

Natural Features Summary of Compartment 06

Barry State Game Area



Prepared by:

Jesse M. Lincoln, Joshua G. Cohen, and Aaron P. Kortenhoven
Michigan Natural Features Inventory
P.O. Box 13036
Lansing, MI 48901-3036

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Cover Photo: Gun Lake Hills in northwestern Compartment 6. The dry-mesic forests in Barry State Game Area are some of the most impressive in the region. July 2017. Photos throughout the document by Jesse M. Lincoln unless noted.

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INTRODUCTION

Barry State Game Area (BSGA, Figure 1) is in central Barry County and is one of the largest continuous blocks of public land in southern Michigan, consisting of 16,784 acres. In conjunction with adjacent Yankee Springs State Recreation Area, these two properties total more than 22,000 acres. Barry SGA provides critical habitat for a myriad of game and non-game species and supports over 1,500 acres of high-quality natural communities. Barry SGA contains over 10,000 acres of forest and close to 800 acres of high-quality forest. Because the landscape surrounding Barry SGA is dominated by agriculture and rural development, the large area of forest within the game area serves as an important island of biodiversity for the local region, especially for interior forest obligates. In addition, the numerous and diverse high-quality wetlands within the game area support an array of rare insects, herptiles, and birds. Barry SGA is especially important for

reptile and amphibian species and its numerous headwater streams and creeks provide critical habitat for numerous aquatic species (Cohen et al. 2014).

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 2010, the Department of Natural Resources (DNR) and Michigan Natural Features Inventory (MNFI) conducted the Stage 1 survey of BSGA 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

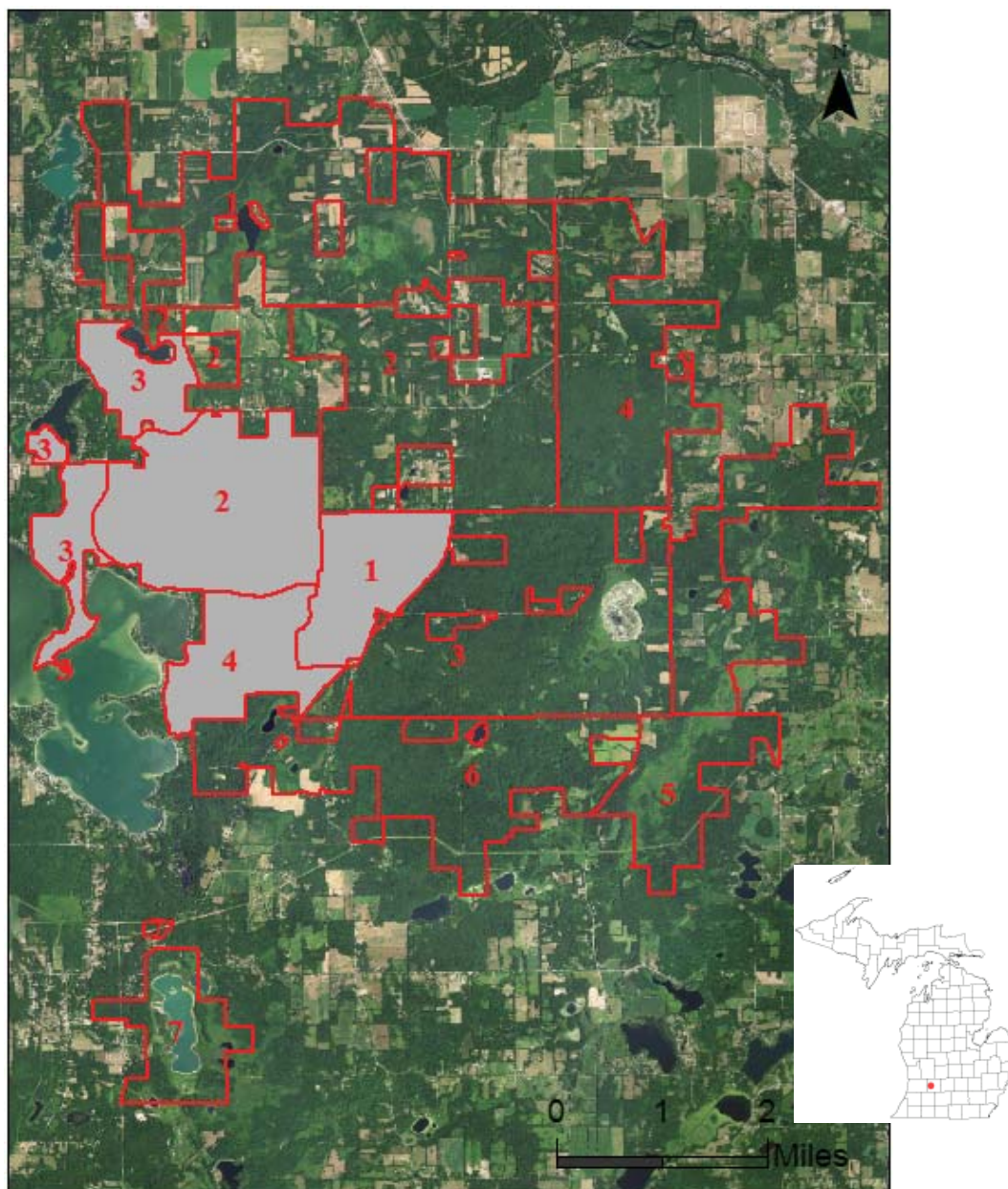


Figure 1. Compartment boundaries and land cover in and around Barry State Game Area. Yankee Springs State Recreation Area is in gray.

stand data and helped target the locations of previously undocumented exemplary natural community Element Occurrences (EOs).

There are 7 compartments in BSGA (Figure 1). Compartment 6 consists of 2240 acres in the southern portion of the game area. 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 BSGA and Compartment 6, an overview of the known EOs and significant natural communities in Compartment 6, and management recommendations for relevant 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. This document also incorporates information from a full summary of the natural communities and rare taxa found in Barry State Game Area which was provided in a detailed report in 2014 (Cohen et al. 2014).

The focus of this project and report is on native biodiversity with an emphasis on high-quality natural communities. 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.

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 (Cohen et al. 2014).

Barry SGA lays within the Kalamazoo Interlobate subsection (Subsection VI.2), and within two sub-subsections, the Battle Creek Outwash Plain (Sub-subsection VI.2.1) and the Cassopolis Ice-Contact Ridges (Sub-subsection VI.2.2). The northwestern quarter of the game area occurs in the Battle Creek Outwash Plain (approximately Compartment 1) and the remainder of the game area (approximately Compartments 2-7) occurs in the Cassopolis Ice-Contact Ridges (Cohen et al. 2014).



Photo 1. Dry-mesic southern forest is a characteristic natural community on the steep slopes of Barry SGA.

The Kalamazoo Interlobate subsection is an interlobate area that formed between three glacial lobes approximately 13,000 to 16,000 years ago. Glacial end moraines, ice-contact ridges, and outwash plains that characterize this area are the result of contact between these three glacial lobes. The entire interlobate is more than 150 miles long and the flat plain within the region was the northernmost extension of the “Prairie Peninsula”, as described by Transeau (1935). Kettle lakes, kettle depressions, and streams are numerous throughout the subsection and the prevalent soils are sands and sandy loams (Albert 1995; Cohen et al. 2014).

The Battle Creek Outwash Plain (VI.2.1) is a broad, flat outwash plain containing numerous small lakes and wetlands and ground moraine ridges (Figure 2). Portions of the outwash are excessively drained and fire prone, while other areas are poorly drained, with numerous kettle lakes and wetlands. Numerous streams and headwater streams occur within this region. Historically (i.e., circa 1800) the areas of well-drained outwash plain supported fire-dependent tallgrass prairie and oak savanna. Islands of ground moraine supported savanna and oak woodland and steeper end moraines supported oak woodland and oak forest. Areas of poorly drained outwash plain, outwash channels, and kettle depressions supported swamp forest, wet prairie, prairie fen, and wet meadow. Today most of

the prairie and savanna systems have been eliminated due to fire suppression and agricultural conversion. Forests and wetlands persist locally, typically in areas with either excessive or poor drainage (Albert 1995; Cohen et al. 2014).

The Cassopolis Ice-Contact Ridges (VI.2.2) consists of steep, narrow bands of end-moraine and ice-contact ridges (Figure 2). The ridges are broken periodically by outwash channels. The height of the ridges range from 50 to 200 feet and the glacial drift is 250 to 350 feet thick (Akers 1938). Kettle lakes and depressions are common, as are linear lakes and wetlands that occupy abandoned drainageways or glacial meltwater streams. Many of the smaller kettles are occupied wetland communities, including bog, shrub wetland, and forested wetland types. Many streams originate near the margins of the sub-subsection and may be associated with seepage areas and prairie fens. The soils are characterized by well drained loamy and gravelly sands in the uplands and poorly drained organic soils in the kettle depressions and drainageways. Historically the steep ridges were dominated by oak-hickory forest with white pine (*Pinus strobus*) as a common co-dominant in the northern third of the sub-subsection. Oak barrens or savanna occurred locally on some south and west aspects and on some of the more gently sloping ridges (Cohen et al. 2014).

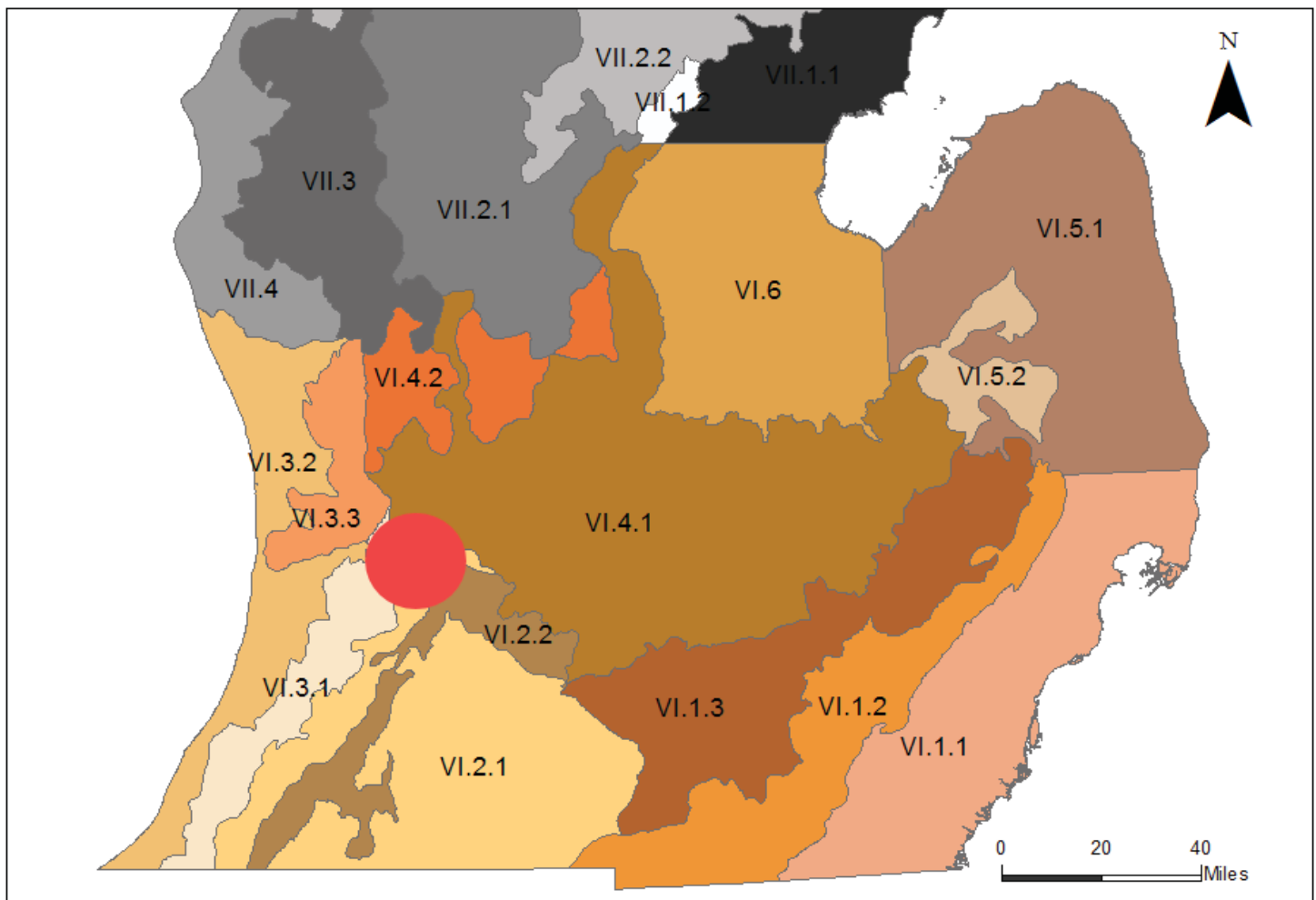


Figure 2. Ecoregions of southern Michigan (Albert 1995). The red dot signifies the location of Barry SGA.

