively flat terrain was a mosaic of uplands and wetlands with dry-mesic and mesic forest transitioning into southern hardwood and hardwood conifer swamp. Open wetlands occurred throughout and the depth of the water table fluctuated dramatically from season to season and year to year. Today, Compartment 20 is characterized by extensive forest and much of the historic covertime remains, despite logging, extensive ditching, and localized attempts at agriculture. Brief descriptions of the community types are included below as is a list of stands where the highest quality examples of natural community remain.

Southern Hardwood Swamp

Southern hardwood swamp was historically the most dominant covertime of Compartment 20 (Figures 3 and 4). Locally this forest type occurs around open wetlands, along drainages, and in seasonally inundated depressions with mineral soils where the water table is close to the surface. Today this community type is characterized by canopy dominance of red maple (*Acer rubrum*), pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), black gum (*Nyssa sylvatica*) and green ash (*Fraxinus pennsylvanica*). Throughout this compartment, cottonwood (*Populus deltoides*), basswood (*Tilia americana*), tulip tree (*Liriodendron tulipifera*), American elm (*Ulmus americana*), and quaking aspen (*Populus tremuloides*) occur as important codominants. Conifers were much more prevalent historically and white pine (*Pinus strobus*) and eastern hemlock (*Tsuga canadensis*) occur throughout but were locally dominant in many of the forested wetlands.

Prior to the introduction and spread of Dutch elm disease, American elm was an important canopy constituent in swamps and moist forests, but is now largely relegated to the subcanopy and sapling layers. Likewise, ash numbers have been reduced by emerald ash borer and mortality of canopy ash is near-total, though many small individuals persist in the subcanopy. The data collected from the 2011 MiFI surveys may not reflect the current composition of ash as the invasion was only in the early stages and the ash were not yet visibly affected. The recent mortality of canopy ash as a result of emerald ash borer has eliminated a major component of the canopy and dramatically increased the light to lower levels of the forest.

Other common understory species include saplings of canopy tree species, musclewood (*Carpinus caroliniana*), and witch hazel (*Hamamelis virginiana*). Characteristic shrub species include spicebush (*Lindera benzoin*), elderberry (*Sambucus canadensis*), winterberry (*Ilex verticillata*), and buttonbush (*Cephalanthus occidentalis*).

The ground layer is typically sparse in these forested

swamps due to prolonged inundation during the early growing season. Other areas can be quite lush due to the micro-heterogeneity of topography. Commonly encountered species include false nettle (*Boehmeria cylindrica*), marsh marigold (*Caltha palustris*), spring cress (*Cardamine bulbosa*), fowl manna grass (*Glyceria striata*), jewelweed (*Impatiens capensis*), swamp buttercup (*Ranunculus hispidus*), bishop's cap (*Mitella diphylla*), wild geranium (*Geranium maculatum*), dwarf raspberry (*Rubus pubescens*), spinulose woodfern (*Dryopteris carthusiana*), cinnamon fern (*Osmunda cinnamomea*), sedges (*Carex gracillima*, *C. intumescens*, *C. radiata*, and *C. stipata*), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*).

Southern hardwood swamp provides critical habitat for a variety of animal species. The community provides important breeding and foraging habitat for several amphibians, and reptiles, including state-listed species, such as spotted turtle (*Clemmys guttata*), Kirtland's snake (*Clonophis kirtlandii*), and Blanding's turtle (*Emydoidea blandingii*). Red-shouldered hawk (*Buteo lineatus*), barred owl (*Strix varia*) pileated woodpecker (*Dryocopus pileatus*), and Indiana bat (*Myotis sodalists*, Focal Species) also nest and/or roost in southern hardwood swamp, where they utilize large, mature trees and snags.



Photo 2. Red-shouldered hawks (State Threatened) have been documented within Compartment 20 and utilize forested wetland like those within the Compartment. Photo by Aaron Kortenhoven 2016.



Photo 3. Extensive ditching occurs throughout much of this compartment. Despite attempts to lower the water table and convert areas into agriculture, the compartment predominantly reflects historic vegetation patterns and is extensively forested.

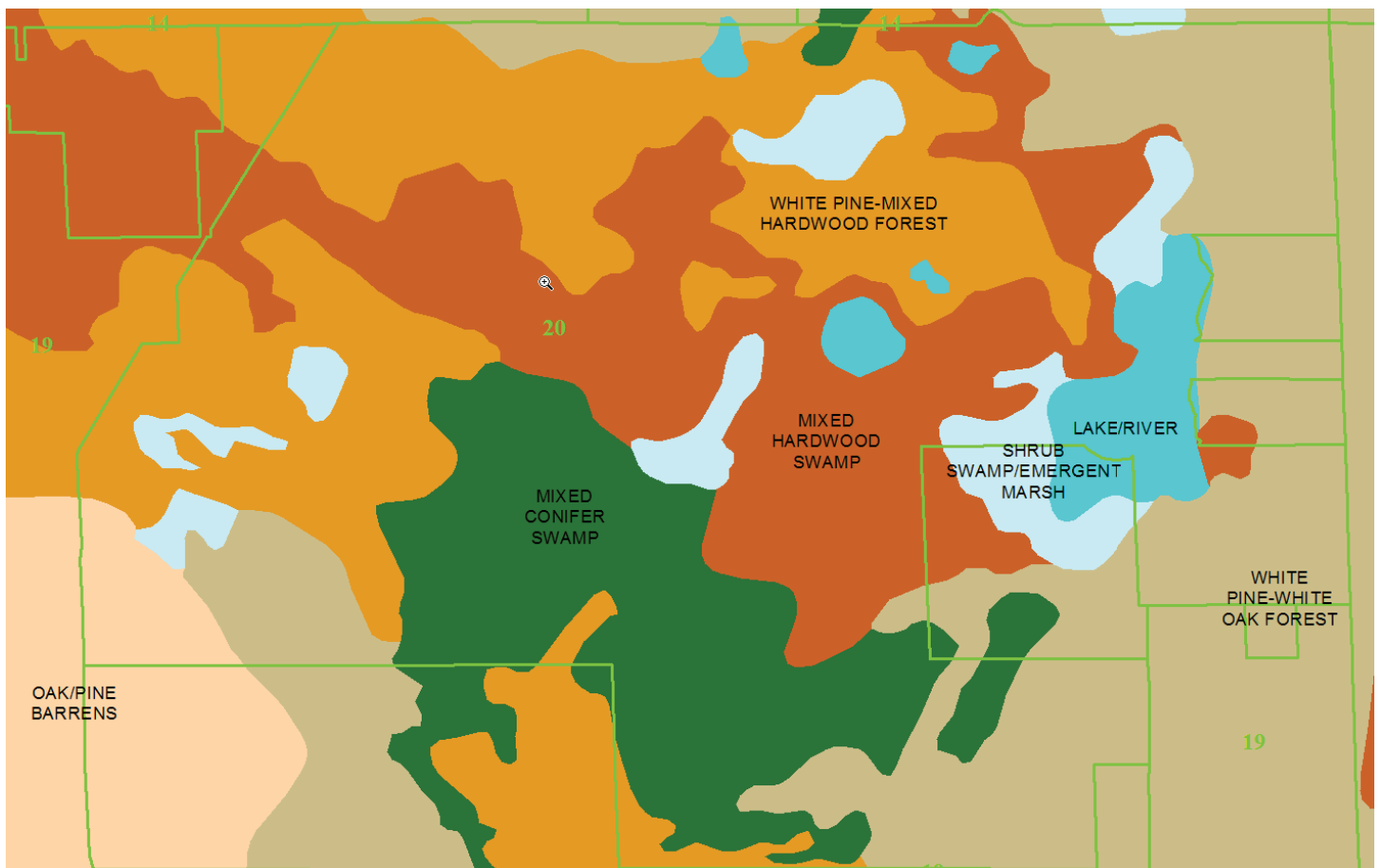


Figure 4. Vegetation of Compartment 20 circa 1800.

Dry-Mesic Northern Forest

Dry-mesic northern forest was the second most prevalent covertype within Compartment 20 and a common community type in this region. The relatively close proximity of the game area to Lake Michigan provides a buffer from higher temperatures more prevalent further from the lakeshore. Therefore, forests here are a regional variant of the dry-mesic forest community type with components that are typical of both northern and southern systems. Protracted fire suppression and a history of aggressive logging have altered the successional trajectory of the entire area from one that includes abundant oak-pine barrens to a predominantly closed-canopy oak forest with scattered pine. For the sake of simplicity, we are describing the community type as dry-mesic northern forest while acknowledging the variability of the community type.

