
Alleghan State Game Area

Natural Features Summary of Compartment 15



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Michigan Natural Features Inventory

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Wildlife Division

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MICHIGAN STATE
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EXTENSION



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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 (IFMAP, now 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 flagged areas that might meet the standards of exemplary natural community Element Occurrences (EOs) that were undocumented.

This review of Compartment 15 (Figure 1) is intended to complement current management plans by the WLD. This report will provide an overview of the historical and ecoregional context of ASGA and Compartment 15, and a summary of known element occurrences and natural community restoration potential in Compartment 15. This report will also provide management recommendations for the areas of interest in Compartment 15. Information used in this report was obtained from MNFI's Biotics database (MNFI 2015), observations by surveyors, and on notes taken during MiFI surveys.

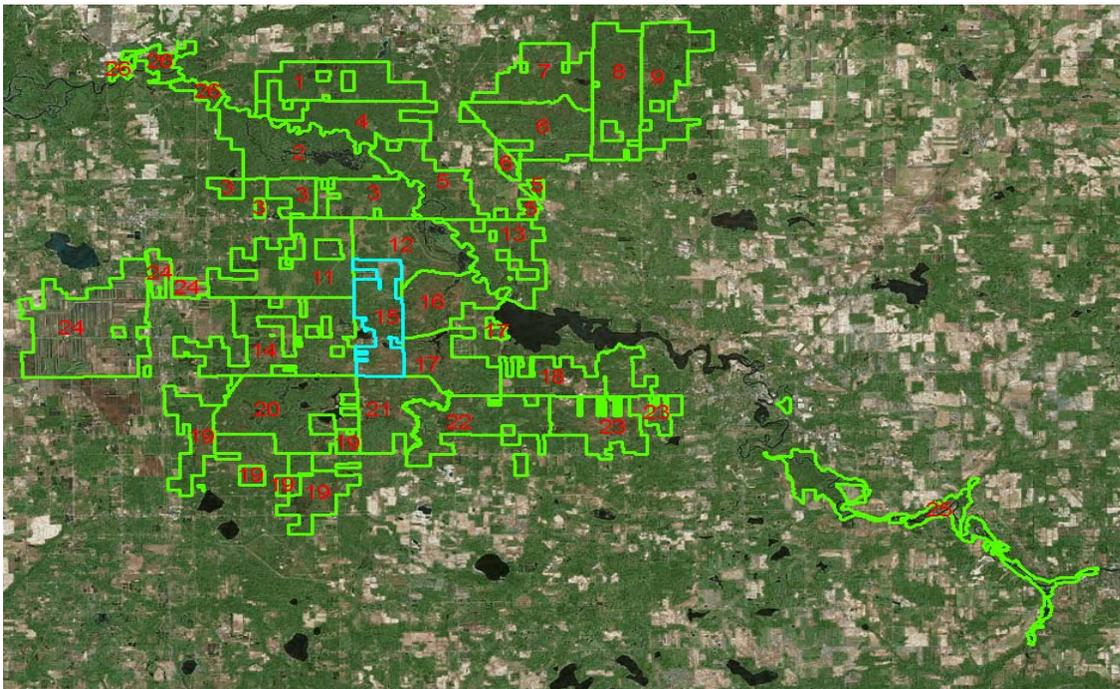


Figure 1. Compartments of Allegan State Game Area (green); Compartment 15 is highlighted (blue).

Ecoregional Context of ASGA and Compartment 15

Based on the regional landscape classification by Albert (1995), ASGA is almost entirely within the Southern Lake Michigan Lake Plain and Compartment 15 is completely within Southern Lake Michigan Lake Plain (Figure 2). The Southern Lake Michigan Lake Plain is characterized by flat to gently rolling topography with well drained and excessively-well drained soils dominated by oak-pine barrens in the northern third and the southern two-thirds was dominated by white pine-white oak forest (Figure 3, Figure 4). This report focuses primarily on Section 7 as this is the area in which there is the best management potential to restore oak-pine barrens.