Historically, many of the steep ridges were cleared for crops or grazed by livestock, though much of the farmland in this sub-subsection has converted back to forest with some portions never having been cleared. Oak-hickory forest remains the prevalent forest type and many of the kettle wetlands persist. White pine-oak forests occur locally. In addition, the margins of the sub-subsection still support many prairie fens, although these wetlands have been degraded by ditching, fire suppression, and invasive species encroachment (Albert 1995; Cohen et al. 2014).

Circa 1800 Vegetation

Interpretations of the General Land Office (GLO) surveyor notes by MNFI ecologists indicate that Barry SGA and surrounding area contained several distinct vegetation assemblages (Comer et al. 1995, Figure 3). Surveyors recorded information on the tree species composition, tree size, and general condition of the lands within and surrounding Barry SGA. Areas of steep end moraine and ice-contact ridges supported oak-hickory forest and mixed oak forest, the two most prevalent cover types within the game area (covering about 42% and 21% of the game area at the time of the GLO survey, respectively) (Cohen et al. 2014).

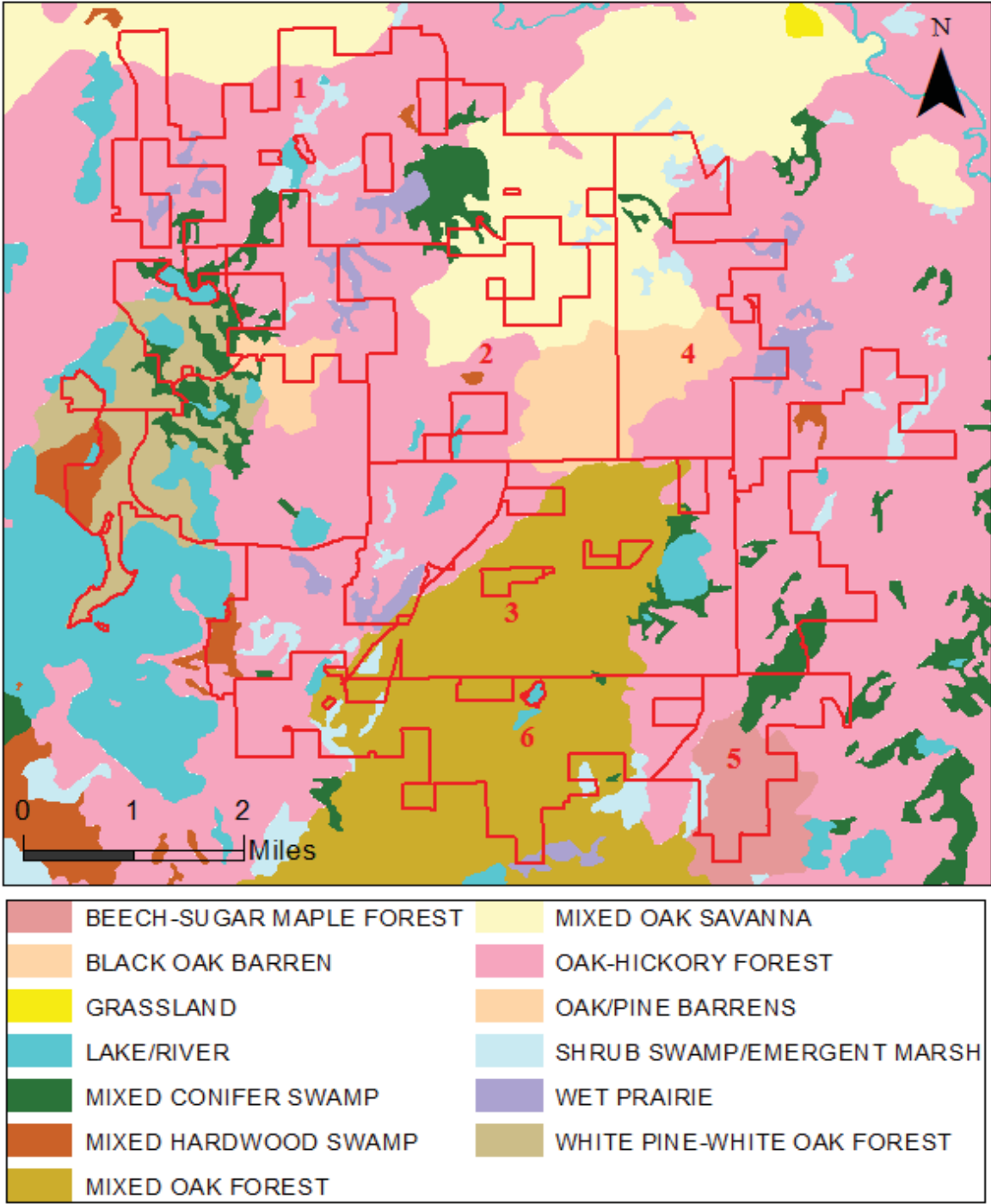


Figure 3. Circa-1800 vegetation cover of Barry State Game Area (Comer 1997).

Mixed oak savanna was common on areas of well-drained outwash and gently sloping moraine and slopes with southern and western aspects. At the time of the GLO survey, mixed oak savanna (oak openings) occurred on approximately 12% of the game area and drier oak barrens occurred on approximately 8% of the game area. Repeated low-intensity fires, working in concert with drought and windthrow, maintained open conditions in these oak savanna ecosystems. Within dry-mesic savanna systems, such as oak openings, it is likely that frequent fire disturbance was the primary factor influencing the vegetative structure and floristic composition. These fires occurred during the late spring, late summer, and fall since flammability peaks in the spring before grass and forb growth resumes and then again in the late summer and autumn after the above-ground biomass dies back (Grimm 1984; Cohen et al. 2014).

Within southwestern Michigan, Native Americans played a primary role in maintaining savanna conditions through their use of fire as a land management tool (Cronon 1983, MacLeigh 1994). Indian trails and encampments were noted throughout the areas identified by the GLO surveyors as oak savanna and oak barrens. These open, fire-dependent oak ecosystems were primarily found in the northern portion of the game area (in portions of Compartments 1, 2, and 4) within the Battle Creek Outwash Plain and along the margin of the Cassopolis Ice-Contact Ridges. Variations in fire frequency and severity generated a dynamic natural community complex with mixed oak savanna, oak

woodland, and oak forest shifting across the landscape. GLO surveyors described oak savanna as “Oak openings (with) no understory” and “thinly timbered”. Small pockets of grassland and “dry prairie” were also noted in this area. Scattered canopy trees recorded in areas of oak openings included white oak (*Quercus alba*), black oak (*Q. velutina*), chinquapin oak (*Q. muehlenbergii*), and bur oak (*Q. macrocarpa*). Drier black oak barrens were characterized by white oak, black oak, and chinquapin oak (Cohen et al. 2014).

Wetlands were scattered throughout the game area, concentrated along the margins of kettle lakes, within kettle depressions, in poorly drained portions of outwash plain and outwash channels, and along creek margins (Figure 3). Prevalent wetland cover types included mixed conifer swamp (7% of game area), shrub swamp/emergent marsh (2.5%), wet prairie (1.5%), and scattered pockets of mixed hardwood swamp (0.1%). In addition, 0.3% of the game area was classified as lake/river and submergent wetland types such as submergent marsh, and intermittent wetland likely occupied portions of these kettle lakes. The broad shrub swamp/emergent marsh cover type likely included southern shrub-carr, inundated shrub swamp, prairie fen, poor fen, bog, southern wet meadow, emergent marsh, coastal plain marsh, and intermittent wetland. Areas classified as wet prairie, likely included a range of wetland types including wet prairie, wet-mesic prairie, prairie fen, and southern wet meadow (Cohen et al. 2014).