Principal hardwood associates of dry-mesic northern forest include white oak (*Quercus alba*), black oak (*Q. velutina*), red oak (*Q. rubra*), and red maple (*Acer rubrum*) with white pine (*Pinus strobus*) an important constituent, often forming a supercanopy. Many areas of this compartment transition to a more mesic forest where fire was historically less prevalent, particularly around wetlands and areas with soils that are saturated for part of the year. In these areas, hemlock (*Tsuga canadensis*), beech (*Fagus grandifolia*),

tulip tree (*Liriodendron tulipifera*), and yellow birch (*Betula allegheniensis*) are locally common. Characteristic species of the shrub layer of this forest type include serviceberries, sassafras (*Sassafras albidum*), bush honeysuckle (*Diervilla lonicera*), huckleberry (*Gaylussacia baccata*), witch hazel (*Hamamelis virginiana*), American fly honeysuckle (*Lonicera canadensis*), choke cherry (*Prunus virginiana*), and blueberries (*Vaccinium* spp.). The ground layer of dry-mesic northern forests is often dominated by bracken fern (*Pteridium aquilinum*). Additional species include, wild sarsaparilla (*Aralia nudicaulis*), pipsissewa (*Chimaphila umbellata*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), trailing arbutus (*Epigaea repens*), wintergreen (*Gaultheria procumbens*), partridge berry (*Mitchella repens*), and starflower (*Trientalis borealis*). The presence of chlorophyll-free, parasitic and saprophytic seed plants such as Indian pipes (*Monotropa* spp.), and coral root orchids (*Corallorhiza* spp.) is a common feature of dry-mesic northern forest. Dry-mesic northern forests provide summer nesting habitat for many neotropical migrants, especially interior forest obligates such as black-throated blue warbler (*Dendroica caerulescens*), black-throated green warbler (*Dendroica virens*), scarlet tanager (*Piranga olivacea*), and ovenbird (*Seiurus aurocapillus*) (Kost et al. 2007).



Photo 4. Mixed oak-pine forest is a prevalent cover type in Compartment 20 and is common throughout Allegan SGA. These are fire-adapted forests and benefit from prescribed fire.

Coastal Plain Marsh

Forests are the dominant cover type of Compartment 20 but there are additional non-forested wetlands throughout, including coastal plain marsh. Coastal plain marsh is a graminoid dominated wetland that contains numerous plant disjuncts from the Atlantic and Gulf Coastal Plains. The dominant natural processes in coastal plain marshes are seasonal and yearly water level fluctuations. Seasonally, water levels tend to be highest during the winter and spring and lowest in late summer and early autumn. Yearly water level fluctuations are less predictable. Fluctuating water levels facilitate seed germination by drawing down water levels and thus allowing direct sunlight to penetrate the exposed pond shore and trigger seed germination. Fluctuating water levels also limit competition from woody plants and are an important mechanism for seed and nutrient dispersal to the outer margins of the wetland basin. Historically, during low-water years, fire likely carried from adjacent uplands into coastal plain marshes. Because fire has been shown to increase seed germination, enhance seedling establishment, and bolster flowering, it likely acted as an important mechanism for maintaining plant species diversity and replenishing seed banks.

Long distance seed dispersal among Midwest coastal plain marshes and between the Midwest and Atlantic and Gulf Coastal Plains is thought to be facilitated by migratory waterfowl. Waterfowl moving among nearby wetlands may also restore species that have been depleted from a site's seed bank.

Coastal plain marshes typically contain four distinct vegetation zones, often occurring as concentric bands around the open water portions of depressions, lakes, and ponds. The deepest portion of the depression is usually inundated and supports submergent marsh with floating aquatic plants such as water shield (*Brasenia schreberi*), sweet-scented water-lily (*Nymphaea odorata*), pondweeds (*Potamogeton* spp.), and bladderworts (*Utricularia* spp.).

Along the shoreline is a seasonally flooded zone that supports a sparse graminoid cover of species such as tall beak-rush (*Rhynchospora macrostachya*, state special concern) and autumn sedge (*Fimbristylis autumnalis*). In the saturated soils further from shore is a dense graminoid-dominated zone of bluejoint grass (*Calamagrostis canadensis*), twig-rush (*Cladium mariscoides*), coastal flat-topped goldenrod (*Euthamia caroliniana*), beak-rush (*Rhynchospora capitellata*), and others.

Many coastal plain marshes contain a temporarily flooded shrub and tree zone with black chokeberry (*Aronia prunifolia*), buttonbush (*Cephalanthus occidentalis*), dogwoods (*Cornus* spp.), and steeplebush (*Spiraea tomentosa*) (Kost and Penskar 2000).



Photo 5. Ely Lake is an exemplary coastal plain marsh and the characteristic zones of vegetation are apparent in this photo.

Landuse History

Similar to much of southern Michigan, Compartment 20 has been altered by European settlement. Logging, agriculture, and alterations to hydrology have had lasting legacies to the landscape. Imagery from 1938 (Figures 5 and 6) shows areas impacted by agriculture, wetlands influenced by altered hydrology, and also provides insight into the age of forests. Many areas cleared for agriculture were unproductive as a result of poor sandy soils. These places were often converted to pine plantations or were abandoned and transitioned to forest or remained in an early stage of succession. Compared to the rest of the game area, there is a limited agricultural legacy in Compartment 20, though extensive ditching still impacts hydrology throughout the compartment and there is at least one water control structure still in use in Stand 24.

Often, areas of abandoned agricultural land that are still non-forested tend to have a concentration of barrens flora as well as a significant component of invasive non-native vegetation. The best examples are Stands 88 and 92. Barrens species readily colonize areas of abandoned agriculture in this region and their presence likely indicates a local occurrence of this community type historically.

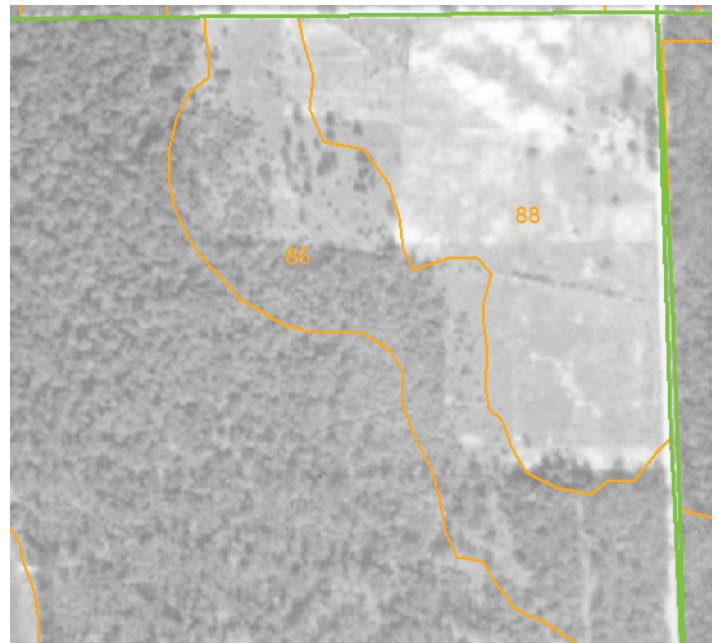


Figure 5. Stand 88 was historically cleared for agriculture but has since been colonized species characteristic of oak-pine barrens. All of the rare insects documented from Compartment 20 were found in Stand 88.

