Allegan State Game Area

Natural Features Summary of Compartment 6

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Michigan Natural Features Inventory

For:
Michigan Department of Natural Resources
Wildlife Division

January16, 2015

Report Number 2015-02

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Introduction

During 2011 and 2012, the Department of Natural Resources (DNR) and Michigan Natural Features Inventory (MNFI) conducted the Stage 1 survey of Allegan State Game Area (ASGA, Figure 1) as part of the DNR's Integrated Forest Monitoring, Assessment, and Prescription System (IFMAP, now 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 review of Compartment 6 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 6, an overview of the known element occurrences and significant natural communities in Compartment 6, and management recommendations for the significant natural features in Compartment 6. 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.

Compartment Overview

Allegan State Game Area is in the central portion of Allegan County. There are 25 compartments in ASGA (Figure 1). Compartment 6 is in the northeast portion of the state game area, north and east of the Kalamazoo River.

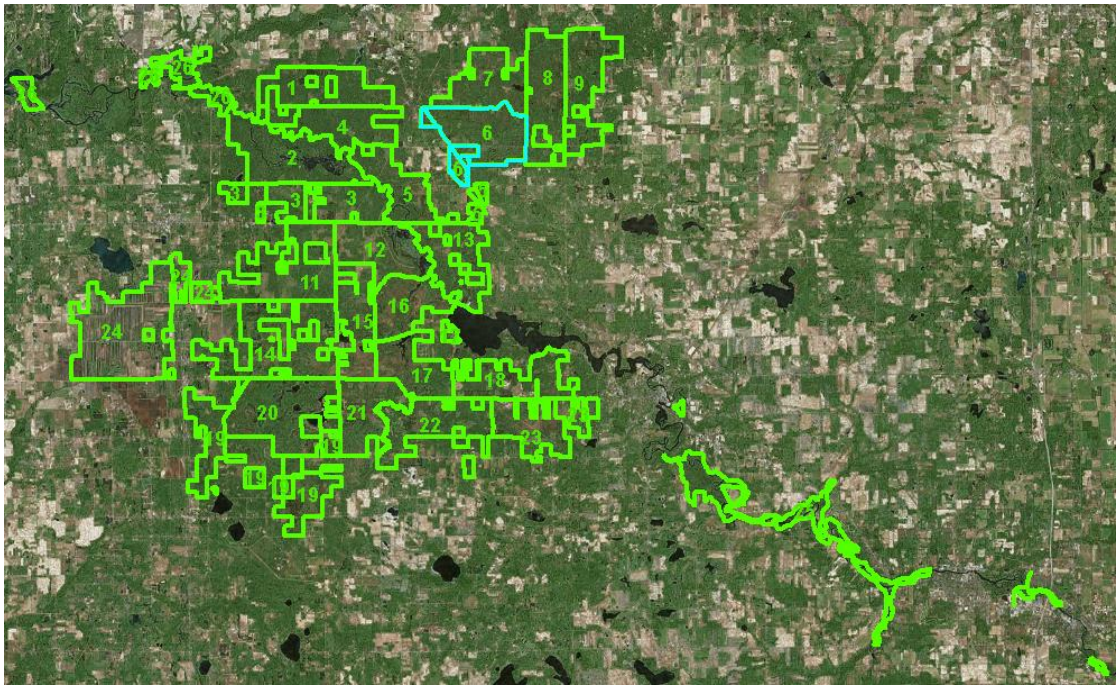

Figure 1: Compartment 6 is highlighted (blue) and is the focus of this report.

Ecoregional Context

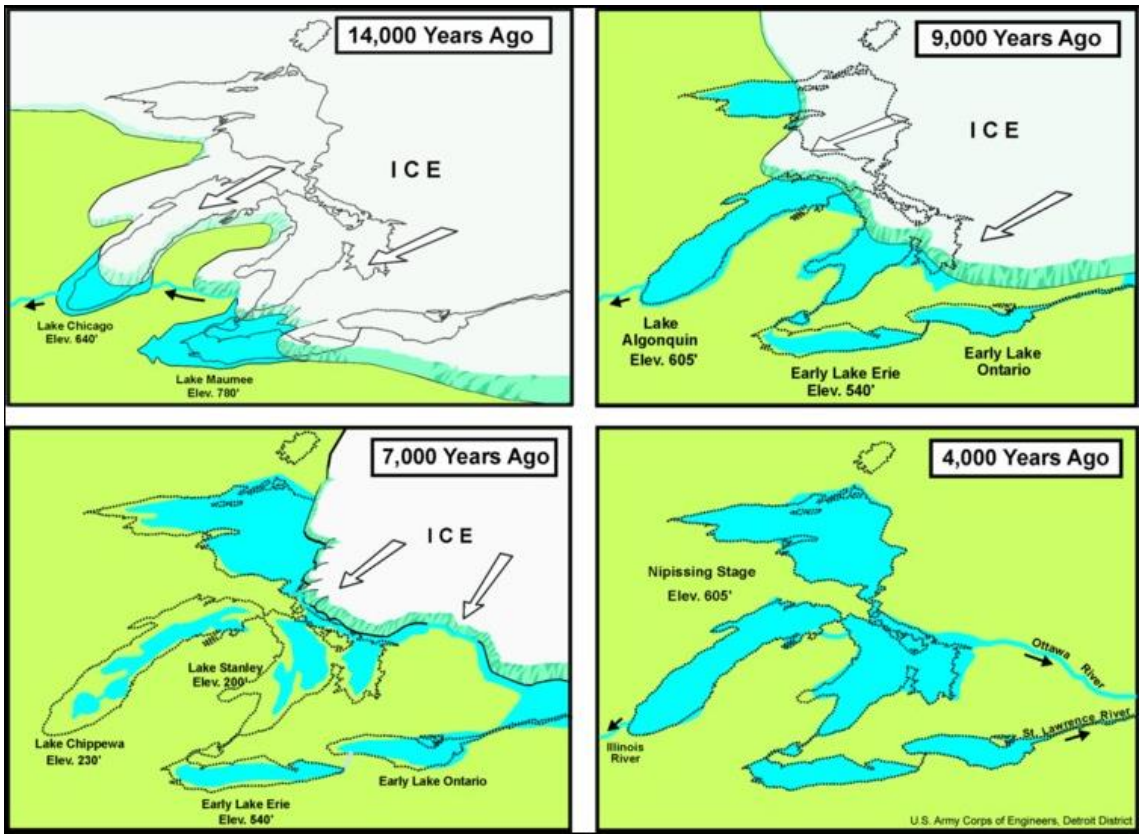

Figure 2: Stages of great Lakes development with the recession of the glaciers.

Around 14,000 to 10,000 years ago, melt waters from receding glaciers caused dramatic increases in the level of Lake Michigan (Figure 2). The western portion of Allegan County was under lake water and sands and clays were deposited at the bottom of this proglacial lake. Areas of lake plain are characterized by flat to gently rolling topography with well drained and excessively-well drained soils.

Based on the regional landscape classification by Albert (1995), ASGA lies nearly completely within the Southern Lake Michigan Lake Plain (Figure 3). The western portion of Compartment 6 falls within the Southern Lake Michigan Lake Plain ecological region and the eastern portion is within the Berrien Springs ecoregion.

The Berrien Springs ecoregion is characterized by a 10 to 20 mile wide band of morainal features, especially ground moraines, paralleling Lake Michigan. The moraines are bounded by flat lake plain to the west and outwash to the east. Soils are typically sandy loams underlain by gravelly sand or clays and are

typically moderately well drained or well drained. Occasional kettle depressions occur within the morainal landscape.

The topography of Compartment 6 has features more characteristic of lake plain than moraines. Some of the larger hills at the eastern end of the compartment are either old dune ridges or moraine. The remainder of the compartment is relatively flat, undulating topography with depression occupied by lowland forest or open marsh and uplands dominated by dry oak forest and oak-pine forests.