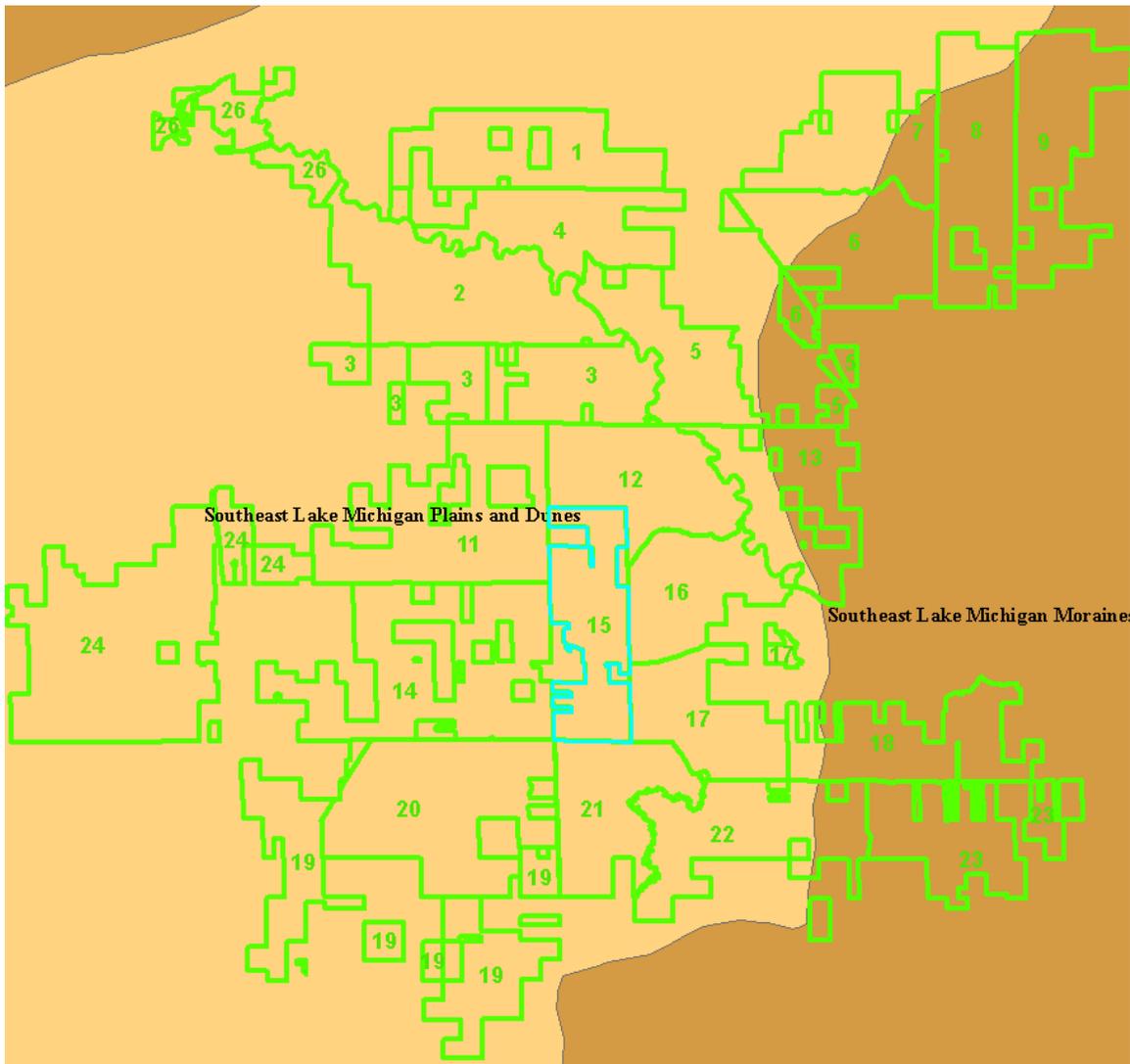


Figure 2. Ecoregions of Allegan State Game Area (Albert 1995).