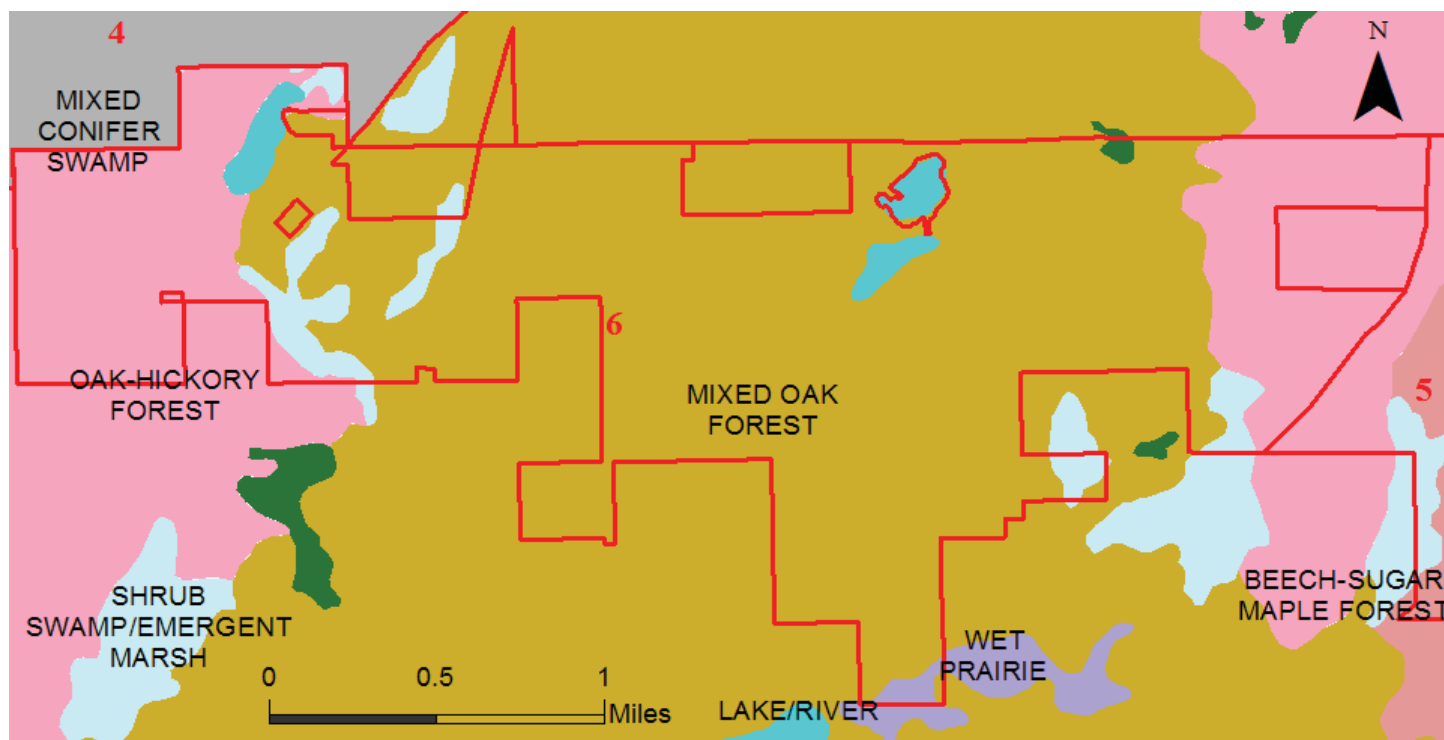


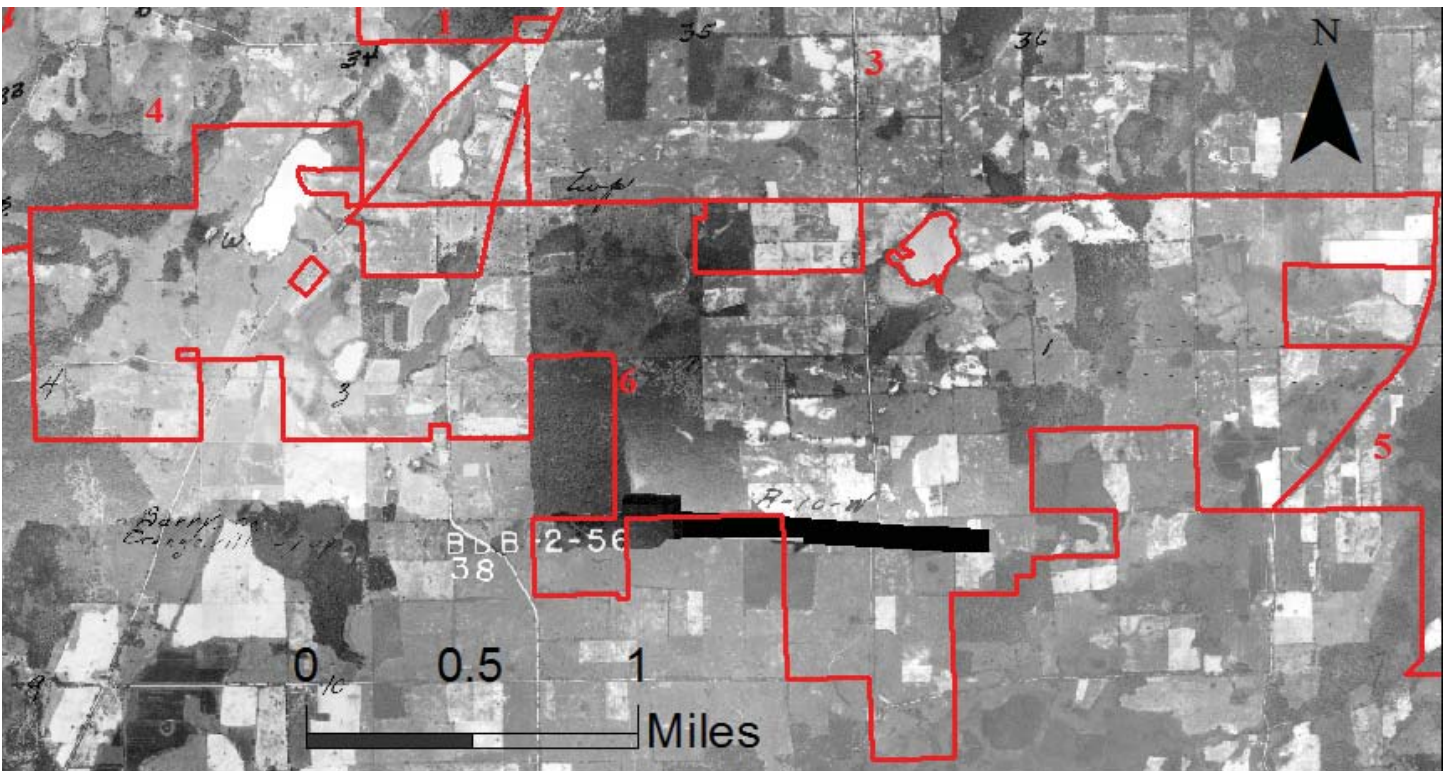
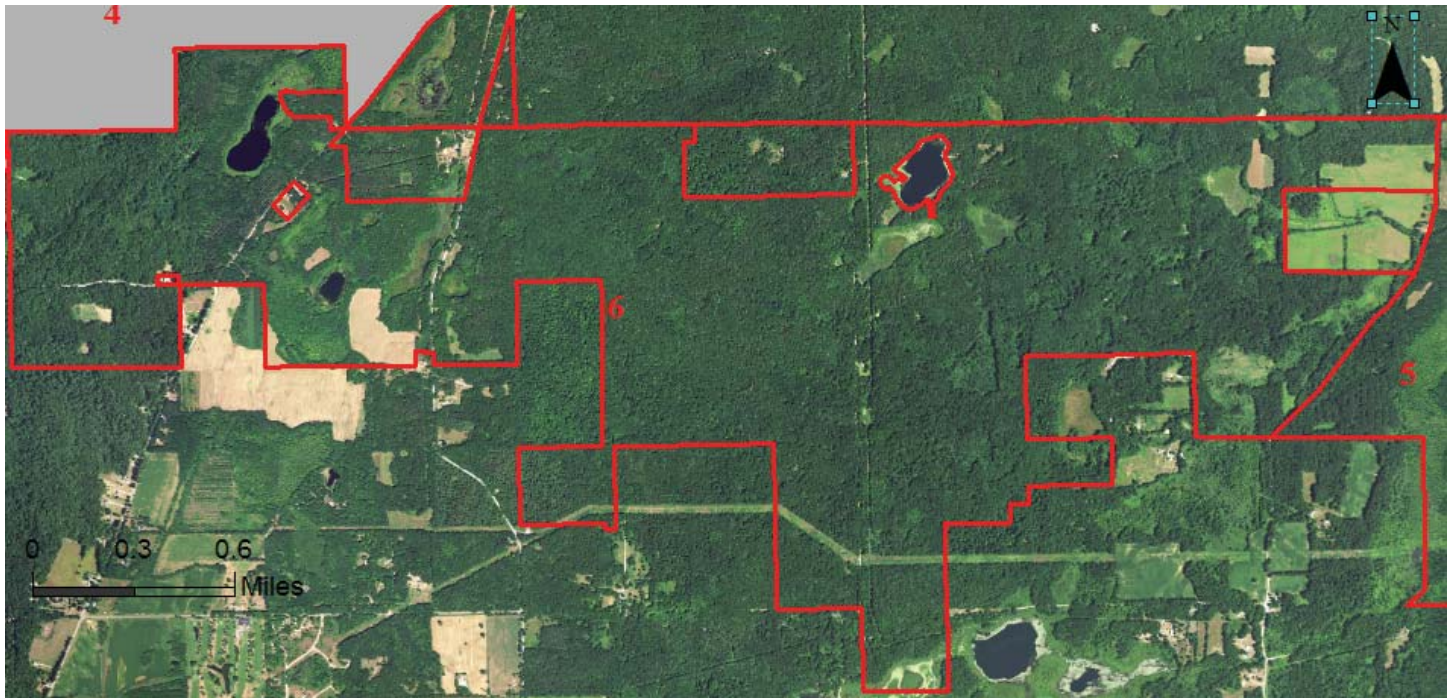
Figure 4. Circa-1800 vegetation cover of Compartment 6, Barry SGA (Comer 1997). This compartment was predominantly forested with small wetlands occurring throughout.

SUMMARY OF COMPARTMENT 6

Landuse History

Similar to much of southern Michigan, Compartment 6 has been altered by European settlement. Logging, agriculture, and alterations to hydrology have lasting legacies across the landscape. Imagery from 1938 (Figure 6) shows areas cleared for agriculture, altered wetlands, and provides insight into the age of forests with the oldest forests clearly visible as the darkest areas in the image. 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. Areas reclaimed from agriculture tend to have the greatest abundance of invasive species.



Figures 5 and 6. Imagery from 1938 (bottom) provides valuable insight into changes within Compartment 6 over the past 80 years. Many of the areas historically cleared for agriculture have been converted to degraded dry-mesic southern forest with a high component of invasive species. The driest areas were converted to pine plantations.

Natural Communities

The landscape is characterized by kettle-kame topography and the highly variable terrain was historically a mosaic of forested uplands and wetlands with dry-mesic and mesic forest transitioning into small and localized pockets of southern hardwood swamp, prairie fen, and intermittent wetlands. Lakes and non-forested wetlands occurred throughout, and the depth of the water table fluctuated from season to season and year to year. In general, BSGA is substantially more forested than the surrounding county. While much of the forests in BSGA 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 barrens, based on circa-1800 vegetation maps and the lack of characteristic barrens vegetation observed throughout the compartment.

Today, Compartment 6 is characterized by extensive forest with large areas resembling historic coertype despite logging, fire suppression, and agricultural endeavors. Brief descriptions of the community types are included below as is a list of stands where the highest quality examples of natural community remain.

Dry-Mesic Southern Forest

Dry-mesic southern forest was the most prevalent coertype within Compartment 6 and a common community type in this region. Dry-mesic southern forest, labeled “mixed oak forest” and “oak-hickory forest” in the circa-1800 vegetation map (Figure 4), is a fire-dependent forest type and a prevalent forested community in southern Michigan. Historically, frequent fires maintained semi-open conditions, promoting oak regeneration and ground and shrub layer diversity.

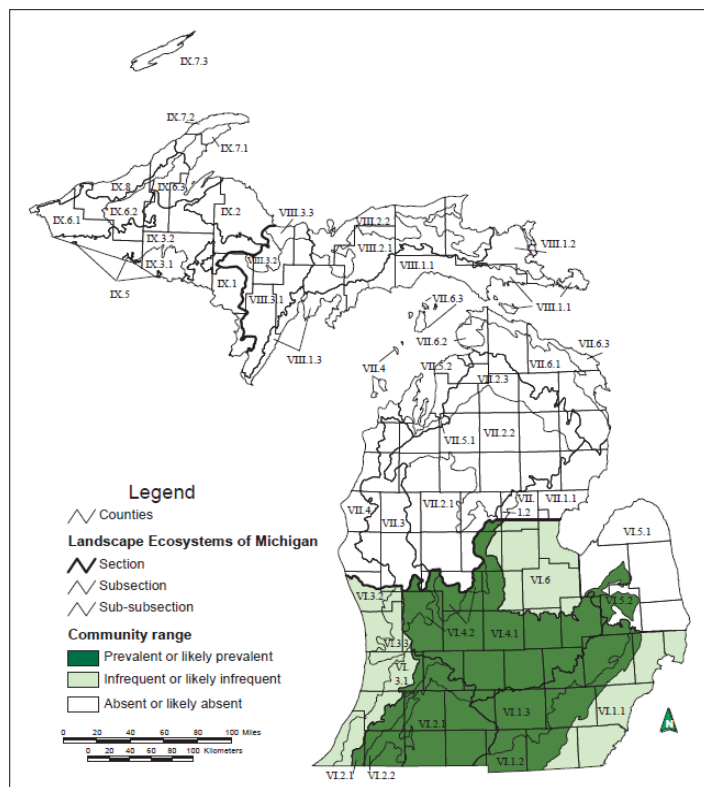


Figure 7. Statewide distribution of dry-mesic southern forest (Albert et al. 2008).

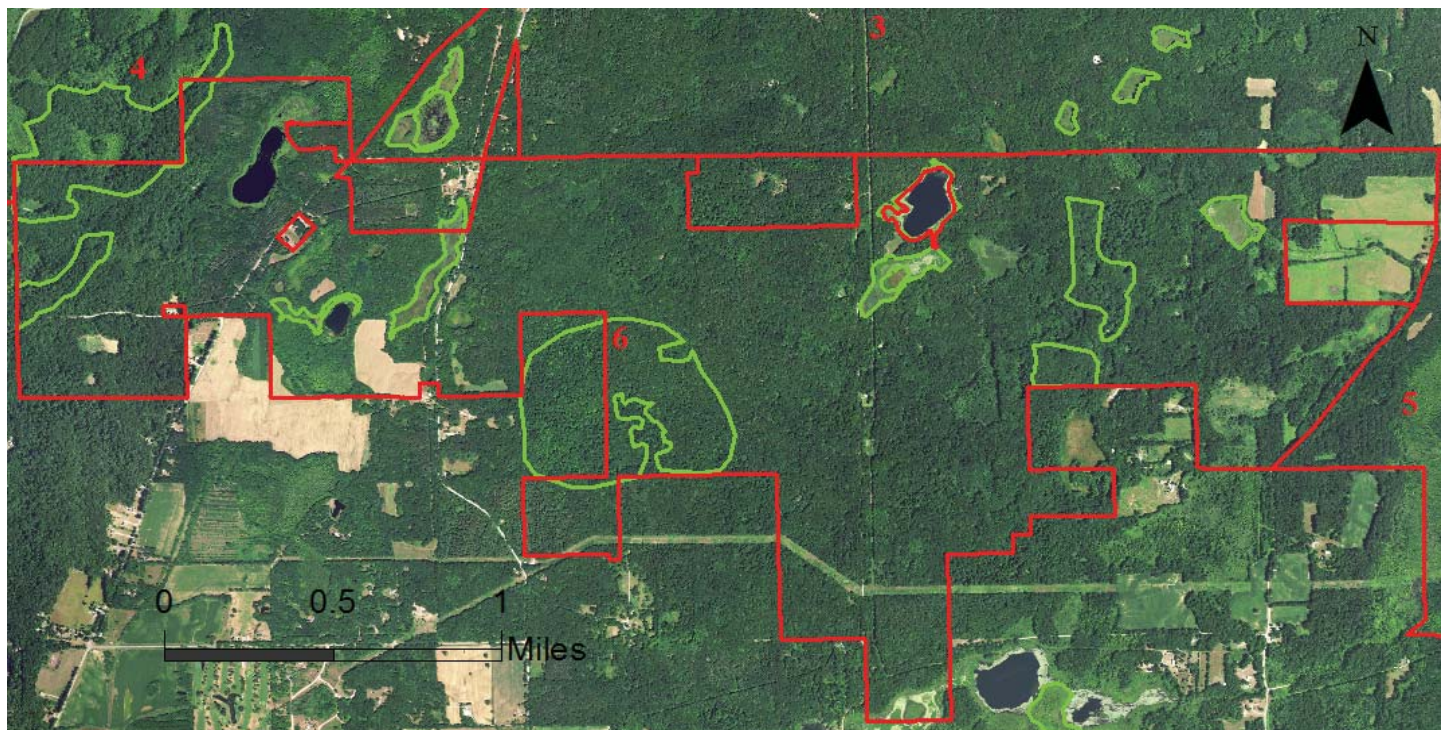


Figure 5. High-quality natural communities found within Compartment 6 are highlighted in green.

The canopy layer of this forest community generally is dominated or codominated by white oak (*Quercus alba*) and black oak (*Q. velutina*), with white oak being the more frequent dominant. Red oak (*Q. rubra*) can occur as a canopy codominant, especially where soils and topographic position favor less droughty conditions such as north- to east-facing slopes and footslopes. Hickories such as pignut hickory (*Carya glabra*), shagbark hickory (*C. ovata*), and bitternut hickory (*C. cordiformis*) are often canopy codominants. Prevalent canopy associates include red maple (*Acer rubrum*), tulip tree (*Liriodendron tulipifera*), black cherry (*Prunus serotina*), Hill's oak (*Q. ellipsoidalis*), basswood (*Tilia americana*), and historically white ash (*Fraxinus americana*). Prevalent species of the subcanopy include red maple, hickories, alternate-leaved dogwood (*Cornus alternifolia*), flowering dogwood (*C. florida*), ironwood (*Ostrya virginiana*), cherries (*Prunus* spp.), and sassafras (*Sassafras albidum*). Characteristic shrubs include serviceberries (*Amelanchier* spp.), witch hazel (*Hamamelis virginiana*), and choke cherry (*P. virginiana*). In fire-suppressed systems, mesophytic trees and shrubs are often dominant in the subcanopy and shrub layers. Typical herbaceous species include doll's eyes (*Actaea pachypoda*), hog peanut (*Amphicarpaea bracteata*), jack-in-the-pulpit (*Arisaema triphyllum*), bearded shorthusk (*Brachyelytrum erectum*), hairy woodland brome (*Bromus pubescens*), rosy sedge (*C. rosea*), enchanter's nightshade (*Circaea canadensis*), spotted coral-root (*Corallorhiza maculata*), pointed-leaf tick-trefoil (*Hylodesmum glutinosum*), naked-flower tick-trefoil (*H. nudiflorum*), fragrant bedstraw (*Galium triflorum*), black snakeroot (*Sanicula marilandica*), bristly greenbrier (*Smilax hispida*), large-flowered bellwort (*Uvularia grandiflora*), and downy

yellow violet (*Viola pubescens*). Dry-mesic southern 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).