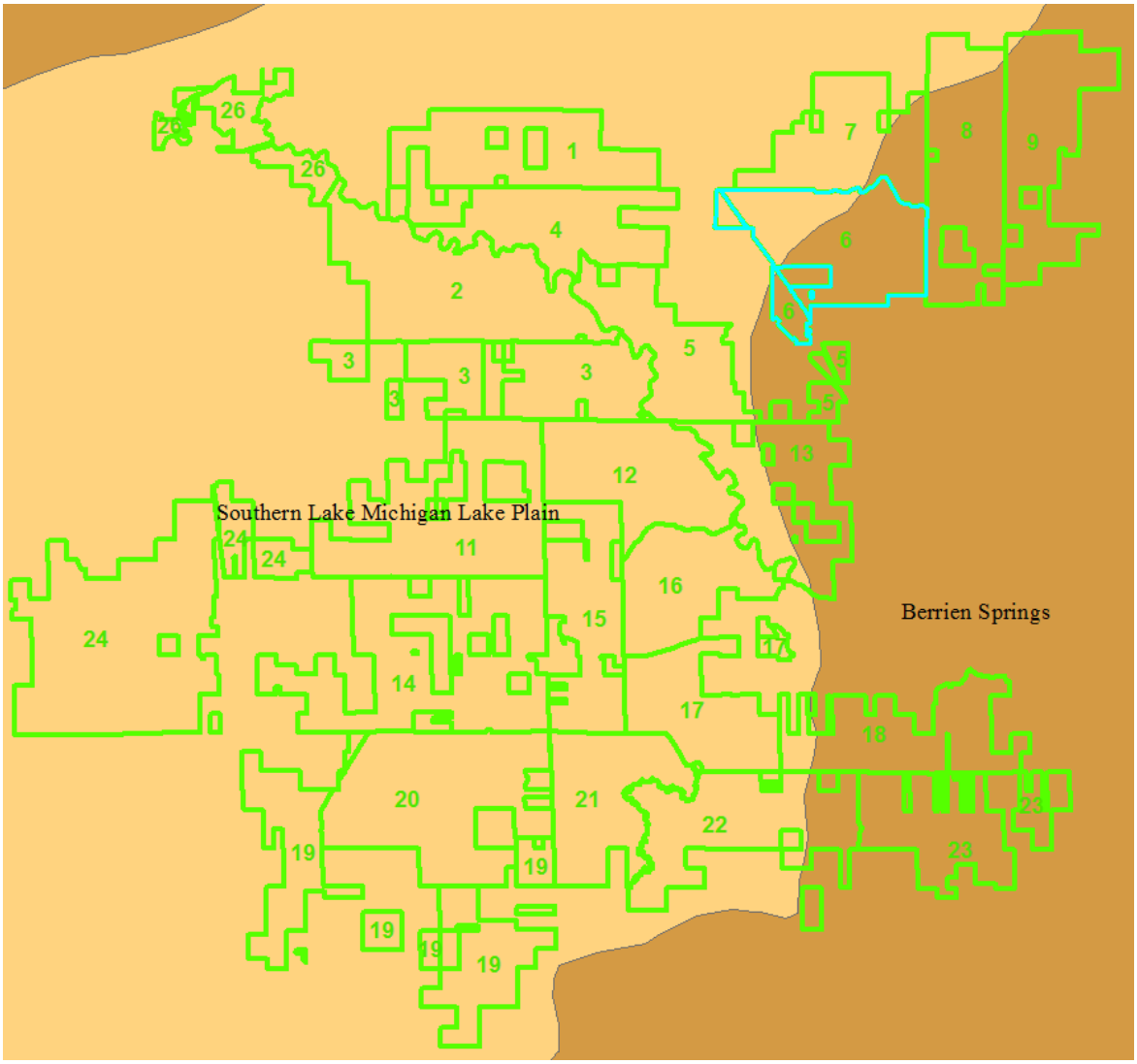

Figure 3: Ecoregions of Allegan State Game Area (Albert 1995).

Circa 1800 Vegetation

Historically, much of the game area was a mosaic of forested and non-forested uplands, with the non-forested areas supporting savanna ecosystems characterized by large open-grown oaks and pines with an herbaceous layer consisting of both prairie and forest species. Forests were predominantly dry-mesic northern forest, a forest type that consisted largely of white pine and mixed oak with the white pine forming a super canopy. Wetlands occur in outwash channels, kettle depressions, and lowlands associated with the Kalamazoo River, which is bordered by extensive tracts of floodplain forests. Lakes, marshes, bogs, inundated shrub swamps, intermittent wetlands, coastal plain marshes, and vernal pools within forested systems would have occupied the kettle depressions created by large blocks of ice left by the retreating glaciers. Outwash channels formed from glacial melt-waters would have been occupied by wet prairies, shrub swamps, and forested swamps.

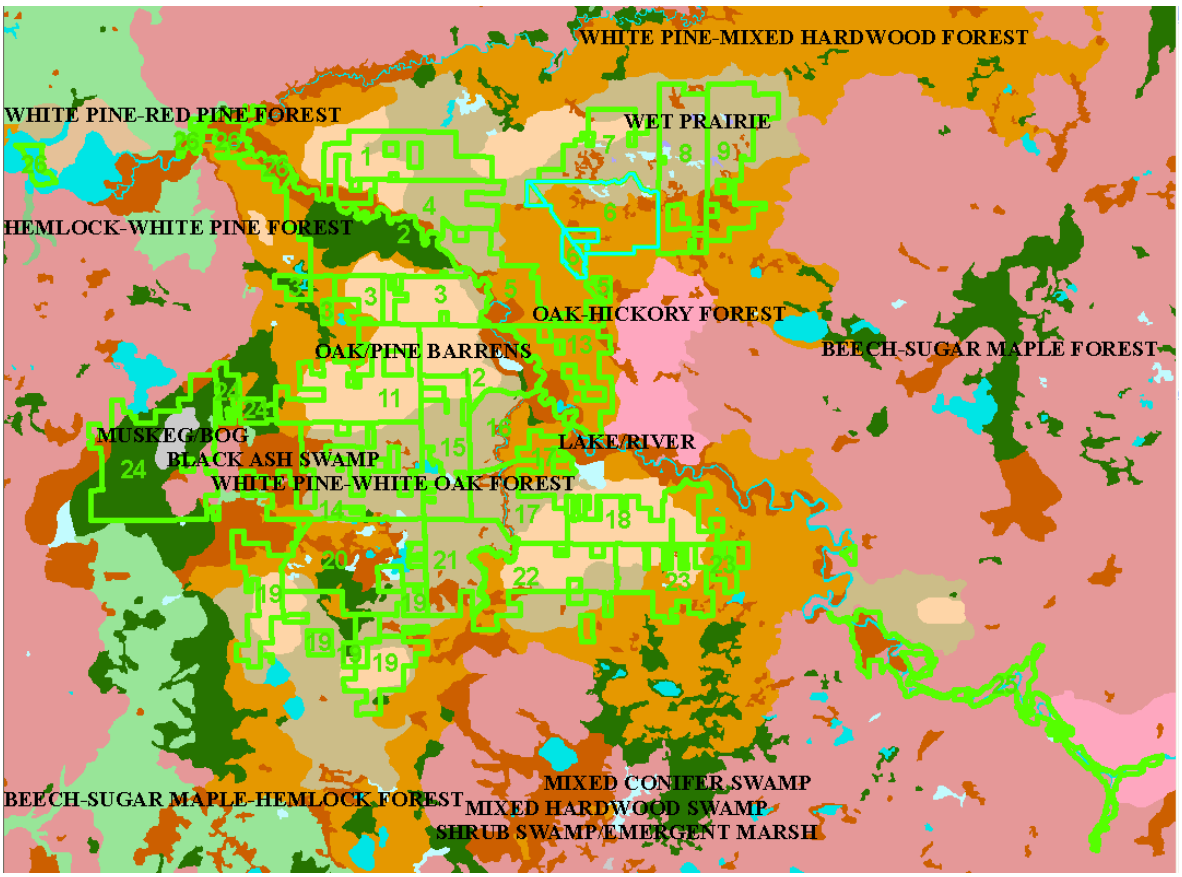

Figure 4: Circa 1800 vegetation cover of Allegan State Game Area and surrounding area (Comer et al. 1995). The region was characterized by white pine/white oak forests (beige/gray), white pine-mixed hardwood forest (tan), oak-pine barrens (beige), forested wetlands, and open wetlands.

Circa 1800 and Current Vegetation of Compartment 6

Compartment 6 consists of 2121 acres in the northeast portion of Allegan State Game Area (Figure 5). Aspects of the historic vegetation maps may not precisely reflect the extent of certain small-scale systems due to gaps in surveyor's notes; particularly emergent wetlands and hardwood swamps. The majority of the upland areas of Compartment 6 were dominated by white pine-mixed hardwood forests and the lowland areas were characterized by hardwood swamps, and emergent wetlands. Coastal plain marshes occurred throughout the compartment in depressions that occurred between old dune ridges. Small pockets of barrens may have also historically occurred in the western portions of the compartment, based on observations made during the IFMAP surveys. The outwash channel occupied by Bear Creek in the southern portion of the compartment has elements of floodplain forest and mesic northern forest and likely supported these systems historically.