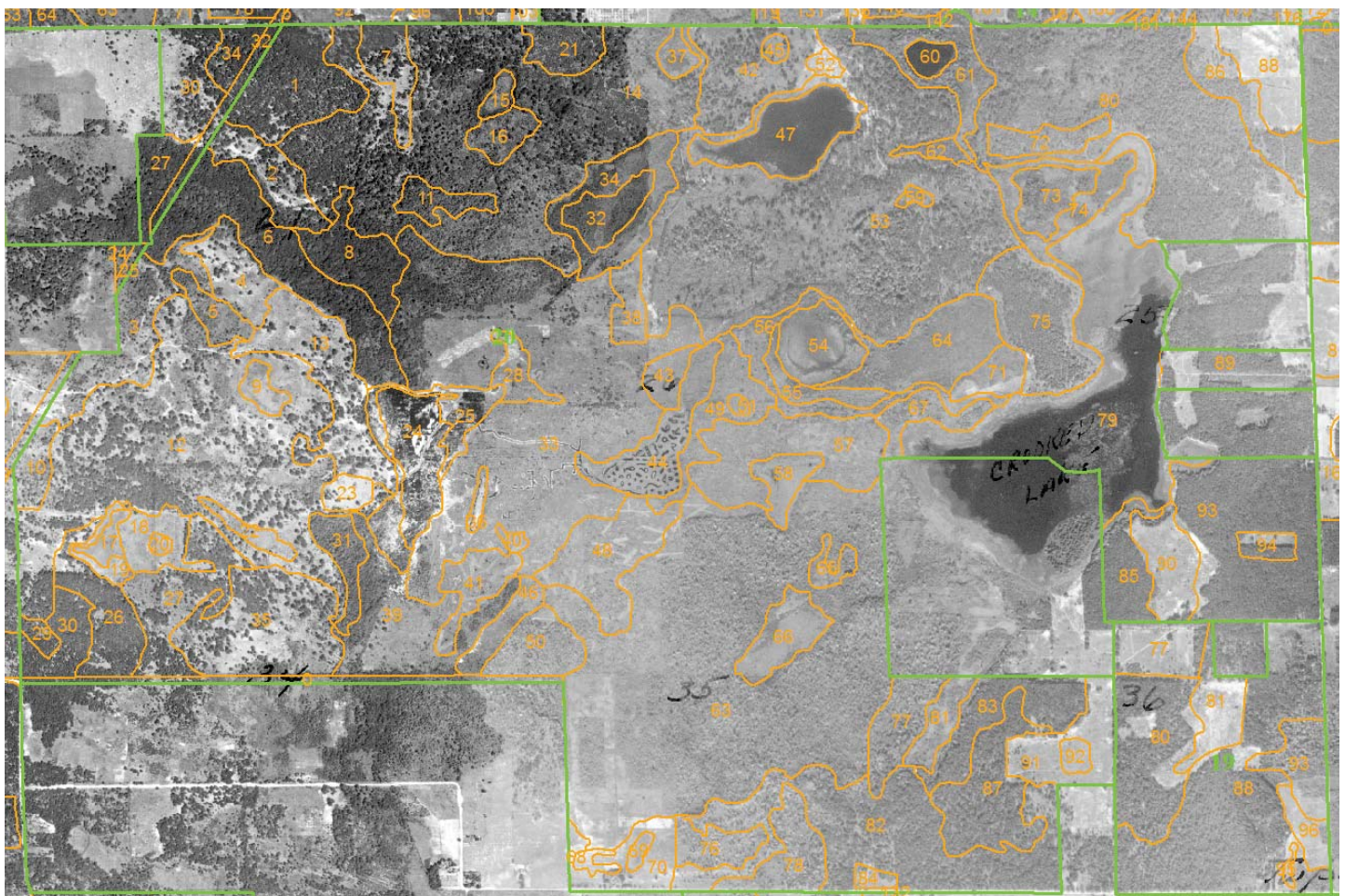


Figure 6. Imagery from 1938 provides valuable insight into changes within Compartment 20 over the past 80 years.

Important Natural Areas

The greatest concentration of documented rare species in Compartment 20 occur around the coastal plain marshes. These wetland communities harbor several rare taxa of plants and provide critical habitat to a range of wildlife, including migrating waterfowl. The forested wetlands surrounding these coastal plain marshes are some of the most extensive in ASGA, aside from the corridor flanking the Kalamazoo River. These forests are of particular value for herptiles, red-shouldered hawks, and neotropical migrants. There is additional opportunity for improving wildlife habitat throughout this compartment by implementing prescribed fire in areas that support fire-adapted forests and the limited barrens remnants within the compartment.

Non-Forested Wetlands

Some of the most significant coastal plain marshes in the state occur within Compartment 20 (Figure 7). Crooked Lake (Stand 79) and Ely Lake (Stand 47) have been studied by ecologists and botanists for over 60 years and harbor populations of plants observed in few other places in the state or even the Midwest. The abundance of rare plant taxa and the protection of these wetlands is an important consideration for area managers. Additional coastal plain marshes occur in Stands 9 and 17. There is also high-quality wet meadow in the southern end of the Crooked Lake basin (Stand 81). These systems provide important habitat to migrating waterfowl, Massasauga rattlesnakes, spotted turtles, and the majority of the rare plants found within this compartment.

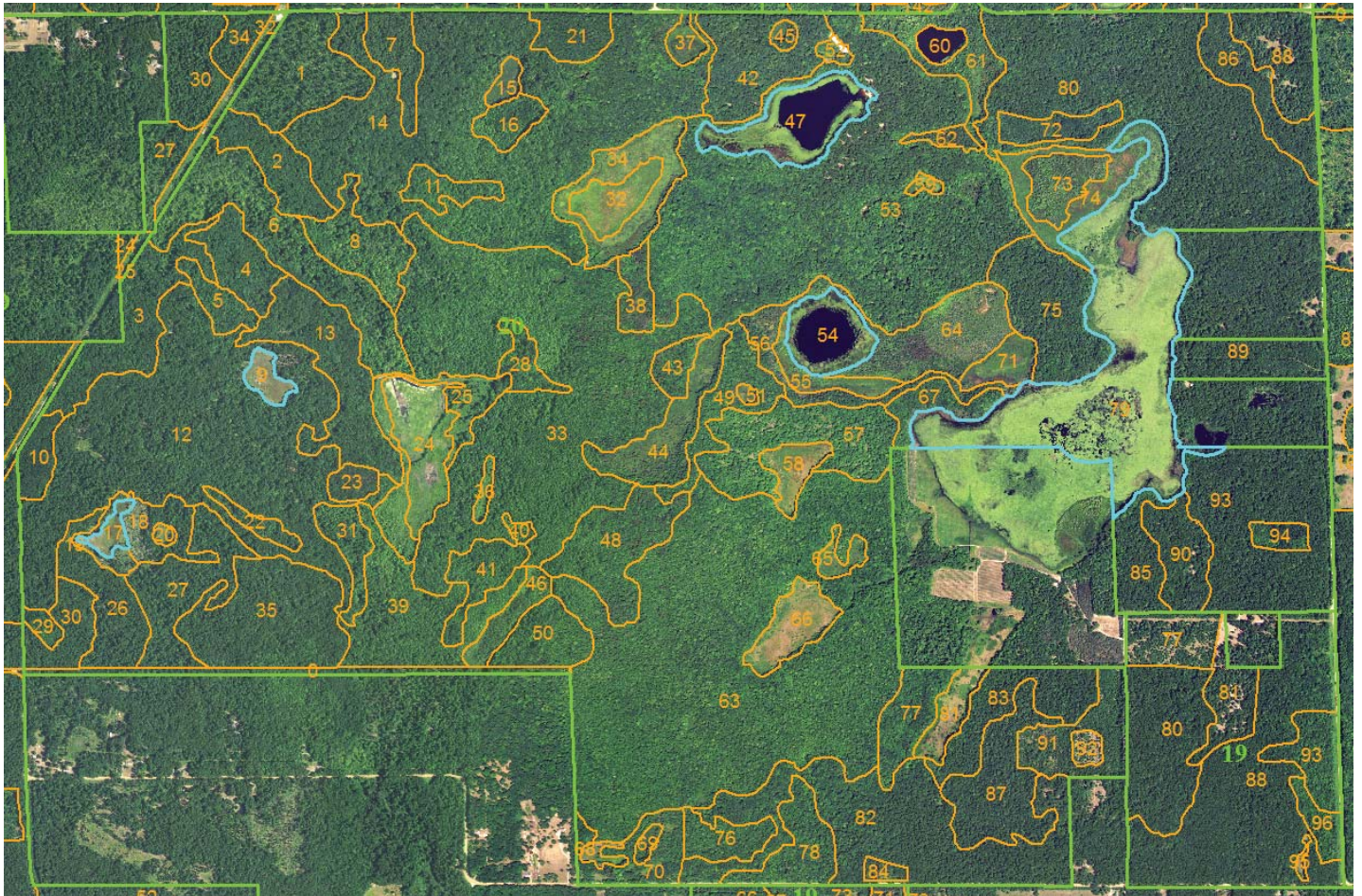


Figure 7. Mature lowland forests in the highlighted stands provide an opportunity for promoting and protecting large tracts of late-succession forest.