Coastal Plain Marsh/Intermittent Wetland

Small areas of forested and non-forested wetlands occur throughout Compartment 6, including high-quality examples of coastal plain marsh and intermittent wetland. These two distinct community types are both graminoid-dominated wetlands characterized by 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 these systems. 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. Coastal plain marshes contain numerous plant disjuncts from the Atlantic and Gulf coastal plains, a fundamental characteristic that distinguishes coastal plain marshes from intermittent wetlands. Long distance

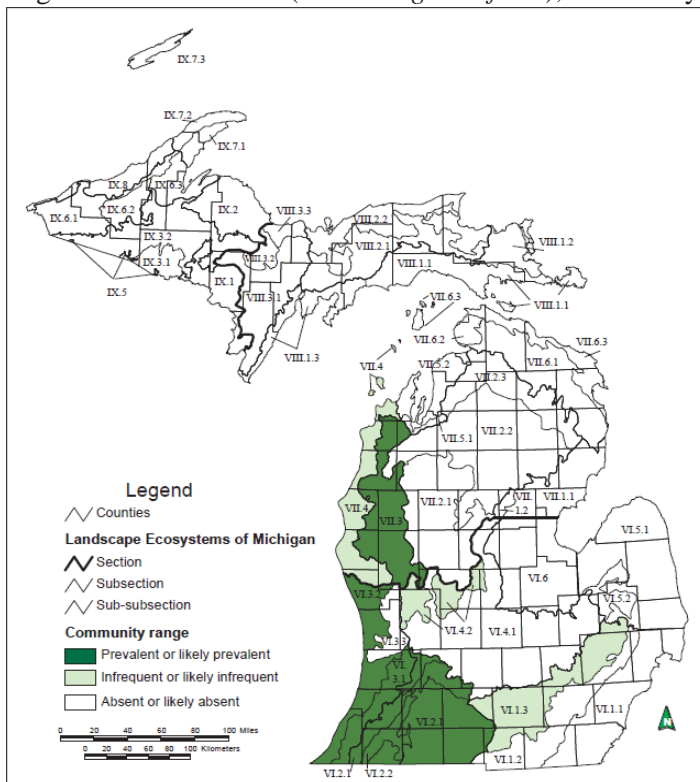


Figure 9. Statewide distribution of coastal plain marsh (Albert et al. 2008).

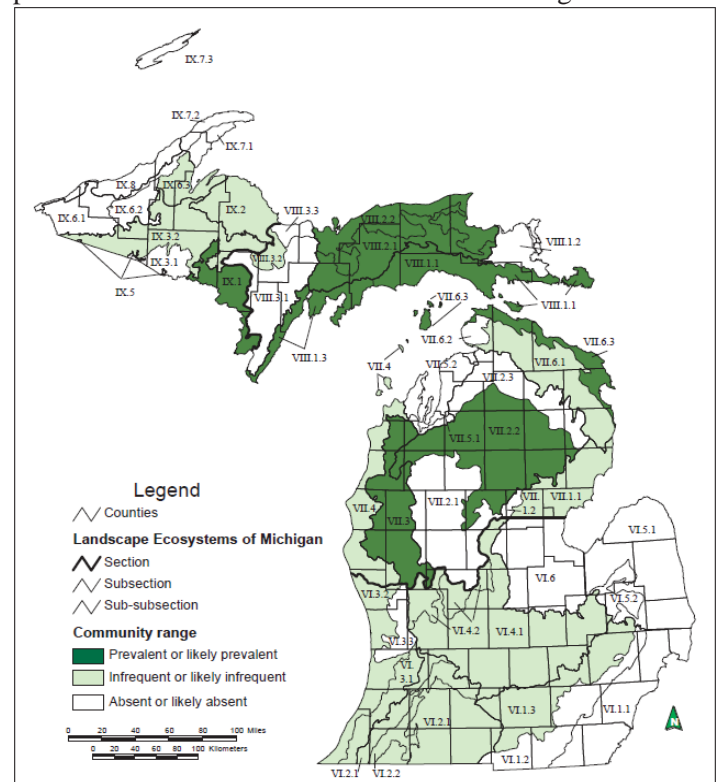


Figure 10. Statewide distribution of intermittent wetland (Albert et al. 2008).

seed dispersal among Midwest coastal plain marshes and between the Midwest and Atlantic and Gulf coastal plains is thought to have been facilitated by historic variability in lake and ocean levels as well as migratory waterfowl. Waterfowl moving among regional coastal plain marshes may also restore species that have been depleted from a site's seed bank.

Intermittent wetlands typically contain several vegetation zones, especially when they are adjacent to or encircle a lake or pond. The deepest portion of the depression is usually inundated and supports floating aquatic plants including water shield (*Brasenia schreberi*), yellow pond-lily (*Nuphar variegata*), sweet-scented water-lily (*Nymphaea odorata*), pondweeds (*Potamogeton* spp.), and bladderworts (*Utricularia* spp.). Occurring along the lower shores and pond margins is a seasonally flooded zone with sparse cover of low forbs and graminoids including pipewort (*Eriocaulon aquaticum*), bright green spike-rush (*Eleocharis flavescens*), Robbin's spike-rush (*E. robbinsii*), autumn sedge (*Fimbristylis autumnalis*), brown-fruited rush (*Juncus pelocarpus*), beak-rushes (*Rhynchospora capitellata* and *R. fusca*), bulrushes (*Schoenoplectus purshianus* and *S. smithii*), and Torrey's bulrush (*S. torreyi*, state special concern). In the saturated soil further from the shore, where the seasonal water levels typically reach their peak, is a dense graminoid-dominated zone. This is the most floristically diverse zone and typically includes species such as bluejoint grass (*Calamagrostis canadensis*), narrow-leaved reedgrass (*C. stricta*), few-seed sedge (*Carex oligosperma*), wiregrass sedge (*C. lasiocarpa*), twig-rush (*Cladium mariscoides*), three-way sedge (*Dulichium arundinaceum*), grass-leaved goldenrod (*Euthamia graminifolia*), wild blue flag (*Iris versicolor*), swamp candles (*Lysimachia terrestris*), ticklegrass (*Agrostis scabra*), and panic grass (*Dichanthelium*

lindheimeri). Many intermittent wetlands contain a bog mat with vegetation typical of an ombrotrophic bog. These bog mats are characterized by sphagnum mosses, and low, ericaceous shrubs, with leatherleaf (*Chamaedaphne calyculata*) being the most prevalent. These bog mats are typically very low in herbaceous plant diversity. Trees within intermittent wetlands are typically absent or occur on the bog mat. Trees occurring on bog mats within the community are usually widely scattered and stunted conifers such as black spruce (*Picea mariana*) and tamarack (*Larix laricina*), and occasionally jack pine (*Pinus banksiana*) and white pine (*P. strobus*).

Coastal plain marshes also typically contain four distinct vegetation zones, often occurring as concentric bands around the open water portions of depressions, lakes, and ponds with much of the same vegetation that is typical of intermittent wetlands. The following species are characteristic of coastal plain marsh: three-awned grass (*Aristida necopina*), bushy aster (*Symphotrichum dumosum*), sedge (*Bulbostylis capillaris*), umbrella sedge (*Cyperus bipartitus*), Robin's spike-rush (*Eleocharis robbinsii*), pipewort (*Eriocaulon aquaticum*), dwarf bulrush (*Lipocarpa 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).



Photo 2. The intermittent wetland along Norris Road in Stands 36, 37, and 38 contains several distinct zones of vegetation, including mud flats, pictured above. Providing a buffer of natural cover protects the hydrology of the wetland. This site should be monitored for invasive species, considering its proximity to the road.

Prairie Fen

Prairie fen is a wetland community dominated by sedges, grasses, and other graminoids that occurs on moderately alkaline saturated organic soil and marl south of the climatic tension zone in southern Lower Michigan. Prairie fen occurs where cold, calcareous, groundwater-fed springs reach the surface. The flow rate and volume of groundwater through a fen strongly influence vegetation patterning; thus, the community typically contains multiple, distinct zones of vegetation, some of which contain prairie grasses and forbs (Kost et al. 2007). The vegetation of fens in this area is characterized by wiregrass sedge (*Carex lasiocarpa*) and beaked spike-rush (*Eleocharis rostellata*). Other common species include hardstem bulrush (*Schoenoplectus acutus*), twig-rush (*Cladium mariscoides*), softstem bulrush (*S. tabernaemontani*), Indian grass (*Sorghastrum nutans*), and marsh blazing-star (*Liatris spicata*). Shrubs occur scattered throughout, especially along peat rises, sphagnum hummocks, and along the margins of the fen. Understory shrub species include tamarack (*Larix laricina*), shrubby cinquefoil (*Dasiphora fruticosa*), swamp rose (*Rosa palustris*), alder-leaved buckthorn (*Rhamnus alnifolia*), poison sumac (*Toxicodendron vernix*), silky dogwood (*Cornus amomum*), pussy willow (*Salix discolor*), and bog birch (*Betula pumila*). Scattered trees occur along the margins of fens and include tamarack, red maple (*Acer rubrum*), and red-cedar (*Juniperus virginiana*).

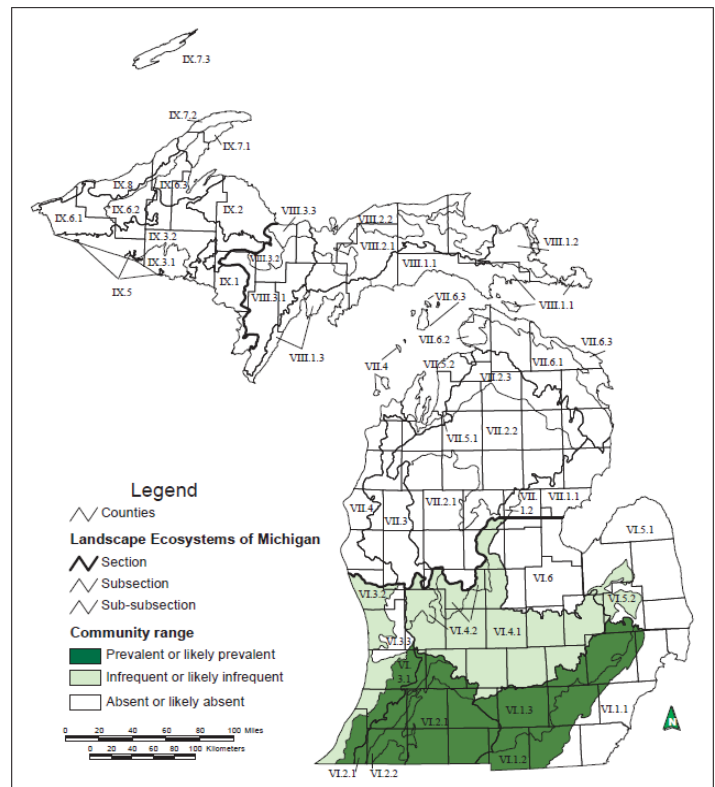


Figure 5. Statewide distribution of prairie fen (Albert et al. 2008).



Photo 3. The prairie fen in Stand 27 occurs along the margins of the kettle lake and has distinct zones of native vegetation.

Important Natural Areas

A natural community is defined as an assemblage of interacting plants, animals, and other organisms that repeatedly occurs under similar environmental conditions across the landscape and is predominantly structured by natural processes rather than modern anthropogenic disturbances. Protecting and managing representative natural communities is critical to biodiversity conservation, since native organisms are best adapted to environmental and biotic forces with which they have survived and evolved over the millennia (Kost et al. 2007).

Upland Forest

Despite the region's history of logging, agriculture, and fire suppression, high-quality examples of dry-mesic southern forest persist within this compartment. The most important upland forests in this compartment are in Stands 7, 50 (the southern portion), 90, 106 (the western portion), 91, 124, and 126. These are documented examples of high-quality, dry-mesic southern forest and were identified as EOs based on age, size of stand, lack of invasive species, and dominance of characteristic vegetation.