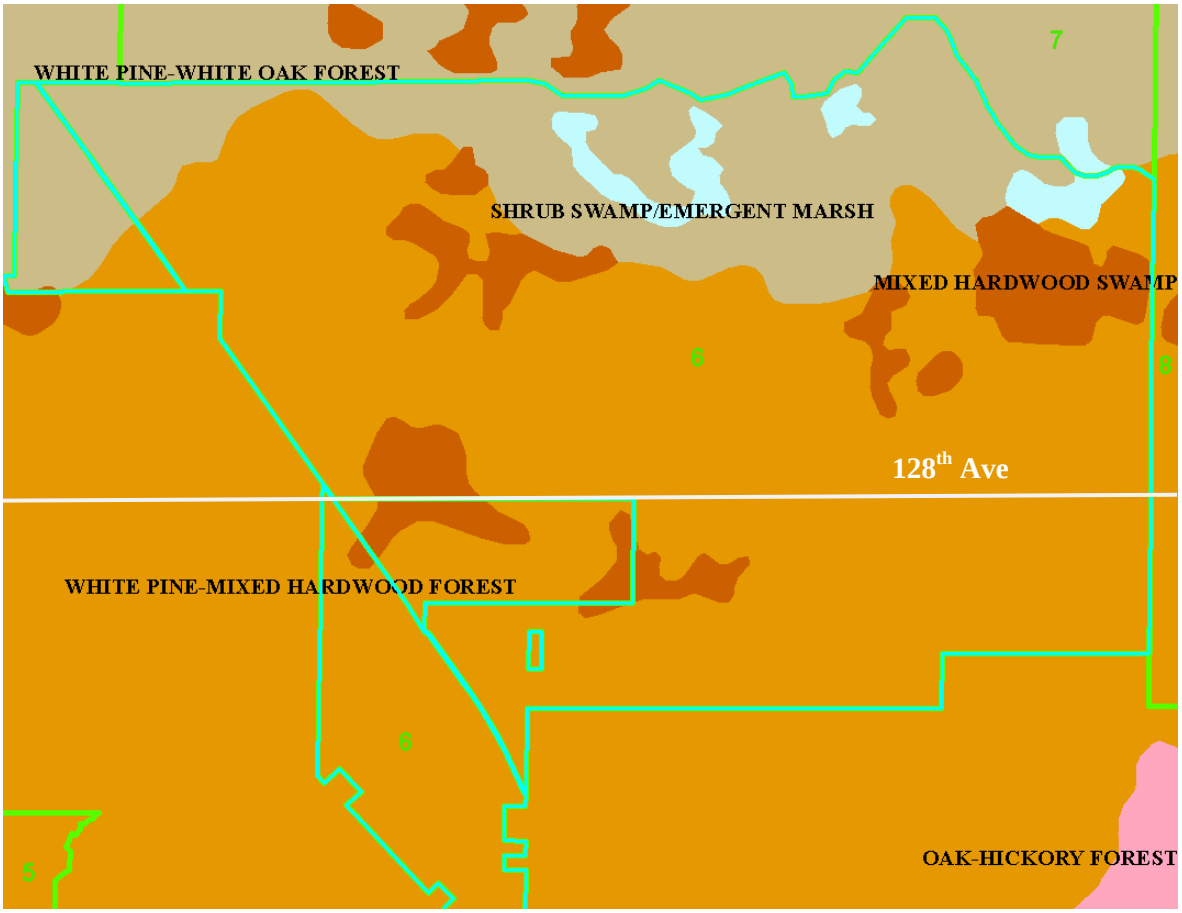

Figure 5: Approximate circa 1800 vegetation of Compartment 6. The two areas of Compartment 6 are separated by 128th avenue (Highlighted in white): Block 1, north of 128th Ave. and Block 2, south of 128th Ave.

The dominant forest cover type for Compartment 6 was dry-mesic northern forest. White pine (*Pinus strobus*) was nearly always a dominant or important canopy species within this forest type, often forming a supercanopy above other tree species. Hemlock (*Tsuga canadensis*) was historically present in wetter habitats and was occasionally codominant with white pine in the canopy or supercanopy, especially along steep slopes and mesic areas that were less fire prone.

Currently, most dry-mesic northern forests in this compartment are characterized by a significant hardwood component and lack of pine in many areas. Hardwood associates include white oak (*Quercus alba*), black oak (*Q. velutina*), red oak (*Q. rubra*), and red maple (*Acer rubrum).* Bracken fern (*Pteridium aquilinum*) often dominates the ground layer.

Characteristic species of the shrub layer include serviceberries (*Amelanchier* spp.), bush honeysuckle (*Diervilla lonicera*), huckleberry (*Gaylussacia baccata*), witch hazel (*Hamamelis virginiana*), American fly honeysuckle (*Lonicera canadensis*), choke cherry (*Prunus virginiana*), and blueberries (*Vaccinium* spp.).

Typical ground layer species include wild sarsaparilla (*Aralia nudicaulis*), pipsissewa (*Chimaphila umbellata*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), trailing arbutus (*Epigaea repens*), wintergreen (*Gaultheria procumbens*), twin flower (*Linnaea borealis*), partridge berry (*Mitchella repens*), gay wings (*Polygala paucifolia*), 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.

This community provides 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*) (Cohen 2000; Kost et al. 2007).

Many parts of Compartment 6 were historically dominated by southern hardwood swamp. Locally, this forest type occurred between dune ridges in seasonally inundated depressions with mineral soils. Today this community type is characterized by canopy dominance of red maple (*Acer rubrum*), pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), and green ash (*Fraxinus pennsylvanica*). Throughout this compartment, sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), basswood (*Tilia americana*), tulip tree (*Liriodendron tulipifera*), and quaking aspen (*Populus tremuloides*) occur as important subdominants. The unusual topography in Compartment 6 creates a matrix of lowlands with small upland inclusions that tend to be dominated

by red oak (*Q. rubra*), white oak (*Q. alba*), beech (*Fagus grandifolia*), and white ash (*F. Americana*).

Prior to the introduction and spread of Dutch elm disease, American elm was an important canopy constituent, but is now largely relegated to the subcanopy and sapling layers. Likewise, ash numbers are being greatly reduced by emerald ash borer and mortality of canopy ash is near total, though many small individuals persist in the subcanopy.

Other common understory species include saplings of canopy tree species (especially red maple), 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*), pink spring cress (*C. douglassii*), 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 sodalist*, Focal Species) also nest and/or roost in southern hardwood swamp, where they utilize large, mature trees and snags.

While the majority of Compartment 6 was forested, many lowland areas were occupied by 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 (*Rhyncospora 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*). In addition to the above, the following species are characteristic of coastal plain marsh: three-awned grass (*Aristida necopina*), bushy aster (*Symphyotrichum dumosum*), sedge (*Bulbostylis capillaris*), umbrella sedge (*Cyperus bipartitus*), Robin's spike-rush (*Eleocharis robbinsii*), pipewort (*Eriocaulon aquaticum*), dwarf bulrush (*Lipocarpha micrantha*, state special concern), Canadian St. John's-wort (*Hypericum canadense*), two-flowered rush (*Juncus biflorus*), brown-fruited rush (*J. pelocarpus*), round-headed rush (*J. scirpoides*, state threatened), bog clubmoss (*Lycopodiella inundata*), panic grass (*Dichanthelium spretum*), beak-rush

(*Rhynchospora capitellata*), tooth-cup (*Rotala ramosior*), tall nutrush (*Scleria triglomerata*, state special concern), bulrushes (*Schoenoplectus purshianus* and *S. smithii*), little ladies'-tresses (*Spiranthes tuberosa*), Virginia marsh St. John's-wort (*Triadenum virginicum*), lance-leaved violet (*Viola lanceolata*), and yellow-eyed-grass (*Xyris torta*) (Kost and Penskar 2000)

Summary of Natural Features in Compartment 6

Block 1

The narrative of Block 1 is complicated. It was likely logged in the late 1800s. Areas with mature trees and a high component of native species were likely logged earlier. Other areas were logged, converted to agriculture, and then abandoned.

The hydrology and topography may have prevented extensive agriculture in this area. Drier areas that were cleared may have been abandoned due to the drought-prone soils. Wetter areas likely fluctuated too dramatically for continuous agriculture. Numerous ditches throughout the compartment have likely lowered the water table leading to a loss of open wetlands as the sites became more favorable for encroachment by trees. This loss of wetlands is evident in the comparison of the 1938 and 2009 aerial imagery (Figure 6).