Lowland Forest

The forested wetlands of Compartment 20 are likely playing a large role in protecting the ecological integrity of the coastal plain marshes. Despite extensive ditching throughout the central portion of this compartment and attempts at conversion to agriculture, the loss of the marshes has been minimal compared to other places in the game area. These forests play a central role in maintaining the integrity of the coastal plain marshes by lessening the amplitude of water fluctuations and mitigating sedimentation of the open wetlands. The extensive nature of this block of mature forest, the rarity of such a large area of hardwood swamp in the region, and the relative scarcity of such systems in southern Michigan make this a forest of significance for the region, particularly for neotropical migrants and forest interior obligates. Avoiding intensive management actions in these stand will promote the ecological integrity of the non-forested wetlands and maintain critical habitat for rare birds that have been documented from the area. The most important forested wetlands for protecting water quality and habitat for rare birds are: 6, 8, 31, 33, 39, 48, 57, 63, 76, and 78 (Figure 8).

Upland Forest

Large areas of contiguous mature upland forest have been identified within this compartment. In general, ASGA tends to be significantly more forested than the surrounding county. While much of the forests in ASGA were historically barrens that have converted to closed-canopy forest as a result of fire suppression, the upland forests in this compartment likely only had a minor component of bar-

rens, based on circa-1800 vegetation maps and the lack of characteristic barrens vegetation throughout.

The concentration of these forested stands within this compartment creates a nearly contiguous block of mature forest. Because of the extensive nature of this block of mature forest and the relative scarcity of such systems in southern Michigan, these are forests of significance for the region, particularly for neotropical migrants and forest interior obligates. In addition to providing benefits to migrating birds, these forests also protect the hydrology of the coastal plain marshes. Buffers of upland forest should be established 150 feet from wetlands and mechanical harvest of trees in order to protect hydrology of the area.

The most important upland forests in this compartment are in Stands 14, 26, 30, 53, 80, 83, 87, and 93. These were identified based on age, size of stand, lack of invasive species, proximity to other stands of similar age and quality, and adjacency to important wetlands. Though not necessarily exemplary natural communities, when considered together, these stands are regionally important and provide substantial benefit to wildlife. With the exception of Stand 53, these stands could be maintained with periodic, low-intensity prescribed fire. Stand 53 is primarily upland but is more mesic with several species that are not fire adapted, including: hemlock, beech, red maple, tulip tree, and ironwood. Stand 53 also has several areas of wet depressions, vernal pools, and borders several important non-forested wetlands.



Photo 6. Stand 53 is atypical of the compartment and is more mesic than many of the other upland forests. Many of the canopy species are fire sensitive and historically this stand likely did not burn with regularity or intensity.



Photo 7. Forested wetlands like those in Stand 63 are the most prevalent cover type in Compartment 20. These systems are variable with some areas of deep water and others with a significant conifer component.

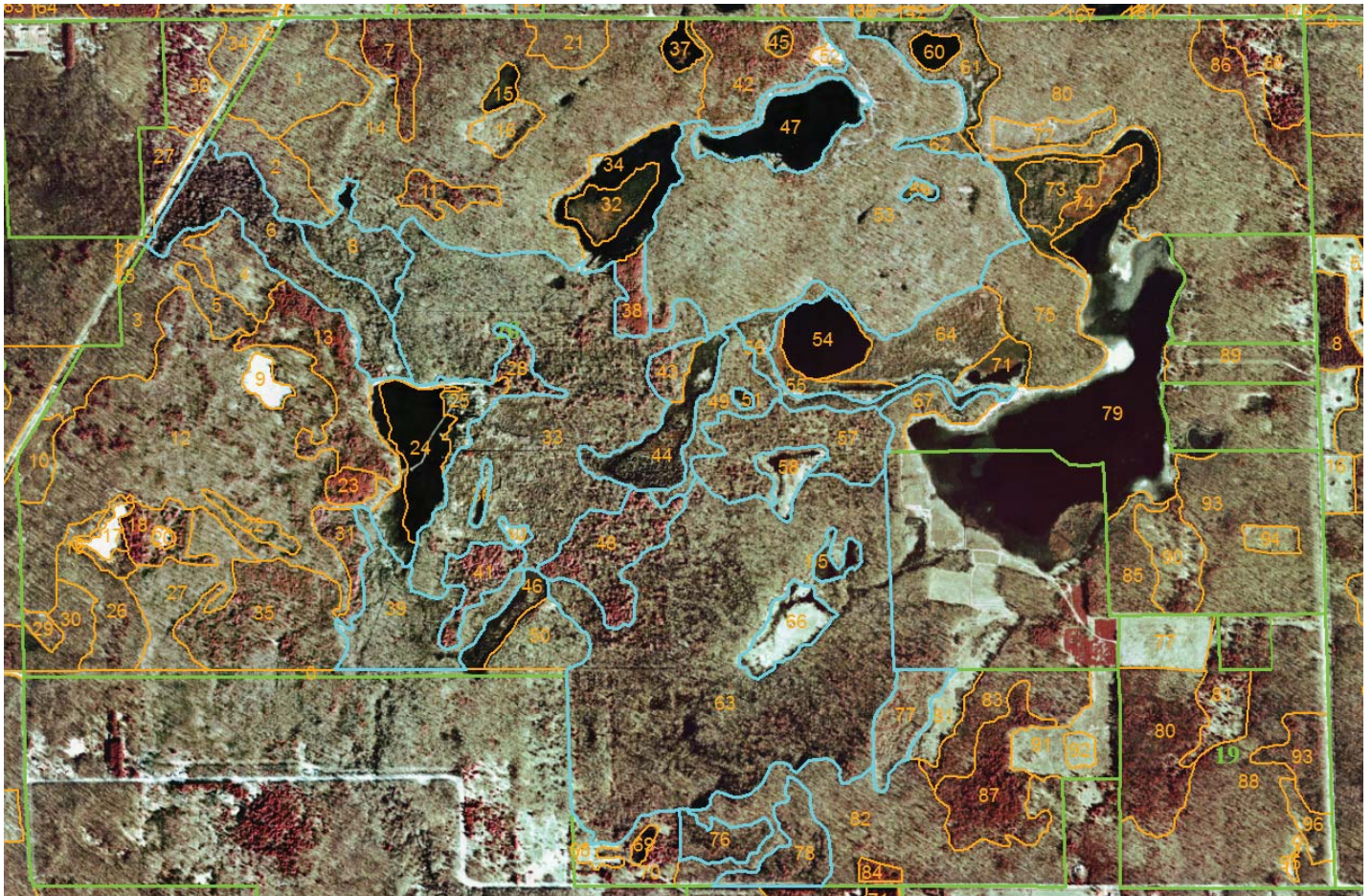


Figure 8. Mature lowland forests in the highlighted stands provide an opportunity for maintaining large tracts of unfragmented late-succession forest and protecting hydrology of coastal plain marshes.

Oak-Pine Barrens

Though likely a minimal component of the Compartment historically, there were a few small pockets of barrens species, primarily in areas historically influenced by agriculture and logging. These areas include Stands 3, 4, 5, 9, 12, 13, 17, 18, 19, 20, 27, 29, 30, 35, 86, and 88 (Figure 9). All of the rare insects documented in this compartment were found in Stand 88. Though none of the populations have been reconfirmed since 1975, Stand 88 and surrounding Stand 86 should be considered for barrens restoration and managed with prescribed fire. Additionally, a group of stands in the southwest portion of the compartment occur on dry soils and were likely historically barrens. These stands could be managed with fire to meet a variety of objectives, including barrens restoration, creation of early-succession habitat, and improvement of habitat adjacent to known coastal plain marshes (Figure 10).