Dagget Lake Woods (Stands 90, 91, and western 106) is a second-growth oak forest that occurs on rolling end moraine of variable aspect. The soils are acidic (pH 5.5) sandy loam. The closed canopy (85-95%) forest is characterized by large-diameter canopy oaks and hickories and moderate volumes of coarse woody debris and small canopy gaps resulting from gap-phase dynamics. Diameters of the canopy cohort range from 50 to 75 cm with some

larger oaks reaching 90 cm. A 62 cm white oak was cored and estimated to be 163 years old and a 60 cm pignut hickory was cored and estimated to be 160 years old. The prevalence of red maple and black cherry in the subcanopy and understory indicates that the site has experienced many decades of fire suppression. Invasives are infrequent in the understory and ground cover and include multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), Japanese barberry (*Berberis thunbergii*), hedge-parsley (*Torilis japonica*), and garlic mustard (*Alliaria petiolata*). Within the understory layer, oak regeneration is sparse due



Photo 5. Ginseng (State Threatened) has been severely poached from Barry SGA with many populations eliminated in the past 15 years. Photo Mike Kost.

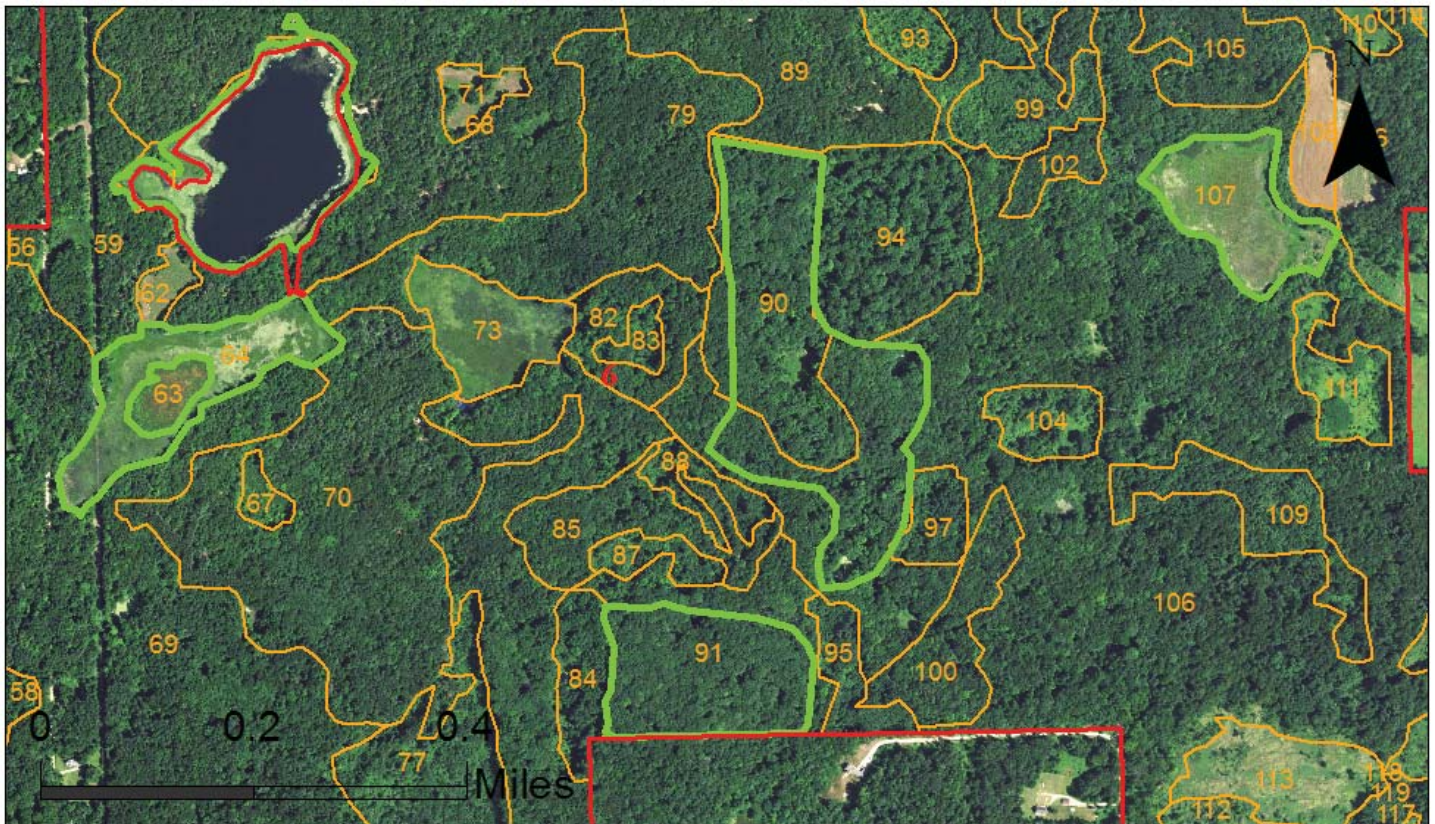


Figure 13. High-quality natural communities of eastern Compartment 6 are highlighted in green. Dagget Lake Woods occurs in Stands 90 and 91. Dagget Lake and surrounding margins (Stand 1) support the game area's only coastal plain marsh. Two intermittent wetlands occur in Stands 64 and 107.

Table 1. Occurrences of high-quality natural communities within Compartment 6, BSGA. EO Rank abbreviations: A = Excellent estimated viability, B = Good estimated viability, C = Fair estimated viability, D = Poor estimated viability.

| Site Names | Natural Community | EOID | EO Rank | First Observed | Last Observed | Stands |
|------------------------|---------------------------|-------|---------|----------------|---------------|--------------------|
| Dagget Lake Woods | Dry-mesic Southern Forest | 18968 | C | 2012 | 2012 | 90, 91,western 106 |
| Norris Road East Woods | Dry-mesic Southern Forest | 13349 | C | 1989 | 2012 | 50 |
| Gun Lake Woods | Dry-mesic Southern Forest | 18973 | BC | 2012 | 2012 | 7, 124, 126 |
| Dagget Lake | Coastal Plain Marsh | 9832 | BC | 1970 | 2012 | 1 |
| Dagget Lake Wetland | Intermittent Wetland | 18977 | C | 2012 | 2012 | 63, 64, 107 |
| Norris Road Wetland | Intermittent Wetland | 18966 | C | 2012 | 2012 | 36, 37, 38 |
| Wildwood Fen | Prairie Fen | 18982 | CD | 2012 | 2012 | 27 |

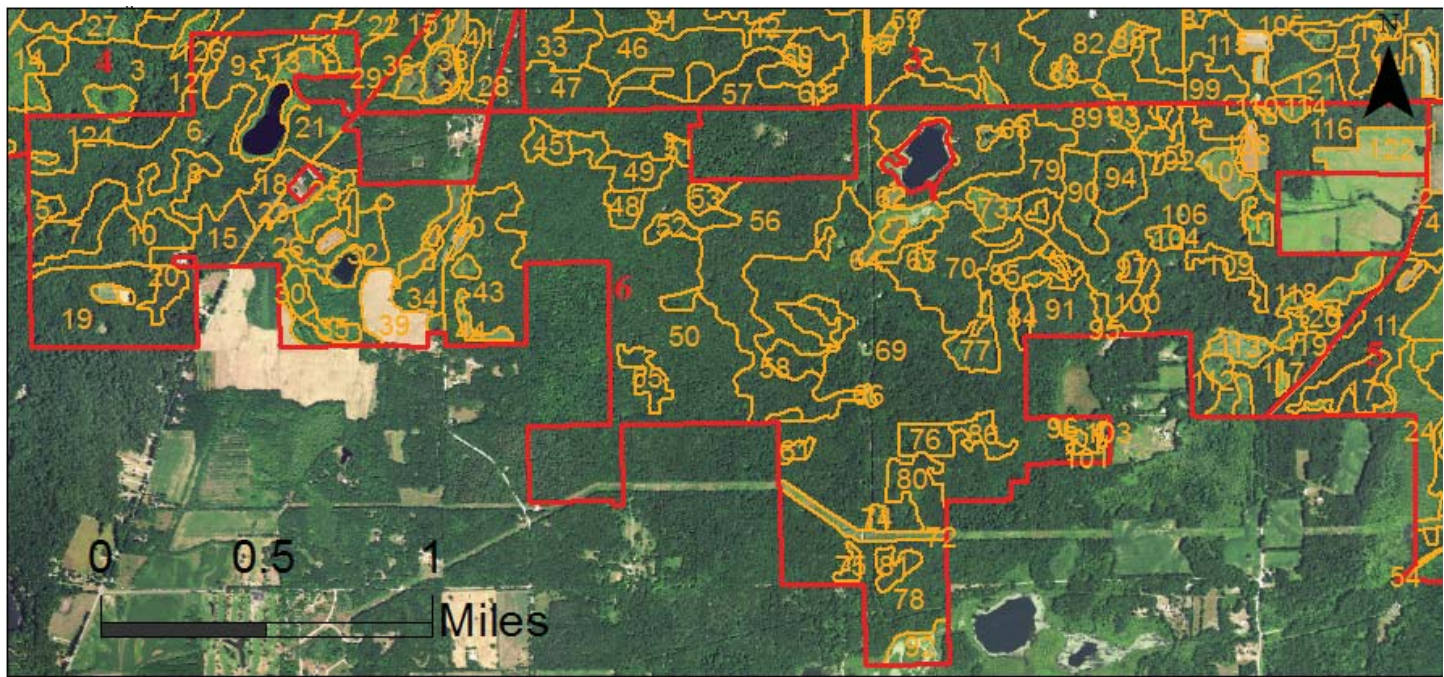


Figure 12. Compartment 6 of Barry State Game Area with all stands of different cover type.



Photo 4. Dagget Lake Woods (Stands 90, 91, and western 106)is a typical dry-mesic southern forest dominated by red oak, white oak, and pignut hickory. Red maple is dominating the subcanopy as a result of fire suppression.

to fire suppression and deer herbivory. In addition, ginseng (*Panax quinquefolius*, state threatened) occurs within this forest. Seventy-eight native, vascular plant species were noted within this forest during the 2012 surveys. Several vernal pools occur within this forest. Hooded warbler (*Setophaga citrina*, State Special Concern) were documented within this forest complex.

Norris Road East Woods (southern portion of Stand 50) is a maturing second-growth oak forest that occurs on coarse-textured end moraine of variable aspect. The soils are acidic (pH 5.5), gravelly, loamy sand. Diameters of the canopy cohort range from 40 to 60 cm with some larger oaks reaching 70 to 80 cm. A 35 cm red oak was cored and estimated to be over 77 years old. Scattered windthrow has generated small canopy gaps and a moderate volume of coarse woody debris of diverse size and decay classes. This is the driest of the dry-mesic southern forests documented within this compartment and would have had the highest frequency of historic fires, based on species composition and aspect. Much of this EO was on private property which appears to have been impacted by recent logging. Vernal pools occur within this forest. Hooded warblers have been documented using this forest complex. Of the documented high-quality forests in this compartment, this is the lowest priority for stewardship activities.



Photo 6. Hooded warblers (State Special Concern) have been documented throughout Compartment 6 and require mature, closed-canopy forest habitat.

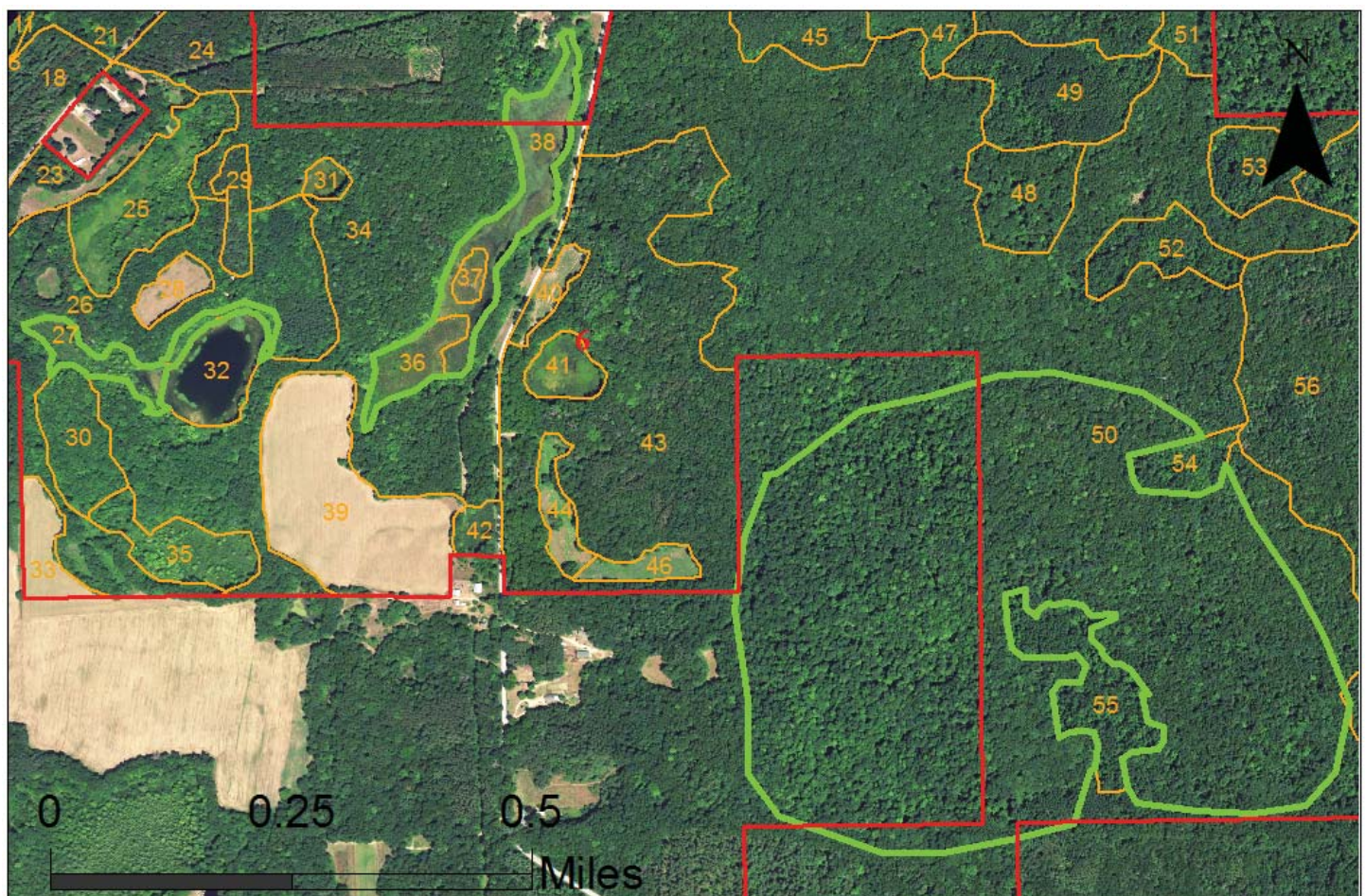


Figure 14. High-quality natural communities of central Compartment 6 are highlighted in green. Norris Road East Woods occurs in southern portion of Stand 50. Norris Road Wetland is in Stands 36, 37, and 38 Wildwood Fen is in Stand 27.