Compartment Overview

Compartment 15 contains 76 stands and is located in the central portion of Allegan State Game Area flanked by 48th and 46th Streets to the east and west and between 122nd and 116th Avenues on the north and south. It is dissected by three roads, 116th, 118th and 120th Avenues.

Compartment 15 covers Sections 7, 18 and 19 of T02N, R14W. Historically the area was

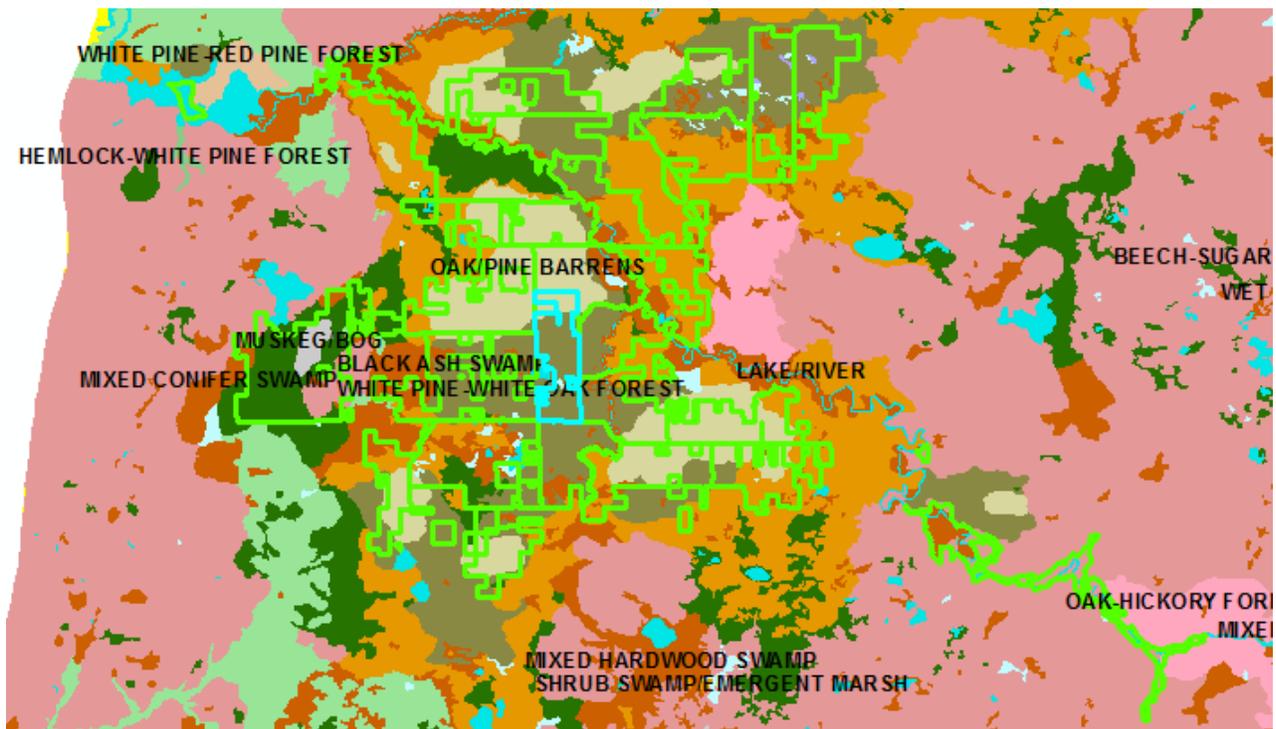


Figure 3. Circa 1800 vegetation cover of Allegan State Game Area and surrounding area (Comer et al. 1995).