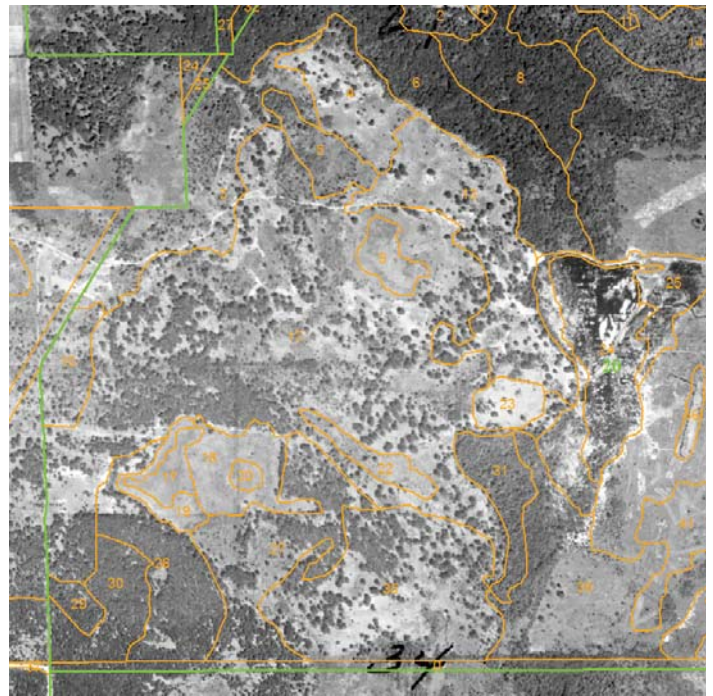


Figure 10. Stand 88 was historically cleared for agriculture but has since been colonized species characteristic of oak-pine barrens. All of the rare insects documented from Compartment 20 were found in Stand 88.

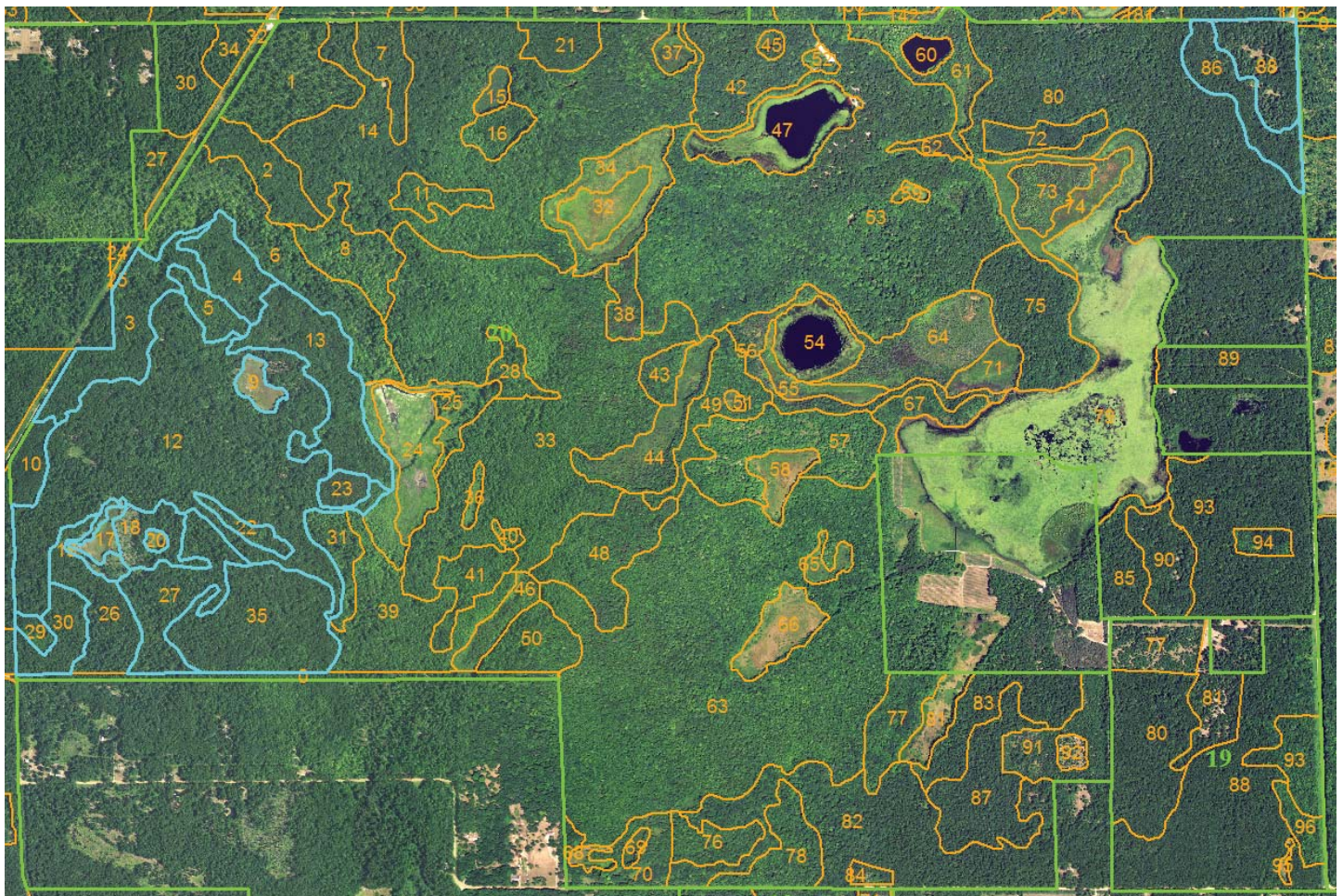


Figure 10. Areas of oak-pine barrens restoration potential in Compartment 20 are highlighted. Prescribed burns are the primary tool recommended to recreate the barrens structure and promote characteristic vegetation.

Rare Species

Mammals

Two woodland voles (*Microtus pinetorum*, State Special Concern) were found in 1939. No information was provided about the vole occurrence other than “near Kalamazoo River”. The woodland vole occurs in deciduous woodlands with loose sandy soils, deep humus, and heavy leaf litter. The species prefers deciduous forests comprised of oak, maple, and/or beech. There is likely abundant habitat for this species throughout the compartment.

Herptiles

Spotted turtles (*Clemmys guttata*, State Threatened) were found in Stand 71 in 1990. These turtles require clean, shallow, slow-moving bodies of water with muddy or mucky bottoms and some aquatic and emergent vegetation. They utilize a variety of shallow wetlands including ponds, wet meadows, tamarack swamps, bogs, fens, sedge meadows, cattail marshes, and woodland streams. There is abundant suitable habitat throughout this compartment.

A gray ratsnake (*Pantherophis spiloides*, State Special Concern) was observed in the area in 2002, though locational information for this record does not provide a specific stand. The gray ratsnake is the largest snake in the Great Lakes region and usually occurs in forested habitats but it also uses adjacent open habitats including shrubby fields, prairies, and marsh and bog edges. The gray ratsnake often climbs trees to eat nestling birds or eggs. Gray ratsnakes hibernate in mammal burrows, root networks, rock crevices or other sites that provide refuge from freezing temperatures. Gray ratsnakes deposit eggs in loose soil, rotted stumps or logs, cavities under rocks, logs, or other cover. ASGA is known to have a population of ratsnakes and suitable habitat likely exists throughout the compartment.

Eastern massasauga rattlesnakes (*Sistrurus catenatus*, Federally Threatened) were found in this compartment as recently as 2006. This species has been recently listed as federally threatened and is facing decline from habitat loss, persecution, and recently from snake fungal disease. Populations in southern Michigan are typically associated with open wetlands. They also utilize open uplands and forest openings for foraging, basking, gestation and giving birth to young. Massasaugas usually hibernate below the frost line in crayfish or small mammal burrows, tree root networks or rock crevices in or along the edge of wetlands or in upland areas with presumably high water tables. Massasauga habitat is generally open, sunny areas intermixed with shaded areas for thermoregulation, presence of the water table near the surface for hibernation, and variable elevations between adjoining lowland and upland habitats. Several individuals have been documented in Stands 24, 25, and 33 and this is likely one of the largest breeding populations in ASGA. Additional habitat occurs in Stand 58, 66, and 81.

Birds

Three species of rare bird have been documented within this compartment: Red-shouldered hawk (*Buteo lineatus*, State Threatened), Cerulean warblers (*Setophaga cerulea*, State Threatened), and Hooded warbler (*Setophaga citrina*, State Special Concern). These species are most commonly found in the canopy of large tracts of mature deciduous forest. Given their habitat requirement, there is additional suitable habitat for these birds throughout the compartment in mature forests.