Gun Lake Woods (Stands 7, 124, and 126) is a diverse forest on steep hillsides dominated by very large maturing oaks and hickories with beech (*Fagus grandifolia*) and maple much more dominant on the north-facing slopes. This is one of the larger and more diverse forests within BSGA and the surrounding region. The forest occurs on steep topography of end moraine with variable aspect. Soils of this dry-mesic southern forest are coarse-textured, acidic (pH 6.5) sandy loam with abundant glacial erratics. Diameters of the canopy cohort typically range from 25 to 75 cm with some larger oaks reaching 100 cm and one tulip tree was measured to be 125 cm. A 56 cm beech was cored and estimated to be 120 years old and a 53 cm red oak was cored and estimated to be 103 years old. South-facing slopes tend to be much drier and have more white and black oak and historically had more frequent fires, based on herbaceous vegetation. North-facing slopes are more mesic with a greater component of beech, maple, tulip tree, basswood, and herbaceous vegetation characteristic of forests with a much lower fire frequency. The prevalence of red maple and black cherry in the subcanopy and understory indicates protracted fire suppression, particularly on the south-facing slopes where fire would have most frequently occurred. Invasive plants are locally abundant and include multiflora rose, autumn olive, Morrow honeysuckle, winged euonymus, Japanese barberry, and garlic mustard. Oak regeneration is sparse due to fire suppression and deer browse pressure. Scattered windthrow and the loss of canopy ash has generated small canopy

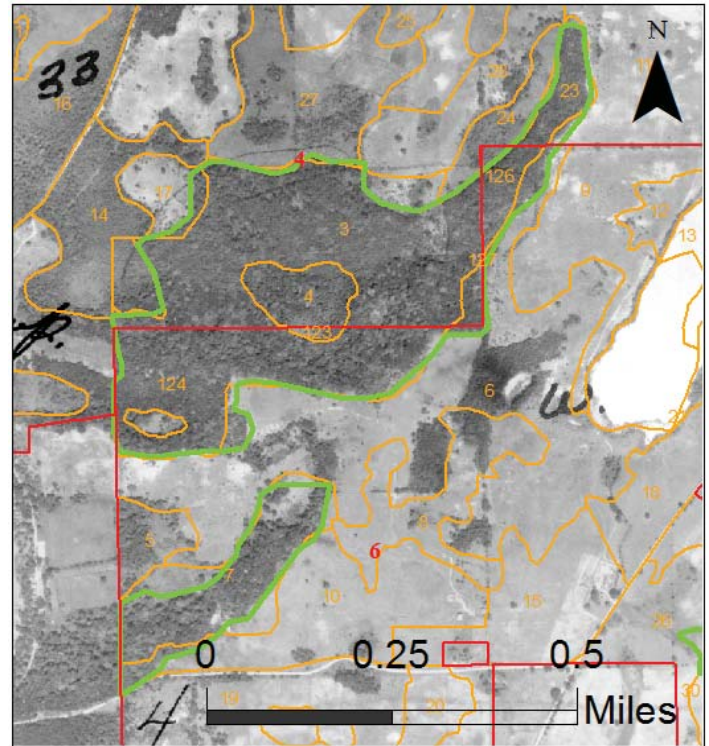


Figure 15. Gun Lake Woods is clearly visible in imagery from 1938. Utilizing this type of imagery is an effective method for identifying the oldest forests that were not tilled.

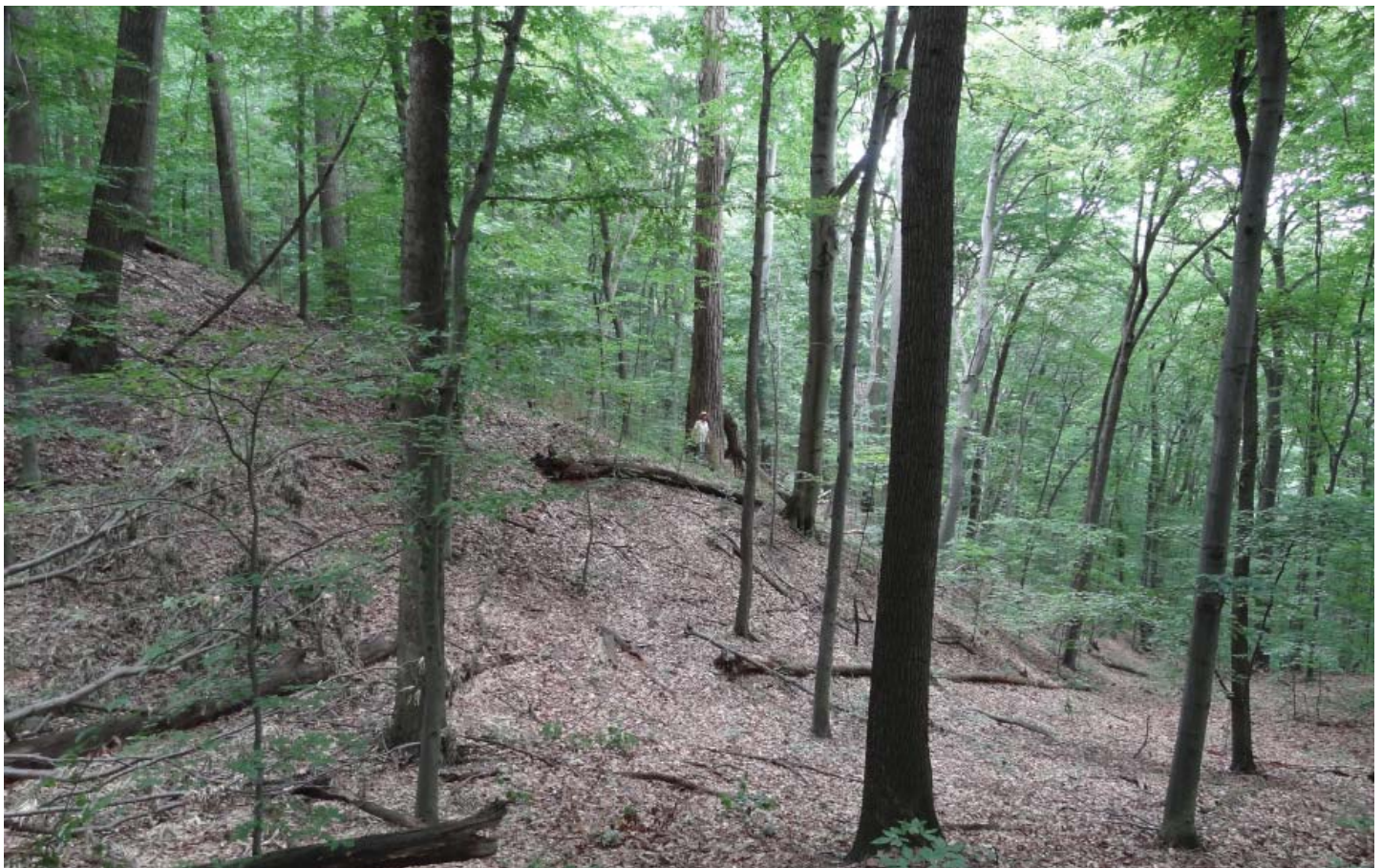


Photo 7. The steep terrain in Gun Lake Hills supports some of the oldest and most expansive forest in southwest Michigan. Photo by Mike Kost 2012.

gaps and a moderate volume of coarse woody debris. Several vernal pools occur within this forest. In addition, ginseng was documented growing in this forest. Ninety-six native, vascular plant species were noted within this forest during the 2012 surveys. This forest supports breeding populations of cerulean warbler (*Setophaga cerulea*, State Threatened) (Cohen et al. 2014).

Non-Forested Wetlands

The Dagget Lake coastal plain marsh occurs along the shores of Dagget Lake (Stand 1), a softwater seepage lake that occupies an ice-block depression in a coarse-textured end moraine. The coastal plain marsh is best developed along the eastern and western shores of the lake and is characterized by seasonally and interannually fluctuating water levels. The soils are acidic sands (pH 4.8-5.6) with moderate organics. Areas of shallow water are characterized by sweet-scented waterlily, yellow pond-lilies (*Nuphar* spp.), and pipewort (*Eriocaulon aquaticum*). A band of emergent graminoids rings the shallow water zone and is dominated by blue-joint, spike-rushes (*Eleocharis* spp.), and brownish beak-rush (*Rhynchospora capitellata*). Characteristic species include Canadian rush (*Juncus canadensis*), common boneset (*Eupatorium perfoliatum*), wild blue flag (*Iris versicolor*), slender goldentop (*Euthamia caroliniana*), northern bugle weed (*Lycopus uniflorus*), tooth-cup (*Rotala ramosior*), and wool-grass (*Scirpus cyperinus*). In addition, six rare coastal plain disjuncts occur within this emergent zone: black-fruited spike-rush (*Eleocharis melanocarpa*, State Special Concern), round-headed rush (*Juncus scirpoides*, State Threatened), dwarf bulrush (*Lipocarpha micrantha*, State Special Concern), tall beak-

rush (*Rhynchospora macrostachya*, State Special Concern), bald-rush (*Rhynchospora scirpoides*, State Threatened), and umbrella-grass (*Fuirena pumila*, State Threatened). Scattered shrubs occur along the margin of the marsh including willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), meadowsweet (*Spiraea alba*), steeplebush (*S. tomentosa*), swamp rose (*Rosa palustris*), and highbush blueberry (*Vaccinium corymbosum*). Blanchard's cricket frog (*Acris crepitans blanchardi*, State Threatened) was last documented in this wetland in 1986 and surveys in 2013 did not document any. The primary threats to the coastal plain marsh are alterations of hydrology and fire suppression and associated tree and shrub encroachment. Shrub and tree encroachment is occurring locally along the western shore of the wetland. In the past, purple loosestrife (*Lythrum salicaria*) has been reported from this site but was not recorded during surveys in 2012 (Cohen et al. 2014). This is the only coastal plain marsh documented in BSGA and we recommend prioritizing monitoring efforts for invasive species within this wetland as well as preventing alterations to hydrology.

There are several documented high-quality intermittent wetlands (Collectively referred to as Dagget Lake Wetlands) in Compartments 3 and 6. These occur in flat, poorly drained ice-block depressions within a coarse-textured end moraine. Two of these depressions are within Compartment 6 (Stands 63, 64, and 107). Along the open mud flats, sapric peat occurs at variable depths of up to one meter over acidic (pH 5.5) sand. The wetlands are ringed by a shrub-dominated margin with buttonbush, which is adjacent to a band of submergent moat with yellow pond-lily and smartweed. The central portion of the wetlands is



Photo 8. The margins of Dagget Lake support coastal plain marsh vegetation, including several rare species. Photo by Mike Kost 2012.

characterized by extensive mud flats with scattered patches of emergent vegetation. The patches of emergent vegetation are characterized by three-way sedge (*Dulichium arundinaceum*), marsh fern (*Thelypteris palustris*), cut grass (*Leersia oryzoides*), spike-rushes, common boneset, and St. John's-wort. Along the ecotone of the intermittent wetlands and the uplands are scattered trees including red maple, black gum (*Nyssa sylvatica*), white oak, and black oak. Twenty-eight native, vascular plant species were noted within these wetlands during the 2012 surveys (Cohen et al. 2014).