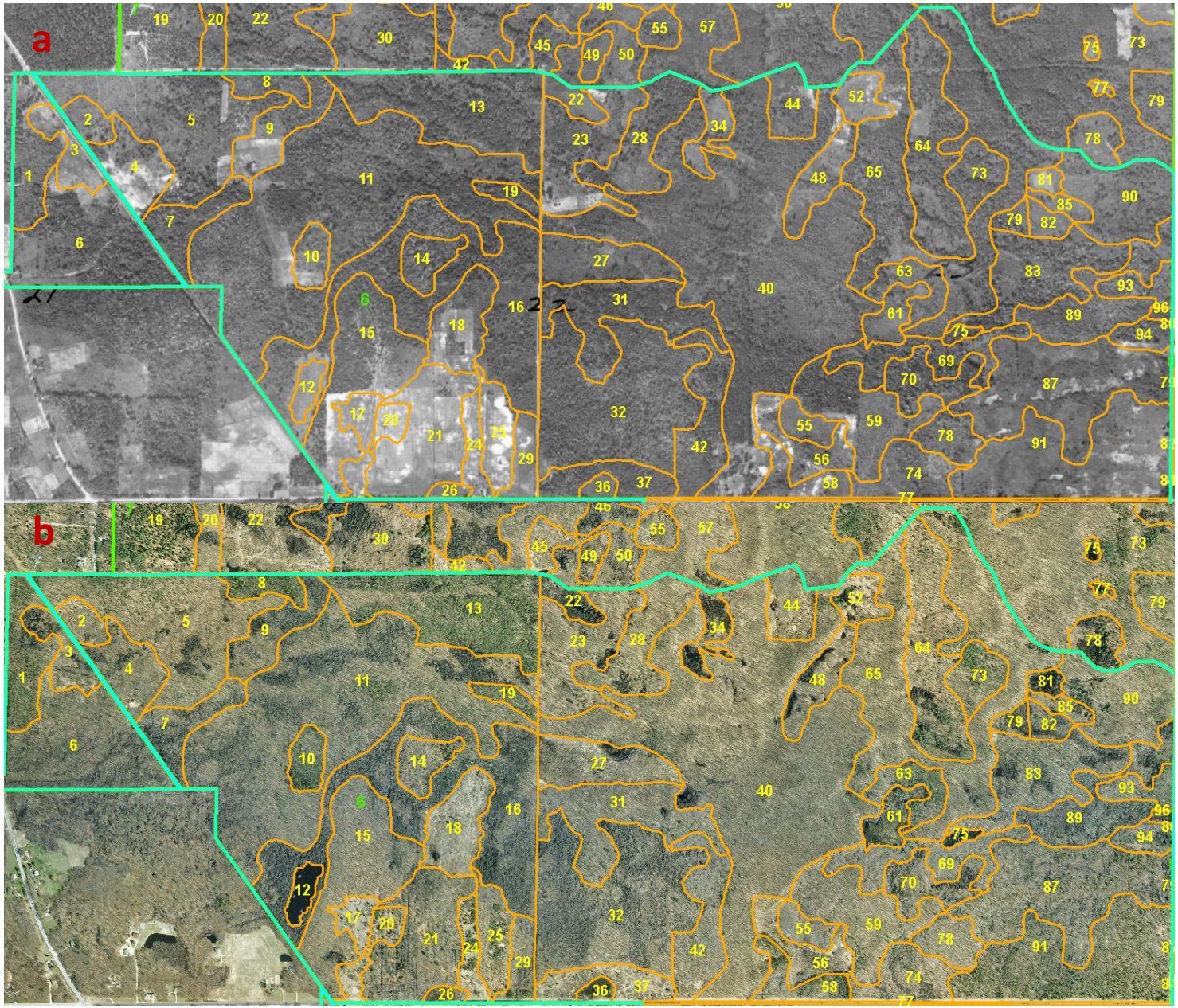

Figure 6: Compartment 6, Block 1, north of 128th St. Imagery showing land cover in1938 (a), and recent leaf-off imagery from 2009 (b).

The topography of Block 1 is relatively flat with old dune ridges that correspond to upland oak forests and shallow depressions that tend to be occupied by oak-maple swamps and coastal plain marshes. The soils are generally well drained sands with marl or clay lenses likely occurring under the sands where there are wetlands. The pines that were historically a dominant portion of the canopy tend to be lacking and there are frequent stumps from past logging events (Photo 1).

Photo 1: Pine stumps from historic logging events in the 1800's occur in upland forests throughout the compartment. Photo by Jesse Lincoln

Some stands of mature forest within the compartment continue to support a significant pine component that is likely similar to historic cover types. These stands include: 13, 63, 73, 90, and the southern portion of 64.

Several other forests lack the pine component and have shifted towards dry southern forest. Stands 40, 65, and 90 are a relatively high-quality forest that are over 100 years old and dominated by black and white oak.

There are large areas of mature lowland forest throughout this block that are of interest. Stands 6, 7, 11, 16, 32, 83, and 89 are examples of relatively high-quality southern hardwood swamp, though most are a mosaic of lowland and upland forest. The variable nature of the topography in these forests provides a wide array of habitats for plants and animals.

The most unique aspects of this part of Compartment 6 are the coastal plain marshes. This natural community is particularly prevalent in this part of the state game area and can be found in Compartments 7, 8, and 9 and 20.

Two known coastal plain marsh EOs occur in this compartment. The first is primarily associated with Stands 22 and 34 and extends into portions of stands 23, 28, and 40.

Photo 2: An old ditch in the coastal plain marsh in Stand 22. Photo by Jesse Lincoln.

The zones of open coastal plain marsh in Stands 22, and 34 (and most other open marsh areas) have declined by an estimated 95 % in area over the past several decades (Figures 6 and 8). This is likely because of ditching (Photo 2) – which has lowered the water table – and fire suppression. Both fire suppression and ditching have facilitated woody encroachment throughout this compartment.

Photo 3: A small coastal plain marsh opening in the southern part of Stand 34. Photo by Jesse Lincoln.

The northern portion of Stand 34 was open in the 1930s but has since become completely dominated by trees (Photo 4).

Photo 4: The northern portion of Stand 34 is completely dominated by southern pin oak and red maple. Photo by Jesse Lincoln.

The second coastal plain marsh EO is in stand 81 and 85 and also Stand 78 in Compartment 7. Like the other coastal plain marsh, this stand is becoming dominated by trees and is likely on a trajectory towards southern hardwood swamp.

A previously undocumented coastal plain marsh occurs in Stand 12 where a new population of three-ribbed spike-rush (*Eleocharis tricostata*, State Threatened) was found. The occurrence of this species is a good indicator that other species restricted to this habitat may be present and additional rare plant surveys are warranted.

Photo 5: Ditch through coastal plain marsh in Stand 12, late December 2014. Photo by Jesse Lincoln.

Photo 6: Stand 12 holds several feet of water during wet years - indicated by the water lines on the tree - but can be nearly dry in other years. Photo by Jesse Lincoln.

There are several additional areas of coastal plain marsh in Compartment 6 that should be surveyed for rare species. Stands 48 and 52 are adjacent and have similar hydrology and species composition to other areas of coastal plain marsh in the compartment. Likewise, the southern portion of Stand 64 has large openings that support wetland plants, including long-leaved panic grass (*Panicum longifolium*, State Threatened). A drastically fluctuating water table has led to widespread tree mortality in Stand 64 where trees over 100 years old died due to inundation in 2009 (Photo 7).

Photo 7: Mortality of mature trees in Stand 64 as a result of dramatically increased water levels in 2009. (Picture from December 2014). Photo by Jesse Lincoln.

Several additional wet depressions in Compartment 6 that are too small to be mapped in MiFI may be found to harbor species characteristic of coastal plain marshes and should be surveyed for additional populations of rare plants.

Stand 61 is continuously inundated and is occupied by a relatively high-quality southern wet meadow. This meadow is dominated by tussock sedge (*Carex stricta*), wool grass (*Scirpus cyperinus*), and Leatherleaf (*Chamaedaphne calyculata*), with zones of black gum (*Nyssa sylvatica*) at the margins and areas of open sphagnum throughout (Photo 8). Like other wetlands in this compartment, the lack of fire is leading to woody encroachment and the loss of open wetland habitat.

Photo 8: Wet meadow in Stand 61. Photo by Jesse Lincoln.

Management Recommendations for Block 1

Management recommendations are based on documented element occurrences within Compartment 6 as well as observations made during initial vegetation surveys in 2011. Species of greatest conservation need were also considered where applicable.