Table 1. Element Occurrences of rare animals in Compartment 20. EO Rank abbreviations: A = Excellent estimated viability, B = Good estimated viability, C = Fair estimated viability, D = Poor estimated viability, E = Extant, viability not assessed, H = Historical Record. Status abbreviations: SC = Special Concern, T = Threatened, E = Endangered, X = Extirpated from Michigan, L denotes federal status.

Common Name	Scientific Name	EO ID	EO Rank	Status	First Observation Date	Last Observation Date	Stands
Mammals							
Woodland vole	<i>Microtus pinetorum</i>	9585	H	SC	1939	1939	Vague Record
Herptiles							
Spotted turtle	<i>Clemmys guttata</i>	12573	E	T	1990	1990	71
Gray ratsnake	<i>Pantherophis spiloides</i>	1288	E	SC	1989	2002	Vague Records
Eastern massasauga	<i>Sistrurus catenatus</i>	18723	B	LT	2002	2006	24, 25, 33
Birds							
Red-shouldered hawk	<i>Buteo lineatus</i>	19694	E	T	2011	2011	76 (33, 63)
Cerulean warbler	<i>Setophaga cerulea</i>	13323	AB	T	1992	2015	53, 82
Hooded warbler	<i>Setophaga citrina</i>	13326	E	SC	1999	1999	6, 12, 27, 31
Insects							
Frosted elfin	<i>Callophrys irus</i>	5527	X?	T	1970	1970	88
Persius dusky wing	<i>Erynnis persius persius</i>	7025	H	T	1970	1975	88
Karner blue	<i>Lycaeides melissa samuelis</i>	8156	H	LE	1970	1970	88
Sprague's pygarcia	<i>Pygarcia spraguei</i>	12188	H	SC	1970	1970	88

Insects

Four species of rare insect have been documented from Compartment 20. All of them were collected in 1970 and all of the records are considered historic as the presence of these species have not been confirmed in over 25 years. The four species: Frosted elfin (*Callophrys irus*, State Threatened), Persius dusky wing (*Erynnis persius persius*, State Threatened), Karner blue (*Lycaeides melissa samuelis*, Federally Endangered), and Sprague's pygarcia (*Pygarctia spraguei*, State Special Concern) are all Lepidopterans (butterfly and moth family) and all are species typically found in oak-pine barrens. The records for them do not have specific stand data, but Stand 88 is most likely the area from which they were collected.

Plants

There are 10 species of rare plants documented from Compartment 20 (Table 2). With the exception of goldenseal (*Hydrastis canadensis*, State Threatened), these are all coastal plain disjuncts and restricted to the coastal plain marshes within this compartment. Protection of the hydrology is critical for these species which require fluctuating water levels and an influx of propagules from migrating waterfowl. Additionally, encroachment of woody vegetation can be problematic and inclusion of coastal plain marshes in prescribed fires can prevent successional transition as well as stimulate the seed bank.

Goldenseal occurs in mesic, closed-canopy forests and is susceptible to excessive canopy removal. Therefore, it is important to maintain healthy intact, mature forests with minimal forest fragmentation. When possible, leave large tracts of unharvested forests and allow natural processes to operate unhindered. Goldenseal has been reported to have medicinal properties and its numbers have greatly decreased over recent decades.

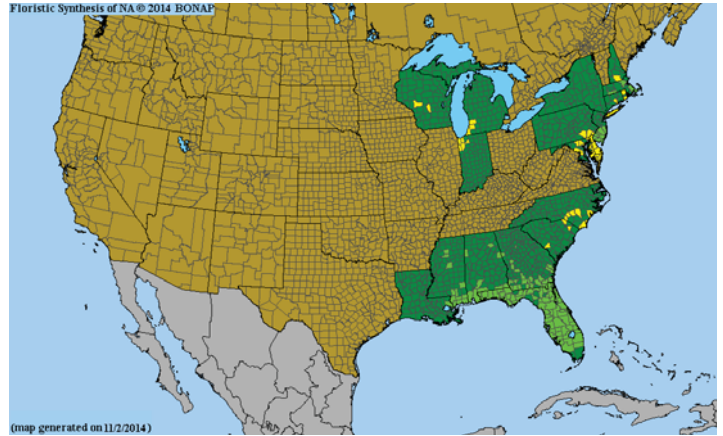


Figure 11. The distribution map of *Scleria reticularis* typifies the distribution of many coastal plain disjuncts that are common along the Atlantic and Gulf Coasts with isolated populations in southwest Michigan.



Photo 8. Fluctuating water tables create ideal habitat for many of the rare plants documented in this compartment. The exposed, sandy shoreline at the margins of Crooked Lake are home to many coastal plain disjuncts.

Table 2. Element Occurrences of rare plants in Compartment 20. EO Rank abbreviations: A = Excellent estimated viability, B = Good estimated viability, C = Fair estimated viability, D = Poor estimated viability, E = Extant, viability not assessed, H = Historical Record. Status abbreviations: SC = Special Concern, T = Threatened, E = Endangered, X = Extirpated from Michigan, L denotes federal status.

Common Name	Scientific Name	EO ID	EO Rank	Status	First Observation Date	Last Observation Date	Stands
Three-awned grass	<i>Aristida longespica</i>	20609	C	T	2010	2010	70
Panicled screwstem	<i>Bartonia paniculata</i>	13238	C	T	1998	2010	70
Black-fruited spike-rush	<i>Eleocharis melanocarpa</i>	197	A	SC	1943	1983	47,79
Goldenseal	<i>Hydrastis canadensis</i>	11010	E	T	1976	1976	53
Cross-leaved milkwort	<i>Polygala cruciata</i>	12682	B	SC	1956	2008	47, 54, 79
Waterthread pondweed	<i>Potamogeton bicupulatus</i>	12055	B	T	1937	2017	47, 54, 79
Meadow beauty	<i>Rhexia virginica</i>	510	A	SC	1948	1989	47, 54, 70, 79
Tall beakrush	<i>Rhynchospora macrostachya</i>	9033	C	SC	1956	2014	47, 54, 79
Bald-rush	<i>Rhynchospora scirpoides</i>	3303	AB	T	1958	1999	47, 79
Netted nut rush	<i>Scleria reticularis</i>	9149	AB	T	1970	2012	47, 79