Norris Road Wetland (Stands 36, 37, and 38) is an intermittent wetland that occurs on a flat, poorly drained ice-block depression within a coarse-textured end moraine. The organic soils are peats of variable depth overlying acidic sands. The water table increases in depth from the center of the wetland toward the upland margin. The water table fluctuates seasonally and annually creating diverse ecological zonation including a shrub-carr margin, an emergent zone, seasonally inundated mud flats with stranded aquatic plants, and a bog mat in the southern and central portions of the wetland. The mud flats are dominated by floating vegetation that gets stranded during draw-down periods. Two bog-like zones occur in the southern two-thirds of the wetland and are dominated by sphagnum moss (*Sphagnum* spp.) and leatherleaf (*Chamaedaphne calyculata*). Two rare plants occur within the intermittent wetland: bald-rush (*Rhynchospora scirpoides*, State Threatened) and spotted pondweed (*Potamogeton pulcher*, State Endangered). Reed canary grass occurs locally within this wetland and can rapidly colonize wetlands. Thirty-four native, vascular plant species were noted within this wetland during the 2012 surveys (Cohen et al. 2014).

Wildwood Fen occurs along the margins of a kettle depression lake (Stand 27) within a coarse-textured end moraine. The fen is surrounded by degraded early-successional dry-mesic southern forest and pine plantations. This graminoid-dominated fen is characterized by groundwater influence and distinct ecological zonation. The groundwater, rich in mineral content, generates minerotrophic conditions. Within the fen, the organic soils are alkaline (pH 7.8) peats and marl with scattered sphagnum hummocks. Sphagnum hummock development and sedge tussocks generate micro-scale heterogeneity by creating fine-scale gradients of soil moisture and chemistry. Zones within the fen include shrubby fen, fen meadow, marl flats, and emergent marsh along the edge of the lake. Invasives occur throughout the fen and include glossy buckthorn (*Frangula alnus*), purple loosestrife (*Lythrum salicaria*), hybrid cat-tail (*Typha x glauca*), multiflora rose (*Rosa multiflora*), reed (*Phragmites australis*), and autumn olive (*Elaeagnus umbellata*). Invasive species are also common in the adjacent uplands and in nearby wetlands. The following invasives occur in nearby wetlands: narrow-leaved cat-tail, reed canary grass, and reed (*Phragmites australis*). In addition, the hydrology of the fen has likely been impacted by the nearby road. The small zones of prairie fen occur at the margins of Glaspie Lake and this was part of a larger wetland complex with inclusions of rich tamarack swamp, and wet meadow that included Stands 25, 30, and 35. Extensive alterations to hydrology – particularly ditching and road crossings – and protracted fire suppression have altered composition, increased the component of invasive species, and accelerated woody encroachment in these nearby wetlands. Because of the degraded nature of the wetland complex and the presence of larger fens in much better condition, we do not recommend prioritizing this wetland for stewardship activities.



Photo 9. The intermittent wetlands have several distinct zones of vegetation, including expansive mud flats. Photo by Mike Kost 2012.

Rare Taxa

We identified rare animal target species for surveys using historical distribution within Michigan, past occurrences in or near Barry SGA, and the presence of potential habitat within the game area. A variety of data sources were used to determine if potential habitat occurred within the game area, including natural community occurrences, MiFI descriptions, aerial photography, and on-the-ground observations. We conducted surveys for target animal species in appropriate potential habitats during time periods when targeted elements were expected to be most active and detectable (e.g., breeding season). Surveys were done to identify new occurrences, update and/or expand existing occurrences, and revisit historical occurrences of select rare species. In addition to documenting rare species, we also recorded observations of species of greatest conservation need (SGCN) identified in Michigan's Wildlife Action Plan (Eagle et al. 2005; full summary available in Cohen et al. 2014). Throughout the state game area, rare plants and animals tend to be concentrated around high-quality natural communities, particularly mature unfragmented forests and diverse wetlands with intact hydrology.

Reptiles and Amphibians

Barry SGA and adjacent public and private lands represent a "hotspot" of amphibian and reptile biodiversity in southern Michigan. Of the 43 amphibian and reptile species that have potential to occur in the Barry SGA and surrounding area, at least 24 species were documented in or around the state game area during surveys conducted by MNFI and others during and/or prior to 2013. These species included six listed or rare amphibian and reptile species, five SGCN, and 13 common species. Additionally, most of the rare species found in Barry SGA were documented at multiple sites. Many of these occurrences have persisted for a number of years (e.g., over 10-60 years), and are estimated to have excellent to good viability

in the foreseeable future (i.e., at least the next 20-30 years) (These data are available in Cohen et al. 2014).

Blanding's turtles (*Emydoidea blandingii*, State Special Concern) were observed in wetlands between Shaw and Otis Lake Roads during 2013 (Table 2). Blanding's turtles are found in clean shallow water bodies with abundant aquatic vegetation and muddy substrates. There is abundant suitable habitat throughout this compartment where this species likely occurs.

Eastern box turtles (*Terrapene carolina carolina*, State Special Concern) were recorded in Stand 94 during 2000 surveys and in Stands 80 and 115 in 2014 (Table 2). The eastern box turtle is Michigan's only truly terrestrial turtle. It typically occurs in forested habitats with sandy soils near a source of water such as a stream, pond, lake, marsh, or swamp. Access to unshaded nesting sites in sandy, open areas is critical for successful reproduction.



Photo 10. Box turtles (State Special Concern) have been documented throughout Compartment 6.

Table 2. Element Occurrences of plants and animals in Compartment 6, BSGA. 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 | EOID | EO Rank | Status | First Observed | Last Observed | Stands |
|----------------------------|------------------------------------|-------|---------|--------|----------------|---------------|-------------------------------|
| Reptiles/Amphibians | | | | | | | |
| Blanchard's cricket frog | <i>Acris blanchardi</i> | 593 | A | T | 1986 | 2013 | 11, 13, 21, 37, 38 |
| Blanding's turtle | <i>Emydoidea blandingii</i> | 1070 | E | SC | 2000 | 2013 | Vague Records |
| Eastern box turtle | <i>Terrapene carolina carolina</i> | 5639 | AB | SC | 1951 | 2014 | 80, 94, 115 |
| Birds | | | | | | | |
| Cerulean warbler | <i>Setophaga cerulea</i> | 18411 | B | T | 2006 | 2013 | 19, 68, 79, 99, 106, 119, 120 |
| Hooded warbler | <i>Setophaga citrina</i> | 18412 | E | SC | 2010 | 2013 | 50, 56, 91, 106, 119 |
| Birds | | | | | | | |
| Black-fruited spike-rush | <i>Eleocharis melanocarpa</i> | 5081 | AB | SC | 1958 | 2012 | 1 |
| Umbrella-grass | <i>Fuirena pumila</i> | 398 | E | T | 1976 | 1976 | 1 |
| Scirpus-like rush | <i>Juncus scirpoides</i> | 4876 | BC | T | 1970 | 2002 | 1 |
| Dwarf-bulrush | <i>Lipocarpa micrantha</i> | 7820 | D | SC | 1979 | 2006 | 1 |
| Ginseng | <i>Panax quinquefolius</i> | 18991 | C | T | 2012 | 2012 | 90, 91 |
| Ginseng | <i>Panax quinquefolius</i> | 18988 | CD | T | 2012 | 2012 | 124 |
| Spotted pondweed | <i>Potamogeton pulcher</i> | 8421 | E | E | 1979 | 1985 | 38 |
| Tall beakrush | <i>Rhynchospora macrostachya</i> | 5256 | C | SC | 1976 | 2012 | 1 |
| Bald-rush | <i>Rhynchospora scirpoides</i> | 9340 | B | T | 2002 | 2002 | 1 |
| Bald-rush | <i>Rhynchospora scirpoides</i> | 16911 | B | T | 2006 | 2012 | 36, 37, 38 |

Blanchard's cricket frog (*Acris blanchardii*, State Threatened) were recorded in Stand 1 in 1986 and in Stands 11, 13, 21, 37, and 38 in 2013 (Table 2). Blanchard's cricket frogs inhabit the shorelines of undisturbed permanent water bodies where they prefer open to partially vegetated mud flats. Habitat loss and predation by fish are primary threats and maintaining natural, undeveloped shoreline is essential for this species (Lee et al. 2000).

Birds

We observed two rare songbird species, cerulean warbler (*Steophaga cerulean*, State Threatened) and hooded warbler (*Setophaga citrina*, State Special Concern), during surveys conducted in Barry SGA in 2013. Both species were documented within Compartment 6, cerulean warblers in Stands 19, 68, 79, 99, 106, 119, and 120, and hooded warbler in Stands 50, 56, 91, 106, 119 (Table 2). These species are known to occur in landscapes consisting of large blocks of mature deciduous forest. Management of Barry SGA and the adjacent Yankee Springs SRA has maintained large areas of forest within a landscape that is largely dominated by agricultural land, residential development, and small fragments of forest. The large areas of forest in Barry SGA and Yankee Springs SRA are providing breeding habitat for cerulean and hooded warblers, as well as other neotropical migrant songbirds. We documented 44 species using forested tracts of the game area. Recorded bird species included several SGCN and four species (red-headed woodpecker, veery, wood thrush, and cerulean warbler) identified as focal species in the Landbird Habitat Conservation Strategy (Potter et al. 2007) for the Upper Mississippi River and Great Lakes Region Joint Venture (Cohen et al. 2014).

Although cerulean and hooded 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 and typically occupies forest tracts that are 3,000 ha (over 7,400 acres) or larger within the core of its breeding range (Hamel 2000). Hooded warblers nest in small trees or shrubs in the understory of mature deciduous forest (Dunn and Garrett 1997), and we observed them in areas of dense young trees and shrubs associated with blowdowns. The maintenance and expansion of mature forest blocks within the game area would benefit cerulean and hooded warblers and other forest-interior species, such as Acadian flycatcher and wood thrush. Activities that reduce the cover of mature forest or increase fragmentation could reduce the value of Barry SGA to forest-interior nesting songbirds. We observed brown-headed cowbirds (*Molothrus ater*) at 8% of the point-count stations surveyed in the game area. Cowbirds thrive in fragmented landscapes and reduce the reproductive success of forest-breeding songbirds through nest parasitism. Efforts to reduce forest fragmentation could decrease nest parasitism by brown-headed cowbirds on rare and declining forest songbirds (Cohen et al. 2014).



Photo 11. Blanding's turtle (State Endangered) are found in clean shallow water bodies with abundant aquatic vegetation and muddy substrates.

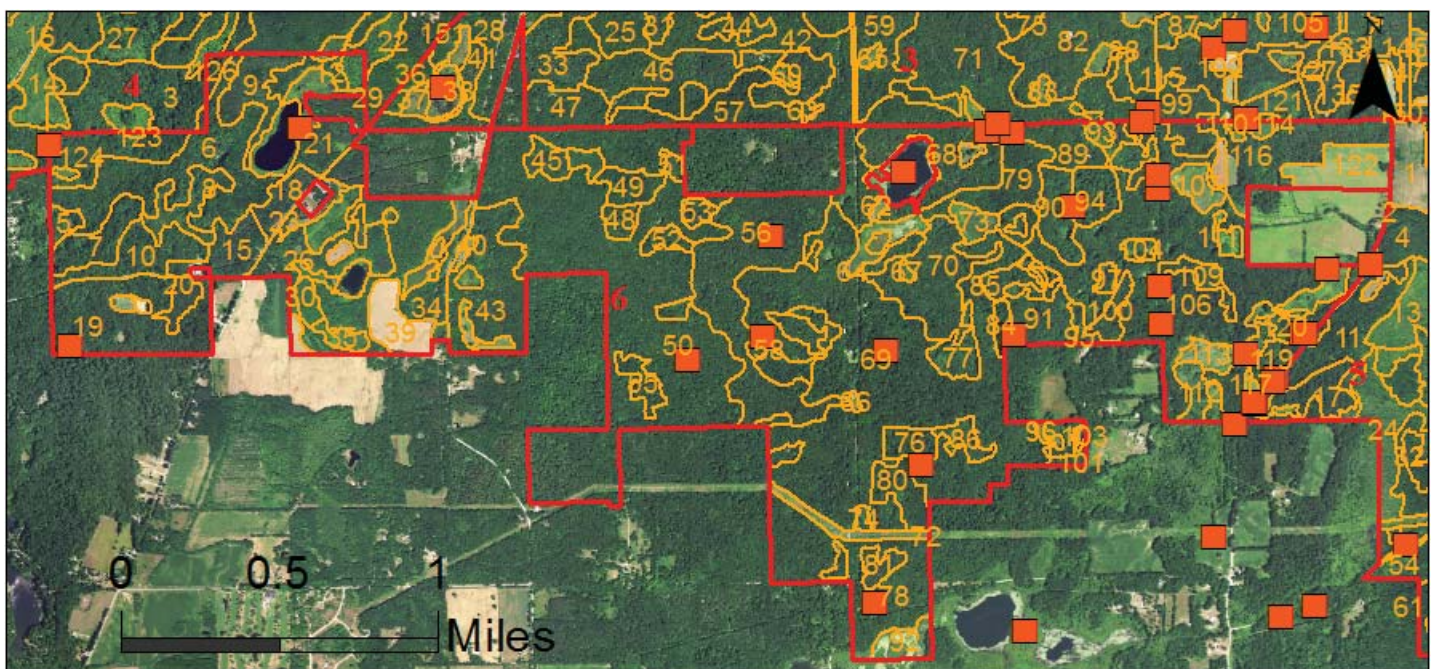


Figure 16. Locational information of rare animals (red squares) was mapped with stands in Compartment 6.