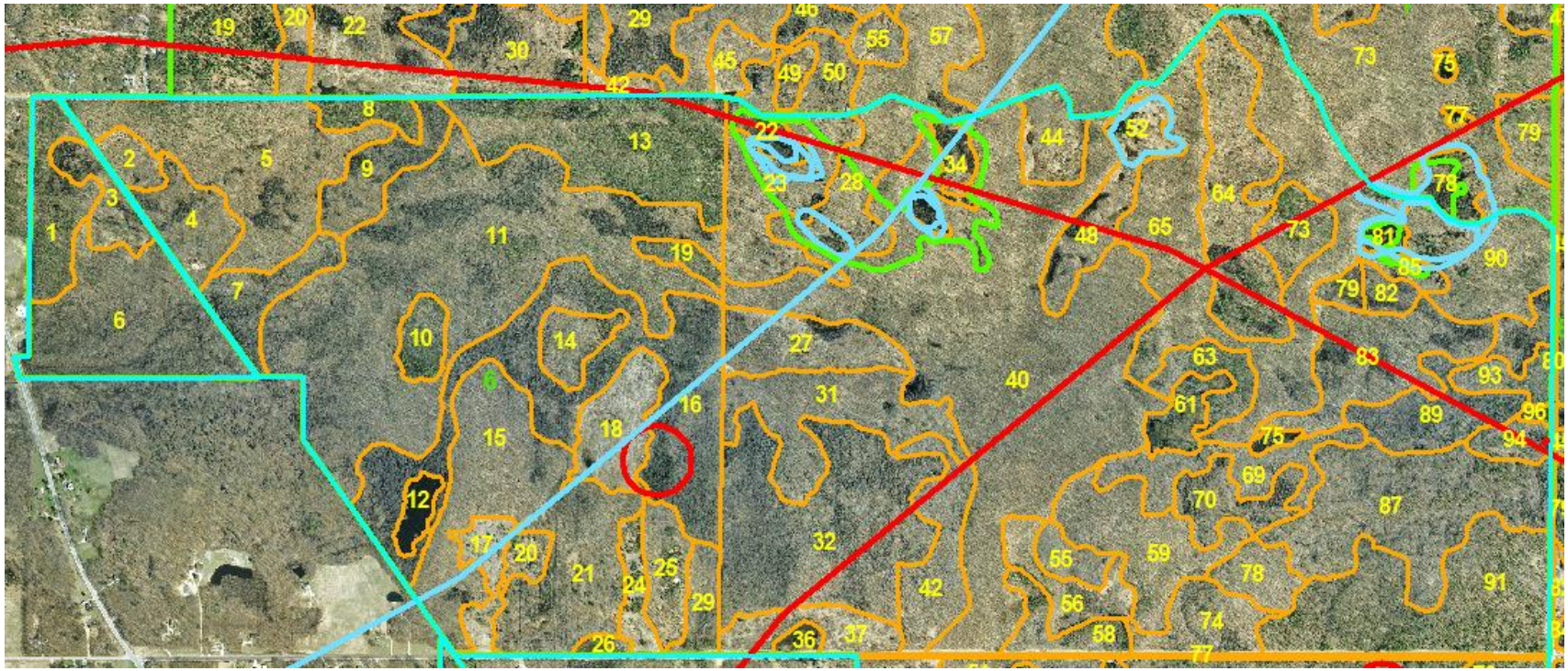

Figure 7: Block 1 with element occurrences mapped. Green polygons are documented natural communities and are coastal plain marshes. The plant element occurrences are delineated in blue and with the exception of a historical record of whiskered sunflower, all plant occurrences are species associated with the coastal plain marshes. There are two recent animal element occurrences, eastern box turtle in Stands 16 and 18 and a red-shouldered hawk in Stand 94. The other occurrences are historical and not associated with this compartment.

Natural Communities

Block 1 has expansive areas of mature and maturing forest that is nearing late-successional stages. Maintaining large blocks of unfragmented dry-mesic forest provides benefits to a range of species, particularly to migrating birds that find cover in the pines in the subcanopy. There are no documented high-quality forested ecosystems in this compartment, however there are several stands with mature trees that are relatively high-quality and provide enormous benefit to wildlife. The most important upland forests are in Stands 13, 40, 63, 65, 73, and 90. These are dry to dry-mesic forests that tend to be fire suppressed and there are several areas where red maple and black cherry are dominating the subcanopy. These systems would benefit from periodic, low-intensity ground fires that would stimulate oak and pine regeneration while reducing the dominance of mesophytic species (i.e., red maple and black cherry) in the subcanopy.

Throughout Block 1 are large areas of forested wetland that are relatively high-quality. Though there are no documented element occurrences of southern hardwood swamp, Stands 6, 7, 11, 16, 32, 83, and 89, are mature forests that provide critical habitat for several species. The management recommendations for these stands are to let these stands continue maturing, prevent further changes to hydrology, allow prescribed fires to extinguish naturally within these wetland systems. The large blocks of upland and lowland forest in Compartment 6 provide critical habitat for the numerous species of greatest conservation need that were observed in this area. These species include Cooper's hawk, red-shouldered hawk, woodcock, black- and yellow-billed cuckoo, chuck-will's widow, red headed woodpecker, northern flicker, Acadian flycatcher, blue winged warbler, and black-throated blue warbler. In addition, Cerulean warbler (*Denroica cerulea*, State Threatened), a WLD Focal Species, has been observed just northeast of the compartment and could be found within the compartment, in both mature forested wetland and mature upland forest.

As described before, there are several documented occurrences of coastal plain marsh in Compartment 6. In the north-central portion of the compartment is EOID 4306 which has two primary openings remaining in Stand 22 and the southern portion of 34. In the northeast portion of the compartment is EOID 5466, which occupies Stands 81 as well as 78 of Compartment 7. Many other pockets of coastal plain marsh exist throughout the compartment, including Stands 12, 48, 52, and 64. It is likely that many of the other small openings

throughout this compartment harbor coastal plain marsh species.

One of the defining characteristics of this community type is the vegetation which is often composed of species more typical of the Atlantic and Gulf coastal plains. Fire suppression facilitates shrub and tree establishment during low water years and allows for the buildup of a thick layer of litter, which stifles seed germination and seedling establishment. As coastal plain marshes contain a unique suite of coastal plain disjuncts, the loss of any single marsh may negatively impact population dynamics at other sites by eliminating opportunities for genetic exchange and recolonization (Kost and Penskar 2000).

We estimate that many coastal plain marshes in this compartment have been reduced by up to 95% over the past century as a result of ditching and fire suppression (Figure 8).

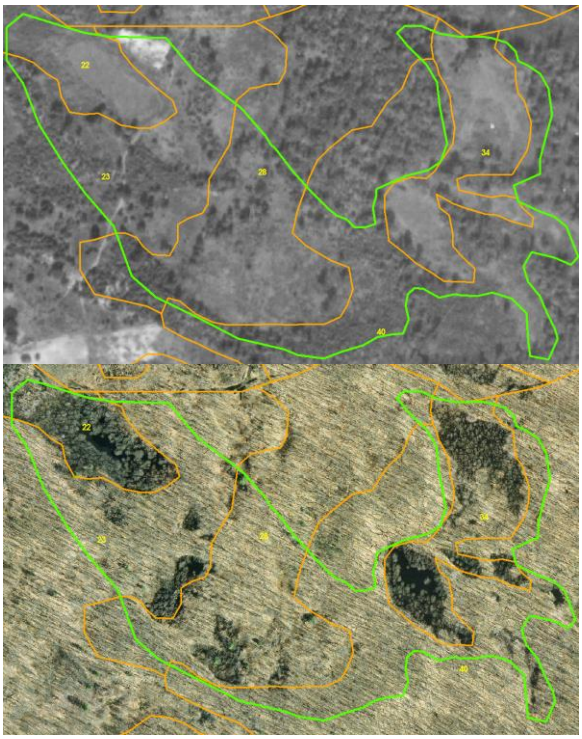

Figure 8: The loss of coastal plain marsh over the past 80 years. Open marsh has transitioned to forest over the past several decades as a result of ditching and fire suppression. Top image is from 1938; bottom from 2009. Green line indicates mapped element occurrence of coastal plain marsh.

Coastal plain marshes occur as shallow depressions within a fire-dependent matrix of upland forest and barrens. Management of coastal plain marsh with prescribed fire, which should include burning adjacent wetland and upland communities, can be used to stimulate flowering and seed germination, reduce encroachment of woody plants, and maintain a diverse seed bank. Because these areas tend to be inundated in winter, spring, and early summer, it may be necessary to target these

areas with late-season burns, particularly during drought years when the graminoids form a dense layer and can carry a flame.

Due to the prolonged periods of fire suppression in portions of this compartment, it may be necessary to perform repeated burns every 2 or 3 years for the foreseeable future. The adjacent uplands are also fire-adapted communities and there are several undocumented pockets of coastal plain marsh throughout this compartment; therefore, the best approach for maintaining this habitat type is likely large-scale prescribed burns that include several stands, using the roads as burn breaks.

Because many areas of coastal plain marsh in this compartment are transitioning to forest, it may be necessary to suppliment prescribed burns with targeted tree removal or girdling. These systems are highly susceptable to invasive species and major disturbance like logging may introduce undesirable species. Further, it is likely that heavy equipment will influence the hydrology due to the fact that the soils rut easily. Therefore, it is recommended that target trees within stands occupied by coastal plain marsh be girdled when possible and and remain in place to help revert these systems back to open wetland. Any timber harvest in and around these wetlands should be avoided, but if necessary, conducted when the ground is frozen. All logging equipment should be washed to remove or sterilize propagules of invasive species. We recommend killing or removing of 50 to 80 % of the canopy in lowland stands adjacent to coastal plain marsh openings.

Plants

There are several rare plant species that have been previously documented within Block 1, all associated with coastal plain marsh EOs. Plants characteristic of coastal plain marsh tend to have the majority of their populations along the Atlantic and Gulf coast with several satellite populations occurring sporadically throughout the eastern United States. Long-leaved panic grass (*Panicum longifolium*, State Threatened) typifies this distribution pattern and within Michigan has been found only in the coastal plain marshes of ASGA and only in Compartments 6, 7, and 8 with the next nearest population several hundred miles away (Figure 9).

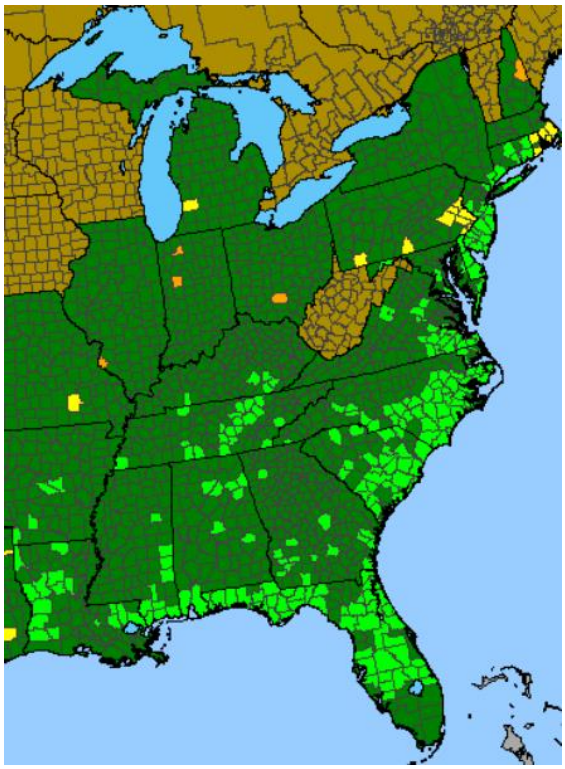

Figure 9: The distribution of long-leaved panic grass (Kartesz 2014). This pattern is similar to other species associated with coastal plain marsh. Dark green signifies presence within a particular state. Light green indicates species is present in a particular county and not rare. Yellow indicates species is present and rare. Orange indicates species is extirpated.