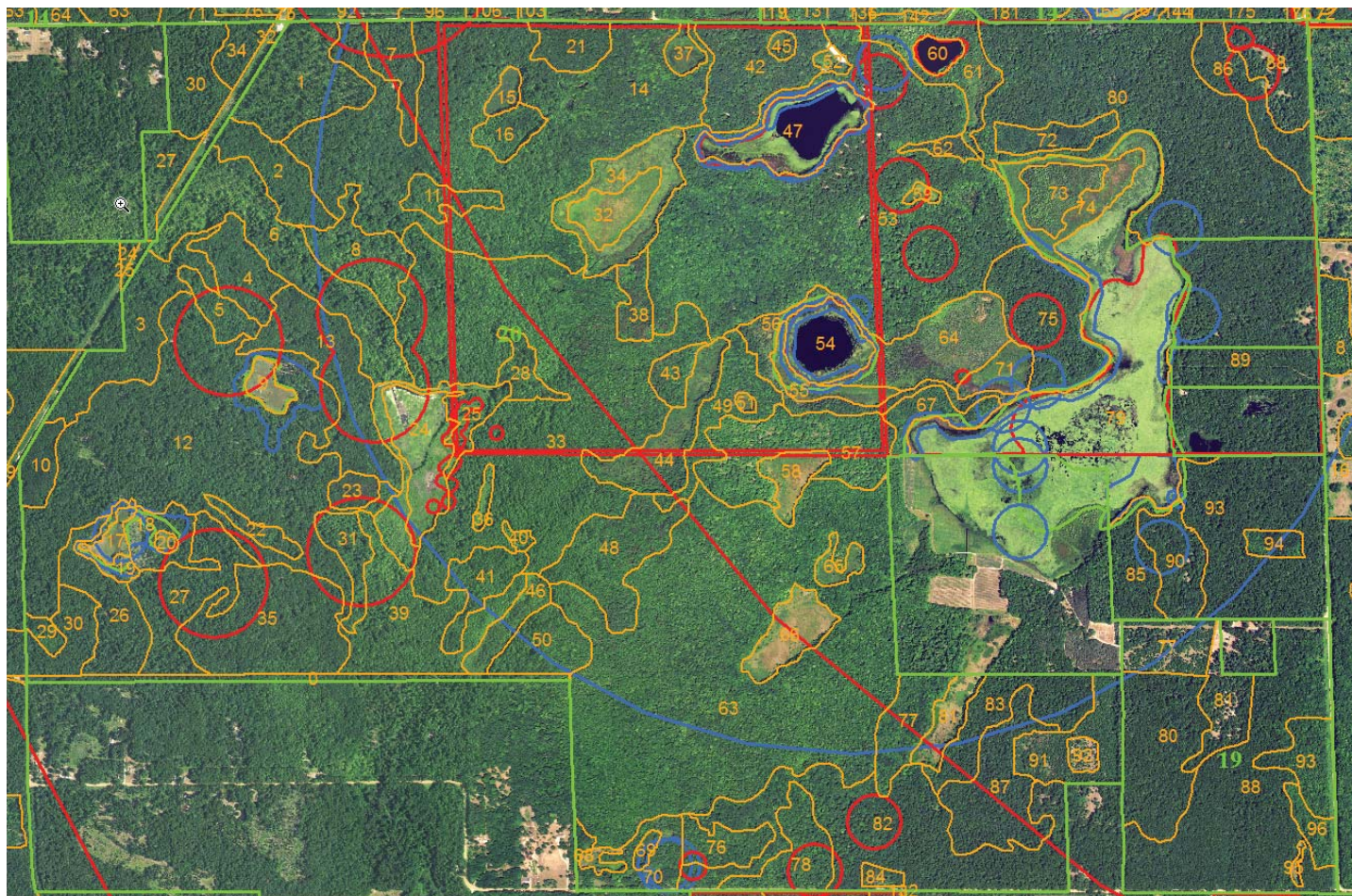


Figure 12. Locational information of EOs mapped with Compartment 20 stands. Red polygons are animals, blue polygons are plants, and green polygons are natural communities. Vague and older records are visualized as large squares or circles, representing the uncertainty in the historic record.

MANAGEMENT RECOMMENDATIONS

Management recommendations are intended to promote and protect native biodiversity, especially rare species and native communities. Recommendations are arranged in order of priority: monitor and control populations of aquatic invasive species, allow forests to continue maturing, return fire as a disturbance to the landscape, and promote barrens and early successional habitat.

The most important management action we recommend is to treat and monitor populations of invasive species the invasive non-native reed (*Phragmites australis* subsp. *australis*) and black alder (*Alnus glutinosa*), both of which are growing in Stand 61 along the south side of the road (Figure 13, Photo 9). These are pernicious invasive plants that can completely alter the composition and structure of affected wetlands. Stand 61 is connected to Crooked Lake and very close to Ely Lake, two of the region's most important coastal plain marshes. The dynamic nature of the coastal plain marshes makes this type of system particularly vulnerable to these invasive species which respond positively to fluctuating water levels. The treatment of these two invasives must be a priority in order to protect the long-term health of this compartment's wetlands.

The extensive forested wetlands in this area are critical habitat for rare bird taxa. Maintaining their ecological integrity and limiting fragmentation is a management objective that will promote habitat for rare birds as well as protect the hydrology and quality of coastal plain marshes. While we recommend avoiding mechanical harvest of timber, fire is a particularly useful tool for forest ecosystem management. The use of fire will minimize mesophytic invaders (such as maple and cherry), stimulate regeneration of pine and oak, create structural diversity by causing localized mortality of canopy trees, lessen the dominance of greenbriar, and favor barrens species that may lie

dormant within the seed bank. The reduction of red maple in the subcanopy of oak-pine forests will be particularly important as this mesophytic species intercepts sunlight and limits the herbaceous vegetation that white-tailed deer utilize in the summer months. A more robust fire regimen would therefore increase food sources for focal species while promoting ecosystem integrity and habitat for rare species.

Ideally, the fire regimen would be varied across the compartment in order to create refugia for the species that utilize the affected habitats. Fire frequency and intensity can be varied to achieve additional objectives, such as: maintaining barrens openings, creating barrens openings where characteristic species are present, maintaining early-succession habitat, and promoting aspen regeneration. Within this compartment, fire as a management tool can replace mechanical harvest in most situations and thereby avoid fragmentation and long-lasting impacts to hydrology observed with heavy machinery. The varied and uneven nature of burns will ideally create a complex habitat that favors both game and non-game species.

Fire is a critical management tool for maintaining an open canopy, promoting high levels of grass and forb diversity, deterring the encroachment of woody vegetation and invasive species, and limiting the success of canopy dominants. Fire intervals of one to three years bolster graminoid dominance, increase overall grass and forb diversity, and remove woody cover of saplings and shrubs. Burning at longer time intervals will allow for woody plant seedling establishment and persistence. Managing for open barrens will the rare insects documented in Compartment 20 as well as numerous other species that utilize this rare habitat.

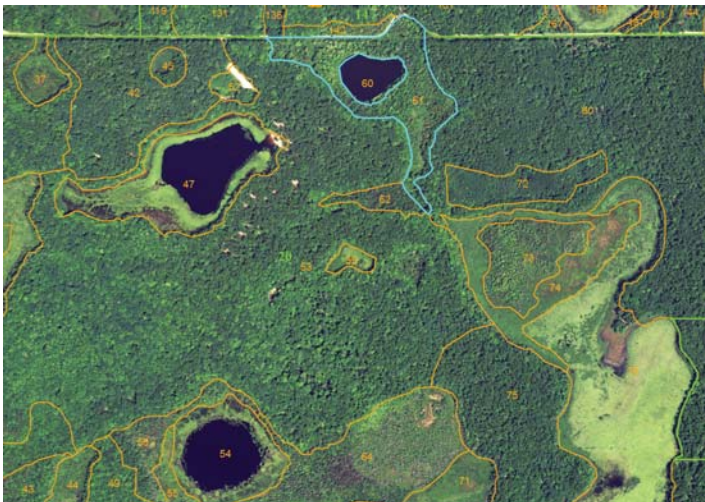


Figure 13. The two invasive species of greatest concern are growing along the south side of 116th Ave. in Stand 61. Treatment of *Phragmites* and black alder are a top management objective for protecting the area's wetlands.



Photo 9. *Phragmites* and black alder growing along the south side of 116th Ave in Stand 61.

The restriction of burning to spring time is a management concern. Fires have the greatest impact on those plants that are actively growing at the time of the burn. Repeated fires at the same time of year impacts the same species year after year, and over time can lower floristic diversity. For example, forbs that flower in early spring often overwinter as a green rosette or may have buds very close to the soil surface and in the litter layer. Repeated burns in early spring can be detrimental to such species. Fires historically burned in a variety of seasons, including spring, during the growing season, and fall. Many of the natural communities found in ASGA, including oak-pine barrens and dry-mesic northern forest, likely historically burned primarily in late summer and early fall. Varying the seasonality of prescribed burns to match the full range of historical variability better mimics the natural disturbance regime and leads to higher biodiversity: pyrodiversity facilitates biodiversity.

Repeated early spring burns are of particular concern in oak-pine barrens and dry-mesic northern forest where a goal for prescribed burning is to control woody species. Prior to bud break and leaf flushing, the vast majority of energy in a woody plant is stored in roots as carbohydrate reserves. As plants expend energy to make leaves, flowers, and fruits, these carbohydrate reserves diminish, reaching a seasonal low during flowering and fruiting. As fall approaches, energy root reserves are replenished. Thus, when woody species are top-killed by early spring fires, they are able to resprout vigorously using large energy stores, a phenomenon seen frequently with sassafras, black cherry, red maple, and oaks. However, if burns are conducted later in the spring after leafout, or during the growing season, energy reserves are already partially depleted, and resprouting vigor is lower, particularly for clonal species like sassafras.