Plants

Ten rare plant species have been documented in Compartment 6 (Table 2). Six of these are coastal plain disjuncts and restricted to the coastal plain marsh at the margins of Dagget Lake (Stand 1). 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. Including this coastal plain marsh in larger prescribed fires can prevent successional transition woody encroachment and stimulate the sprouting of coastal plain disjunct species from the seed bank.

Spotted pondweed (*Potamogeton pulcher*, State Endangered) was recorded in Stand 38 and is a species restricted moderately deep water at the bog-like margins of lakes. Protecting natural hydrology is critical for this species.

Ginseng (*Panax quinquefolius*, State Threatened) occurs in dry-mesic to 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. Ginseng is highly sought after for its medicinal properties and poaching along with habitat loss threaten BSGA populations. Populations have greatly decreased over recent decades within the game area and across the state (Penskar and Higman 2007).

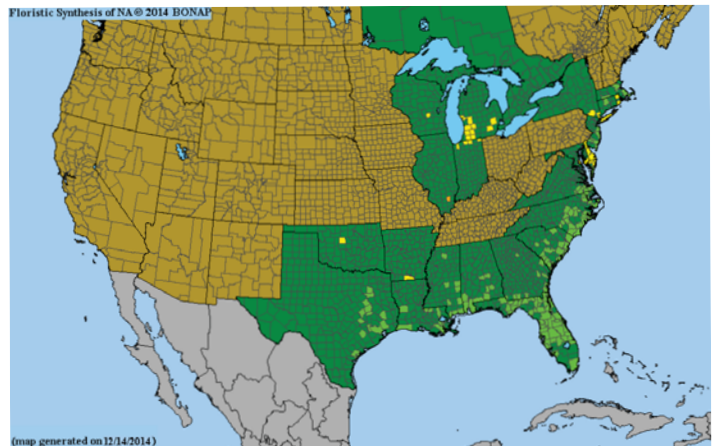


Photo 12 and Figure 17. Umbrella-grass (State Threatened) is a coastal plain disjunct found primarily on the Atlantic and Gulf coasts with clusters of inland populations around the great lakes. Photo by Mike Kost 2012.

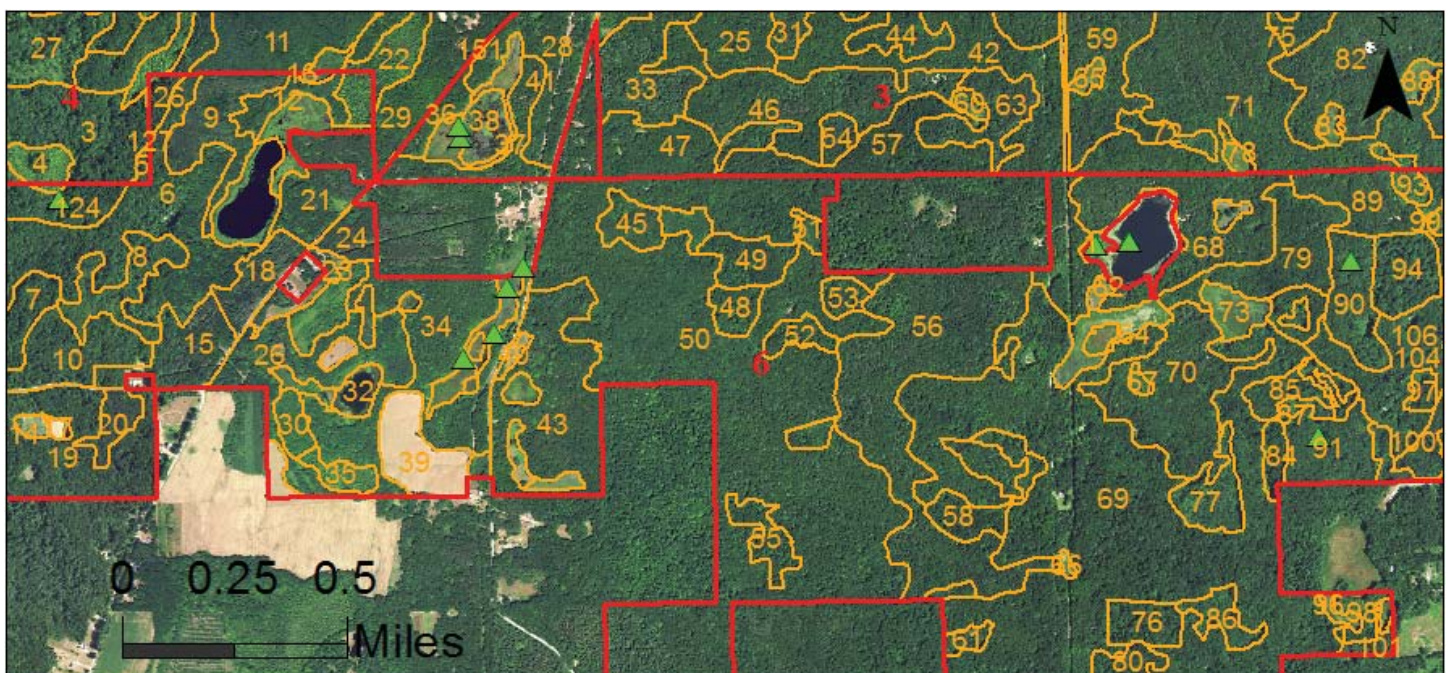


Figure 18. Locational information of rare plants (green triangles) was mapped with stands in Compartment 6.

MANAGEMENT RECOMMENDATIONS

Management recommendations for Compartment 6 are intended to promote and protect native biodiversity, especially rare species and natural communities.

Recommendations for Compartment 6 are arranged in order of priority: 1) allow high-quality forests to continue maturing; 2) limit fragmentation in and around high-quality forests; 3) protect hydrology of high-quality wetlands; 4) return fire as a disturbance to the landscape; and 5) monitor and control populations of wetland invasive species.

The forested stands within this compartment form a nearly contiguous block of closed-canopy forest with several areas of mature forest and sensitive wetlands throughout. Of the upland forests within this compartment, only 164 acres are documented as high-quality, mature forest, representing 7.3 % of the total area of Compartment 6. Maintaining the forest canopy of mature forest systems will help ensure that high-quality habitat remains for the diverse array of plants and animals, including the many rare species and SGCN that utilize this forested island. The conservation significance of these forests is heightened by the presence of forty-four species of birds of which ten are SGCN and four

are DNR featured species. Additionally, these forests protect hydrology of wetlands and support populations of ginseng. Because of the relative scarcity of such extensive upland forested systems in southern Michigan, this is an area of ecological significance for the region, particularly for neotropical migrants and obligate forest interior birds. Therefore, the highest priority for protecting and maintaining biodiversity and ecological integrity in this compartment is the maintenance of the extensive, mature closed-canopy forests. Avoiding tree harvest within and around the highest quality areas and preventing additional fragmentation adjacent to the EOs is of primary importance. Likewise, maintaining closed-canopy conditions around wetlands, especially those identified as important natural communities (i.e., EOs), will help maintain hydrologic conditions, protect water quality, and reduce the potential for an influx of invasive species within wetland systems. We therefore recommend avoiding mechanical harvest of trees in and around the areas identified as high-quality wetland communities. We also recommend establishing or maintaining buffers of upland forest at least 150 feet from wetlands and streams to protect wetland hydrology.



Photo 13. Gun Lake Woods is a dry-mesic southern forest with large, mature trees on steep end moraine. The forest occurs both on state game area as well as state recreation area lands. The north-facing slopes are characterized by large red oak, tulip tree, and beech. High-quality forests occur on less than 10 % of Compartment 6 and are some of southwest Michigan's most impressive.

An important component of maintaining the high-quality natural communities within Compartment 6 is the reintroduction of fire as a prevalent disturbance factor. Because this compartment is part of a fire-adapted landscape, we recommend including the highest quality forests and wetlands in prescribed fires. Implementation of prescribed fire is best done in the context of landscape-scale fire. Therefore we also recommend creating project areas centered around these high-quality forests where large portions of the compartment, including wetlands, could be burned with regularity. South-facing slopes would have had the highest frequency of historic fires, the greatest concentration of fire-adapted species, and the most severe impacts from mesophytic invaders like red maple. Subcanopy and understory red maple, sassafras, and black cherry could be girdled or mechanically felled if repeated fires do not control these mesophytic species. In addition, cutting and herbicide application to areas of concentrated invasive shrubs in priority forested stands will also complement the use of fire to control invasive shrubs.

Fire is a particularly useful tool for forest ecosystem management. Fire frequency and intensity can be varied to achieve additional objectives, such as: controlling mesophytic forest invaders, reducing woody encroachment in wetlands, promoting oak regeneration, improving deer browse, maintaining early-succession habitat, and promoting uneven age classes of aspen. 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. Within this compartment, fire can replace mechanical harvest as a management tool in most situations and thereby avoid fragmentation and long-lasting impacts to hydrology that can result from the use of heavy machinery.

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 Barry SGA, including forests, savannas, and non-forested wetlands, 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.



Photo 14. Landscape-level growing season burns are already being implemented on Barry SGA. This progressive approach to the application of prescribed fire dramatically impacts the ecosystem by reducing red maple, exposing mineral soils, and top-killing non-native shrubs. These actions promote the oak resource in improve browse for deer.

Repeated early spring burns are of particular concern in dry-mesic southern 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.

Resource managers restrict prescribed fire to the early spring for numerous reasons including ease of controlling burns, increased opportunity for conducting burns, 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 risks and that ultimately, maintenance of forested 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).

Invasive species are ubiquitous across the landscape and their control within ecologically important areas will require long-term efforts. Prioritization of stewardship within Barry SGA should focus on the highest-quality examples of the rarest natural community types. Biodiversity is most easily and effectively protected by preventing high-quality sites from degrading. Invasive species tend to be concentrated in upland areas with a history of agriculture and in wetlands where hydrology has been altered. Therefore one of the most important considerations for limiting additional impacts of invasive species is avoiding forest fragmentation in and around important natural communities. Efforts to combat populations of invasive species should be focused in the high-quality communities outlined in this report. Monitoring should be implemented to assess efforts to control non-native plant populations, to gauge the impact of deer herbivory, and evaluate oak regeneration and response of the forest to fire management. Populations of



Photo 15. Cerulean warbler (State Threatened) requires large blocks of mature, closed-canopy forest. Photo by Aaron Kortenhoven.

reed canary grass and narrow-leaf cat-tail within high-quality wetlands should be treated with wetland-approved herbicides. Partnering with the Barry, Calhoun, and Kalamazoo Cooperative Invasive Species Management Area (CISMA) could provide additional resources for addressing some of the problems around invasive species.

Partnering with CISMA could also help limit the spread of the invasive non-native reed (*Phragmites australis* subsp. *australis*) which has been found in Stand 121. This is a pernicious invasive plant that can completely alter the composition and structure of impacted wetlands. Stand 121 is part of a wetland complex that includes Stands 112, 113, 115, and 118 and though not particularly high-quality, these areas have relatively high native diversity

and some restoration potential, but phragmites jeopardizes the entire wetland complex. The dynamic hydrology of coastal plain marshes and intermittent wetlands makes these communities particularly vulnerable to this invasive species which respond positively to fluctuating water levels. Treatment of phragmites throughout the game area should be a priority in order to protect the long-term health of this game area's significant wetlands.

Prioritization of management actions is necessary when dealing with an area the size of BSGA. The following management recommendations for Compartment 6 are provided for your consideration but should be considered in the wider context of the game area:

Specific Recommendations

- Allow high-quality forests to continue maturing/Maintain large tracts of mature forest
 - Important upland Stands: 7, southern 50, 90, 91, western 106, 124, and 126
 - Include these stands in prescribed fire, particularly south-facing slopes
 - Focus management of upland invasive species in these stands
 - Avoid further fragmentation to protect and promote habitat for cerulean and hooded warblers as well as other neotropical migrants and red-shouldered hawks
 - Provide 150 ft forested buffer between target stands and timber harvest to mitigate fragmentation in most important forests
- Protect hydrology of high-quality wetlands
 - Important wetlands Stands: 1, 27, 31, 37, 38, 63, 64, and 107
 - Prevent alterations to hydrology (ditching, water-level control device, road construction)
 - Provide 150 ft forested buffer between target stands and timber harvest to protect water quality and hydrology
 - Include these stands in prescribed fire
 - Focus monitoring and management of invasive species in these stands
- Return fire as a disturbance
 - Focus fire use in high-quality forests mentioned above
 - Implement before timber harvest to promote oak regeneration and reduce maple
 - Use existing features such as roads and streams as burn breaks
 - Vary seasonality of burns to create habitat variability and improve browse for deer
 - Increase fire frequency and intensity to promote early-succession habitat
 - Replace timber harvest with application of fire as primary tool for forest ecosystem management
- Monitor and control populations of wetland invasive species
 - Focus monitoring in high-quality wetlands and along roads
 - Stand 121 has established phragmites
- 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

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