Long-leaved panic grass occurs in Stands 22 and 34 (and potentially in the southern portion of Stand 64, not enough material to confirm ID), as does three-ribbed spike-rush (*Eleocharis trichostata*, State threatened), which was also found in Stand 12. Black-fruited spike-rush (*Eleocharis melanocarpa*, State Special Concern) is documented from Stands 52 and 81. Two species of meadow beauty have also been documented in this compartment, *Rhexia mariana* (State Threatened), in Stand 52 and *R. virginica* (State Special Concern) in Stand 81.

Finally, there was a historical record of whiskered sunflower (*Helianthus hirsutus*, State Special Concern) collected in 1894 with "Hamilton" as the only locational information. This species is typically found at the margins of dry forests. In 2014 a population was located in Compartment 12 along a linear clearing above the high-banks, near a high-quality oak-pine barrens.

All of the rare plants documented within this compartment are coastal plain marsh obligates. The dynamic nature of the community means that they may be present one year and then absent for several years. Further, each one of these species may be present in any and all of the coastal plain marshes throughout this compartment but were not observed at the time of survey because conditions were not ideal. There may also be additional rare species that are coastal plain marsh obligates such as Hall's bulrush (*Schoenoplectiella hallii*, State Threatened), dwarf burhead (*Echinodorus tenellus*, State Endangered), and several others.

Actions to protect these populations of rare plants should be centered on preservation and protection of the coastal plain marsh systems. It is critical to avoid altering hydrology with ditches, roads, or logging ruts as these actions

will favor invasive species or accelerate succession towards forested swamp by lowering the water table. Returning fire to the landscape, particularly in the late summer or fall during drought years, is critical to maintaining these marshes as open and preventing further loss to woody encroachment. Finally, low-impact tree removal may be necessary in some areas where fire tolerant and flood tolerant trees have already taken hold.

Animals

There are two recent animal element occurrences within this block. Two eastern box turtles (*Terrapene carolina carolina*, State Special Concern) were found in Stand 16 in 1995. The eastern box turtle is Michigan's only truly terrestrial turtle and has been identified as a Focal Species by the WLD. It typically occurs in forested habitats with sandy soils near a source of water such as a stream, pond, lake, marsh or swamp. Box turtles may also be found in adjacent thickets, old fields, pastures, or savannas. Access to unshaded nesting sites in sandy, open areas, is critical for successful reproduction. The open habitats in Stands 17, 20, and 24 offer suitable nesting habitat for box turtles and these stands should be maintained with mowing and prescribed fire to prevent further woody encroachment.

A red-shouldered hawk (*Buteo lineatus*, State Threatened) was documented in Stand 94 in 2000. This species nests in a variety of habitats but is closely associated with mature forests adjacent to wet meadow and swamps. Large, contiguous blocks of mature forest with greater than 70 % canopy closure, large trees for nesting, and abundant associated wetland habitat are ideal for protecting this species. All of these conditions exist in Compartment 6 and it is likely that this will continue to be an ideal place for nesting for this raptor.

Cerulean warbler (*Denroica cerulea*, State Threatened) was observed just northeast of this compartment and could be found utilizing mature forest within the compartment. This species has been identified as a Focal Species by the WLD. This species is known to occur in landscapes consisting of large blocks of mature deciduous forest. Although cerulean warblers are at the northern edges of their breeding ranges in Michigan, they can be locally common breeders in forested landscapes in the southern Lower Peninsula. Cerulean warbler is considered an area-sensitive species. Hamel (1992) noted that the needs of cerulean warbler may be compatible with low-intensity timber management (e.g., single-tree selective removal) that mimics natural forest gap-phase dynamics.

The maintenance and expansion of mature forest blocks within the compartment would

benefit cerulean warblers and other forest-interior species, such as Acadian flycatcher, hooded warbler, and wood thrush. We recommend conducting songbird point counts periodically to monitor use of the compartment and surrounding area by this rare species.

There are three historical records of rare animals with a large amount of uncertainty associated with the location of their occurrence. Two woodland voles (*Microtus pinetorum*, State Special Concern) were found near the Kalamazoo River in 1939. The woodland vole occurs in deciduous woodlands with loose sandy soils, deep humus, and heavy leaf litter. Although it prefers deciduous forests comprised of oak, maple and/or beech, the woodland vole can potentially be found in any forest type.

A least shrew (*Cryptotis parva*, State Threatened) was found in this area in 1935. Little information other than "8 miles NW of Allegan" is available for this occurrence. The least shrew inhabits dry upland meadows with dense coverage of grasses and forbs. It can also be found in marshy areas, fencerows, and woodland edges. Nests are often found tucked under rocks, logs, discarded lumber, metal sheeting, and hay bales left in fields over winter.

A Blanchard's cricket frog (*Acris crepitans blanchardi*, State Threatened) was found in 1961 at a site named "Swan Creek High-banks Unit." Though this site is likely not located within this compartment, there are several areas of suitable habitat for this species within this compartment, particularly around the coastal plain marshes. Blanchard's cricket frogs typically inhabit the open edges of permanent ponds, lakes, floodings, bogs, seeps and slow-moving streams and rivers. They also can utilize temporary water bodies if near permanent water. They prefer open or partially vegetated mud flats, muddy or sandy shorelines, and mats of emergent aquatic vegetation in shallow water. This frog usually does not leave the vicinity of water after the breeding season except during rainy weather

Coastal plain marshes offer excellent habitat for game species as well. The dynamic nature of the hydrology in these systems makes them attractive to migrating waterfowl and several marshes were observed holding up to a few dozen wood ducks when surveyed in 2011.

Photo 9: Water marks on pin oak in Stand 22, December 2014. Several wood ducks were observed here in 2011. Photo by Jesse Lincoln.

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. Maintenance of coastal plain marshes with late season fire and targeted tree girdling would likely protect these openings for continued use by a variety of migrating waterfowl.

Coastal plain marshes were also observed to be used by deer. Several large scrapes were observed in open stands throughout the compartment (Photo 10). These openings may also provide cover for fawns, particularly in dry years when there is high vegetaion. Coastal plain marshes also likely act as watering holes as there are few streams or permanent bodies of water in the immediate vicinity.

Photo 10: A deer scrape in the opening of Stand 34. Photo by Jesse Lincoln.

Additional Notes

One of the major threats to the ecological integrity of wetlands in this compartment is invasive species. Though the wetlands were currently free from obvious infestations, there are established invasive species at the margins of this compartment that threaten the long-term health of coastal plain marshes. Non-native phragmites, European alder, purple loosestrife, and narrow-leaved cat-tail were all observed along 128th Ave at the margins of Stands 36 and 37. These should be treated and controlled immediately to prevent additional spread within the compartment. Without treatment, there is reasonably high potential that they infest sensitive systems within this compartment.

Though oak-pine barrens were not historically a prevalent cover type in this compartment, there are areas that may be suitable for managing as savanna. Lupine was observed along the railroad adjacent to stands 1, 2, and 3. These stands might be good candidates for managing as barrens due to the presence of characteristic vegetation. Likewise, Stand 17 had several characteristic barrens species present and an ideal physiognomy for managing as barrens. Eastern towhee, bluebirds, and field sparrow were observed within this stand. This stand may also offer critical nesting habitat for eastern box turtles which have been observed in nearby stands. Though this stand has been tilled and is not particularly high-quality, it offers a reasonable opportunity for improving and expanding barrens habitat. We recommend that management actions include application of prescribed fire and periodic mowing to expand openings and reduce woody encroachment.