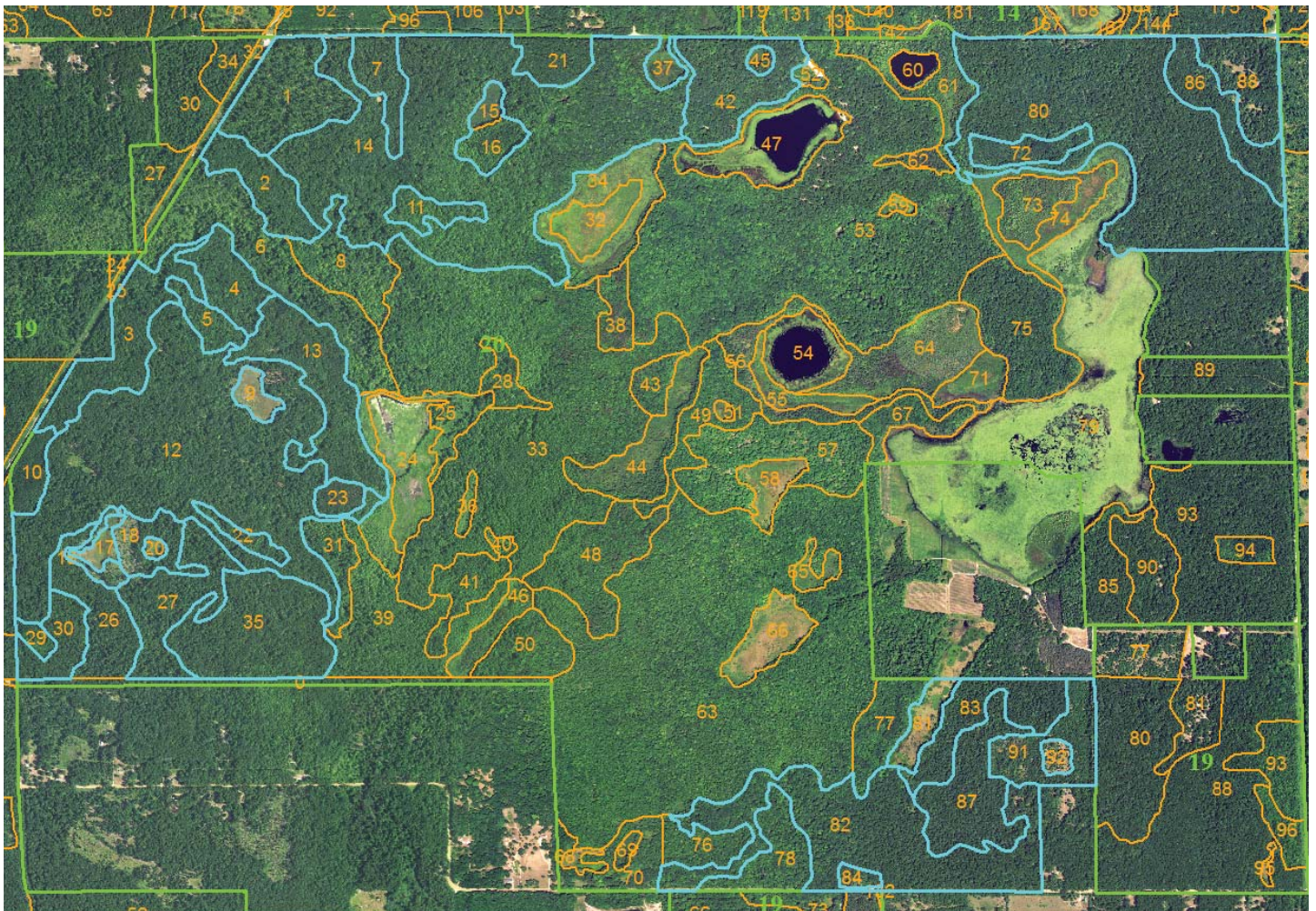


Figure 14. Areas of Compartment 20 where fire-adapted natural communities occur and prescribed fire would be an ideal management tool for improving wildlife habitat.

Resource managers restrict prescribed fire to the early spring for numerous reasons including ease of controlling burns, greater windows of opportunity for conducting burns because suitable burning conditions are often most prevalent this time of year, and the belief that doing so reduces the probability of detrimentally impacting fire-sensitive animal species, such as herptiles (i.e., eastern box turtle). While these are all legitimate reasons, we feel that the long-term benefits of diversifying burn seasonality outweigh the costs and that ultimately, successful restoration of oak-pine barrens ecosystems will depend on expansion of the burn season beyond early spring. Techniques for reducing the risk to fire-sensitive species can be employed during burns throughout the year and include avoiding burning within and around known hibernacula and establishing rotating refugia within large burn units (Cohen et al. 2009).

In addition to benefits to rare species, restoring barrens ecosystems in the ASGA will benefit game species that utilize savanna habitat, including deer and wild turkey. The open herbaceous areas of barrens provide fawning areas for white-tailed deer as well as a different source for browse during mid-summer when warm-season grasses are more palatable. These habitats also offer brooding and foraging sites for turkey and grouse. Further, leguminous forbs are a major component of barrens vegetation and provide a nitrogen-rich food source for insects that are eaten by these game birds.

Landscape-level use of prescribed fire for maintenance of forested systems should be applied to the largest areas of forest with relatively high-quality mature stands, existing features for burn breaks, and would ideally include areas that have potential for barrens restoration. We have identified 4 areas to focus the implementation of prescribed fire in Compartment 20 (Figure 14). The highest priority area to apply fire to meet these conditions is in Stands 80, 86, and 88. Stand 80 is a large, relatively high-quality

oak-pine forest and 88 has barrens species and historic records of rare insects reliant on barrens habitat. Therefore this is one of this areas where fire could be used to meet objectives of forest maintenance and barrens restoration.

Additionally, in the southwest portion of the compartment, prescribed fire could be implemented to maintain barrens and coastal plain marsh habitat, improve health of mature forests, promote early successional habitat, reduce mesophytic invaders, and reduce the dominance of greenbriar, which is locally quite dominant. This would call for a more frequent use of fire with objectives of varying seasonality and intensity in order to include non-forested wetlands in the burns. This is a large (410 acre) and complex management area within which smaller units can be created using existing logging trails in order to employ fire to maintain early succession habitat where pine plantations, aspen stands, and younger forests already exist. The existing patchwork of habitat and burn break options should provide the necessary refugia while allowing managers the flexibility of implementing a diversity of burn plans. Increased fire frequency, burning during the growing season, and targeting barrens areas should virtually eliminate the need for mechanical tree removal.

Two additional areas for the use of prescribed fire are also highlighted in Figure 14. These occur in the northwest and southeast portions of the compartment and feature mature, relatively high-quality dry-mesic forest. Considering the other two potential project options and the need for fire elsewhere within the game area, these areas are not prioritized but would be worthy candidates if additional resources become available. While some barrens species are present in this compartment, the quality of habitat is severely lacking. Considering the abundance of high-quality barrens areas elsewhere within the game area, the areas within Compartment 20 are not likely to be a priority for long-term barrens restoration.

Specific Recommendations

Because of the limited nature of management resources and the abundance of important natural resources, prioritization of management actions is necessary when dealing with an area the size of ASGA. The following management recommendations for Compartment 20 are provided for your consideration but should be considered in the wider context of the game area:

- Treat and monitor invasive species
 - Phragmites and black alder along 116th Ave, Stand 61
 - Monitor adjacent wetlands
 - Reed canary grass is another threat to area wetlands
- Maintain large tracts of mature forest
 - Important lowland Stands: 6, 8, 31, 33, 39, 48, 57, 63, 76, and 78
 - Habitat occupied by cerulean warblers and red-shouldered hawk
 - Systems are protecting hydrology of coastal plain marshes
 - Important upland Stands: 14, 26, 30, 53, 80, 83, 87, and 93
 - Include in prescribed burns when possible
 - Allow these stands to continue maturing
 - Provide 150 ft buffer of mature upland forest between wetlands and intensive forestry operations
 - Avoid further fragmentation to protect and promote habitat for neotropical migrants and red-shouldered hawks
- Return fire as a disturbance
 - Reduce the dominance of greenbrier and increase palatable vegetation for wildlife
 - Implement before timber harvest to promote oak regeneration and reduce maple
 - Focus fire use in high-quality forests mentioned above
 - Use existing features such as roads and streams as burn breaks
 - Vary seasonality of burns to create habitat variability
 - Monitor to identify areas where barrens vegetation is expressed as a result of fire
 - Increase fire frequency and intensity to promote early-succession habitat
- Promote habitat for rare herptiles
 - Avoid alterations to hydrology in occupied wetlands
 - Provide buffers of natural cover between intensive forestry operations and wetlands
 - Reduce mesopredator populations
 - Utilize prescribed fire in uplands adjacent to occupied wetlands in order to promote nesting sites
- Promote oak-pine barrens habitat
 - Not a top priority area for barrens restoration
 - Focus prescribed fire use and restoration efforts in and around Stand 88

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