The following management recommendations for Block 1 are provided for your consideration:

- Important upland forests
    - Stands 13, 40, 63, 65, 73, and 90
    - Allow fire to carry into forests; vary seasonality and intensity of burns
    - Allow forests to continue maturing and avoid fragmentation
    - Limit fragmentation and provide forested buffers between intensive forestry activities to assist obligate forest interior birds such as migrating warblers including cerulean warbler
    - Maintain large diameter trees to function as nesting and roosting locations for species such as red shouldered hawk and Indiana bat
    - Survey for cerulean warbler
- Important lowland forests
    - Stands 6, 7, 11, 16, 32, 83, and 89
    - Prevent further alterations to hydrology
    - Allow fire to carry into forests
    - Allow forests to continue maturing and avoid fragmentation
    - Excellent habitat for several species of greatest conservation need
    - Good for Indiana bat which feeds on aquatic insects
    - Red-shouldered hawk observed in several areas
    - Maintain large diameter trees to function as nesting and roosting locations for species such as red-shouldered hawk and Indiana bat
    - Survey for cerulean warbler
- Important coastal plain marshes
    - Stands 12, 22, 34, 48, 52, 64, and 81
    - Additional opportunity in portions of Stands 23, 28, 40, and 27
    - Avoid disturbing soil and hydrology, prevent logging equipment from entering
    - Prevent horse trails from entering
    - Burn when possible, late season burns in dry years will provide the best fuel load
    - Targeted tree removal through girdiling to reverse succession
    - Prevent ORV use
    - Survey for rare plants associated with coastal plain marsh
- Wet meadow in Stand 61
    - Monitor for invasive species
    - Allow prescribed fire to extend into this stand

- Manage for barrens habitat
    - Thin and burn Stands 1, 2, 3, and the NW portion of 5
    - Burn and mow Stand 17
- Treat invasive species along 128th Avenue
    - Particularly within Stands 36 and 37
    - Target phragmites, European alder, narrow-leaved cat-tail, purple loosestrife
- Trap/kill raccoons and other mesopredators to reduce predation on herptiles and birds

Block 2

Block 2 of Compartment 6 is entirely south of 128th Ave. This block is has been impacted by farming and logging to a much greater extent than Block 1 (Figure 10).

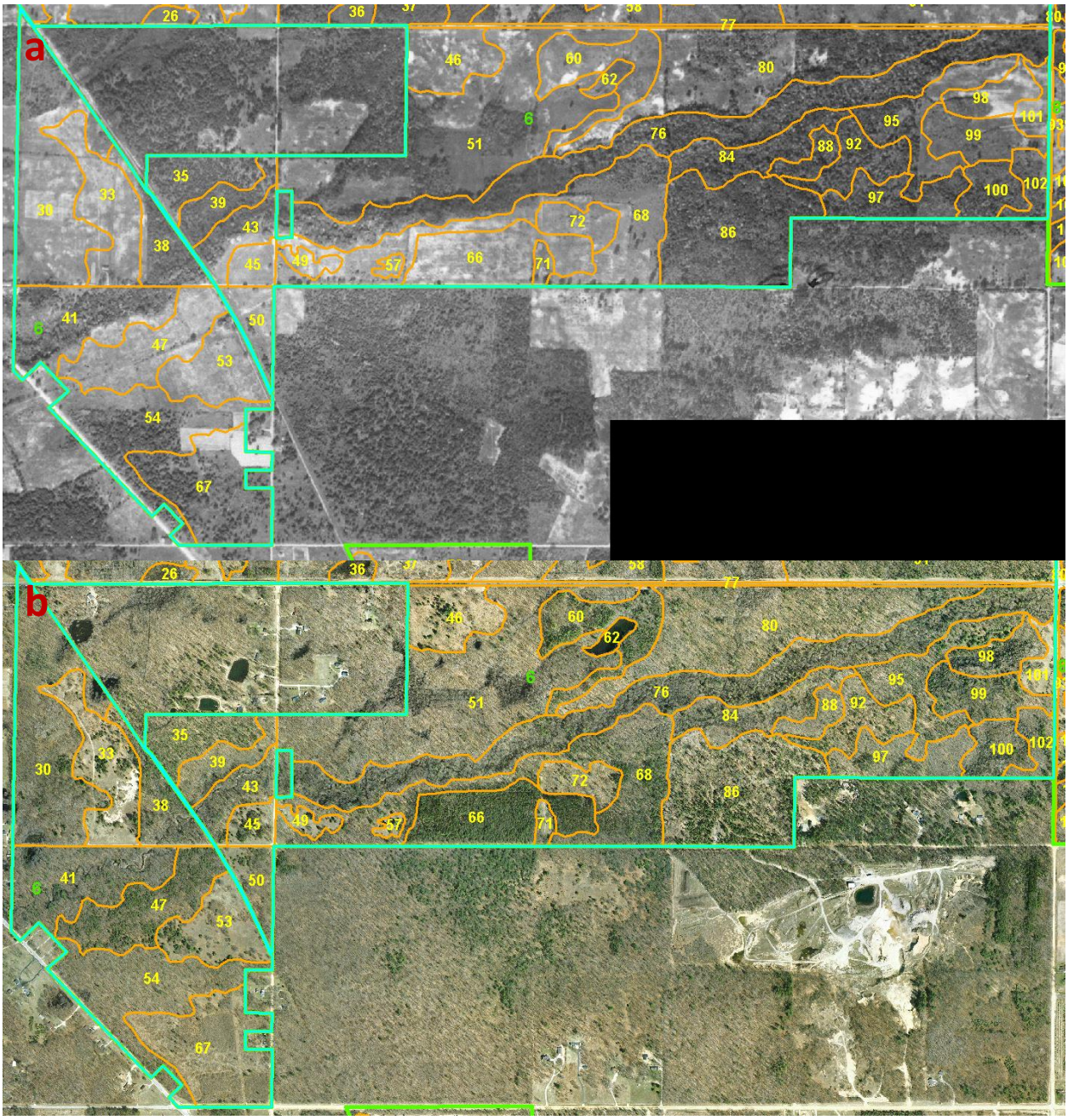

Figure 10: Compartment 6, Block 2, south of 128th St. Imagery showing land cover in1938 (a), and recent leaf-off imagery from 2009.

Bear Creek is the most significant natural feature of Block 2. This small stream is bounded by a mature, relatively high-quality mesic forest. The forest associated with Bear Creek has elements of mesic northern forest, southern hardwood swamp, and dry-mesic northern forests in the drier portions. The high-quality forests associated with Bear Creek are Stands 41, 38, 43, and 76.

Additional small pockets of relatively high-quality mature forest persist in Stands 35 and 54 and the eastern portion of Stand 80. These are primarily dry-mesic northern forest

Stand 62 was dominated by floating aquatic vegetation at the time of survey in 2011 and may harbor rare coastal plain marsh species in dry years.

Some stands have elements of oak-pine barrens. Stands 33, 45, 49, and 57 have at least a few species characteristic of barrens including little bluestem, three-awned grass, wormwood, and others. These stands are particularly vulnerable to abuse by ORVs and Stand 33 is particularly degraded.

Management Recommendations for Block 2

Natural Communities

No natural communities have been documented in this block. Areas of mature, relatively high-quality forest occur primarily in stands adjacent to Bear Creek and these areas should be allowed to continue maturing to benefit species such as red-shouldered hawk, cerulean warbler, Indiana bat, and Louisiana water thrush. Bear Creek makes an excellent fire break and compartment-wide prescribed burns could take advantage of this feature.

Areas of mature dry-mesic northern forest occur in Stands 35, 54, and 80. Like similar areas in Block 1, these stands would benefit from prescribed burns that would help regenerate oak and pine while reducing invasive species and mesophytic invaders like red maple and black cherry.

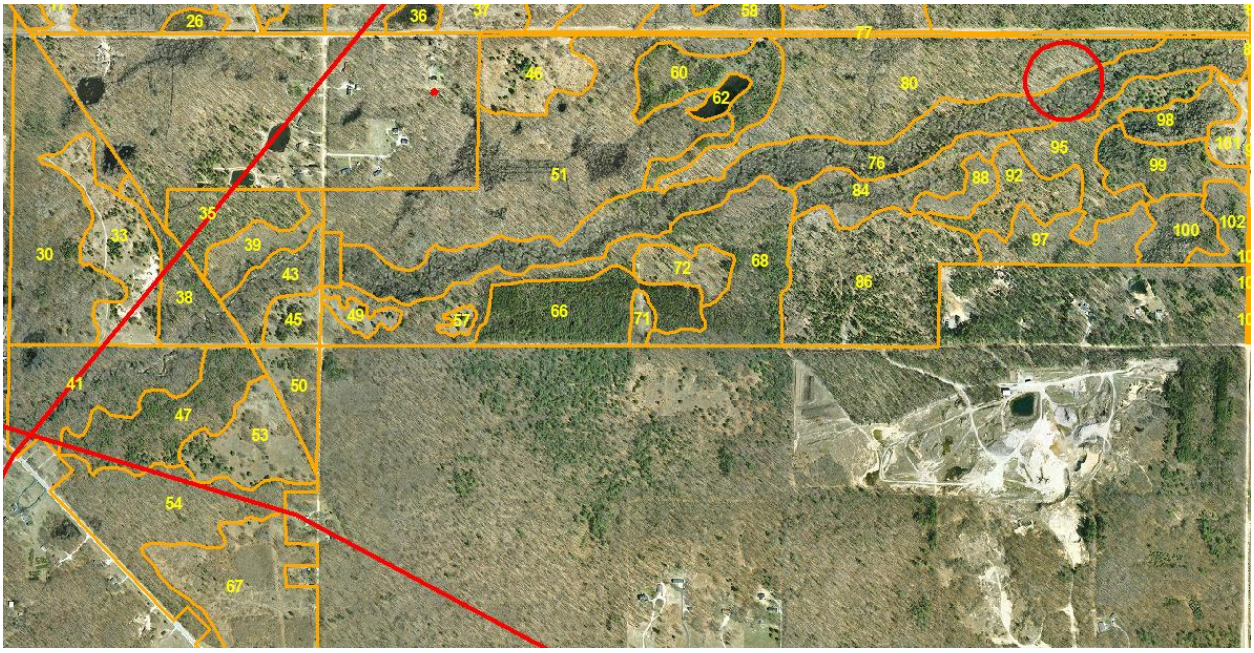

Figure 11: Block 2 with element occurrences mapped. A red-shouldered hawk nesting in eastern Stand 80 is the only recent element occurrence within this stand. The other occurrences are historical and not associated with this compartment.

Plants

There are no rare plant records from Block 2. Pumpkin ash (*Fraxinus profunda*, State Threatened) was observed along Bear Creek, upstream in Compartment 8. There is abundant suitable habitat throughout the stands that border this creek and these areas should be surveyed for this species which is facing serious threat from emerald ash borer. Due to the abundance of mature forest and habitat variability around this riparian corridor, there is excellent potential for additional rare plants throughout. We recommend providing a large forested buffer around the stands associated with Bear Creek to prevent intensive management operations from influencing this sensitive riparian corridor.

Animals

The only documented animal element occurrence in Block 2 is a red-shouldered hawk (*Buteo lineatus*, State Threatened). A pair was observed in 2000, nesting in a white pine in the eastern portion of Stand 80. As noted above, conditions suitable for this species occur throughout the compartment. Recommendations for this species in Block 2 are to prevent further fragmentation of mature forests and provide a large forested buffer around Stand 76 to protect

suitable habitat from intensive forestry management.

A Louisiana water thrush (*Seiurus motacilla*, State Threatened) was observed in 2011 in Stand 76 during the IFMAP surveys. This species prefers expanses of forested areas along clear streams and may nest on stream banks in exposed roots. Additional surveys for this species are merited.

There are three additional historical records of least shrew, woodland vole, and Blanchard's cricket frog that were previously mentioned in the management recommendations for Block 1 of Compartment 6. There may be suitable habitat for Blanchard's cricket frog in and around Stand 62. They prefer open or partially vegetated mud flats, muddy or sandy shorelines, and mats of emergent aquatic vegetation in shallow water.

Additional Observations

The threat of invasive species is another critical issue in this compartment. Many of the ditches along 128th Ave have narrow-leaved cat-tail, purple loosestrife, and phragmites. In addition, there is a patch of Japanese knotweed growing along both sides of 41st St. where Bear Creek crosses under the road. This is an especially pernicious weed that is resistant to many types of herbicide and reproduces vegetatively from small pieces of plant material. Mowing is a common method for spreading this species and great care should be taken to not expand this infestation along the creek. Chemical control is required for successful eradiation and these efforts should focus on the underground structures which may be double the biomass of the above ground material. Imazapyr has shown the greatest documented effectiveness on this species. Additional information on this species control is available at MNFI's website (link provided at end of report).

Though barrens were not a dominant feature of this part of the game area, many abandoned agriculture fields have several characteristic species and may offer habitat for box turtle, eastern towhee, and field sparrow. Stands 33, 45, 49, and 57 all have the physiognomy of barrens – an uncommon feature for this part of the game area – and have a few species characteristic of the community. Mowing, burning, and seeding with local genotypes of native species will reinforce the barrens component. ORV use is particularly bad in Stand 33 and rapidly degrading any barrens remnant in this stand. Although this degraded area is a low priority, it would be necessary to block access in order to facilitate any restoration of this site.

The following management recommendations for Block 2 are provided for your consideration:

- Riparian corridor around Bear Creek
    - Stands 38, 41, 43, 76
    - Create a forested buffer around these stands to prevent sedimentation into the stream and the spread of invasive species
    - Allow stands to continue maturing for maximum benefit to species of greatest conservation need
    - Survey for rare species (e.g., red-shouldered hawk, Cerulean warbler, Indiana bat)
    - Maintain large diameter trees to function as nesting and roosting locations for species such as red-shouldered hawk and Indiana bat
- Additional forests of interest
    - Stand 35, portions of Stand 54, the eastern portion of 80
    - Allow low intensity ground fires to carry into forests
    - Allow stands to continue maturing and minimize fragmentation
    - Limit fragmentation and provide forested buffers between intensive forestry activities to assist obligate forest inerior birds such as migrating warblers
- Manage for barrens habitat
    - Burn and mow Stands 33, 45, 49, 50, 53, and 57
    - Block ORV access
    - These are not high-quality stands, just options for maintaining open habitat
- Treat invasive species
    - Ditches along 128th Ave
    - Japanese knotweed along both sides of 41st Ave, Stand 43
    - Treat knotweed with Imazapyr
    - Burn vegetative material of knotweed
    - Do not spread any cut material of knotweed
- Trap/kill raccoons and other mesopredators to reduce predation on herptiles and birds

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Links

Natural communities

Dry-mesic northern forest: http://mnfi.anr.msu.edu/abstracts/ecology/Dry-mesic_northern_forest.pdf

Dry southern forest: http://mnfi.anr.msu.edu/communities/community.cfm?id=10686

Coastal plain marsh: http://mnfi.anr.msu.edu/abstracts/ecology/Coastal_plain_marsh.pdf

Mesic northern forest: http://mnfi.anr.msu.edu/abstracts/ecology/Mesic_Northern_Forest.pdf

Oak-pine barrens: http://mnfi.anr.msu.edu/abstracts/ecology/Oak-pine_barrens.pdf

Southern hardwood swamp: http://mnfi.anr.msu.edu/abstracts/ecology/Southern_hardwood_swamp.pdf

Plants

Black-fruited spike-rush: http://mnfi.anr.msu.edu/abstracts/botany/Eleocharis_melanocarpa.pdf

Japanese knotweed: http://mnfi.anr.msu.edu/invasive-species/JapaneseKnotweedBCP.pdf

Long-leaved panic grass: http://mnfi.anr.msu.edu/explorer/species.cfm?id=15733

Maryland meadow beauty: http://mnfi.anr.msu.edu/explorer/species.cfm?id=14421

Meadow beauty: http://mnfi.anr.msu.edu/abstracts/botany/Rhexia_virginica.pdf

Three-ribbed spike-rush: http://mnfi.anr.msu.edu/explorer/species.cfm?id=15324

Whiskered sunflower: http://mnfi.anr.msu.edu/abstracts/botany/Helianthus_hirsutus.pdf

Herptiles

Eastern box turtle: http://mnfi.anr.msu.edu/abstracts/zoology/Terrapene_carolina.pdf

Birds

Cerulean warbler: http://mnfi.anr.msu.edu/abstracts/zoology/Dendroica_cerulea.pdf

Louisiana water thrush: http://mnfi.anr.msu.edu/abstracts/zoology/Seiurus_motacilla.pdf

Red-shouldered hawk: http://mnfi.anr.msu.edu/abstracts/zoology/Buteo_lineatus.pdf

Mammals

Indiana bat: http://mnfi.anr.msu.edu/explorer/species.cfm?id=11426

Least shrew: http://mnfi.anr.msu.edu/explorer/species.cfm?id=11422

Woodland vole: http://mnfi.anr.msu.edu/abstracts/zoology/Microtus_pinetorum.pdf

Table 1: Element Occurrences within Compartment 6

Common Name	Type	EOID	Rank	Site	Last Observed
Rare Plant Species					
Whiskered sunflower (SC)	Vascular Plant	8514	H	Hamilton	1894
Long-leaved panic grass (T)	Vascular Plant	4913	B	41st St Marsh	2014
Three-ribbed spike-rush (T)	Vascular Plant	1973	A	41st St Marsh	2014
Black-fruited spike-rush (SC)	Vascular Plant	10105	C	Section 23 Marsh	1991
Maryland meadow beauty (T)	Vascular Plant	9921	BC	Section 23 Marsh	1989
Meadow beauty (SC)	Vascular Plant	7172	B	Section 23 Marsh	1989
Rare Animal Species					
Blanchard's cricket frog (T)	Vertebrate Animal	2366	H	SWAN CREEK HIGHBANKS UNIT	1961-05-24
Woodland vole (SC)	Vertebrate Animal	3247	H	SWAN CREEK	1938-07-26
Woodland vole (SC)	Vertebrate Animal	9585	H	SWAN CREEK	1939-07-14
Eastern box turtle (SC)	Vertebrate Animal	7535	E	41st St Coastal Plain Marsh	1995
Red-shouldered hawk (T)	Vertebrate Animal	13052		38th Street/Bear Creek	
Least shrew (T)	Vertebrate Animal	8373	H		1938-11-24
Natural Communities					
Coastal Plain Marsh (S2)	Natural Community	4306	BC	41st St Marsh	1989
Coastal Plain Marsh (S2)	Natural Community	5166	C	Section 23 Marsh	2009

SC = Special Concern, T = State Threatened, S2 = Imperiled in the state, very few occurrences, H = Historical Record