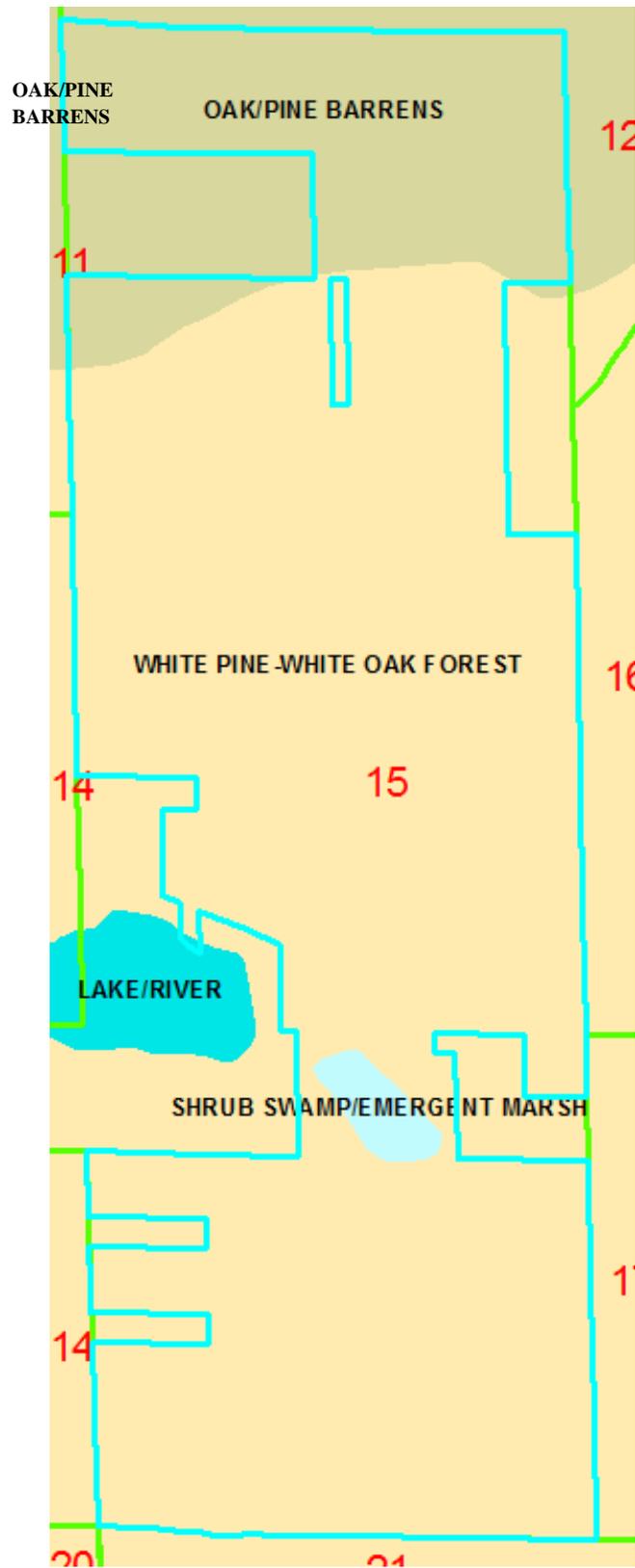


Figure 4. Circa 1800 vegetation cover types in Compartment 15.

Historically (circa 1800) the northern half of section 7 was oak-pine barrens (Figure 4). Based on the vegetation observed and recorded during IFMAP (MiFI) surveys it is likely that oak-pine barrens extended further south in Compartment 15 than indicated on the circa 1800 maps. Oak-pine barrens are a fire-dependent, savanna community dominated by oaks and pines. This community type has canopy cover that typically falls between 5 and 60 percent canopy closure.

Oak-pine barrens likely originated when prairie fires created openings by spreading into surrounding closed oak and pine forests. Repeated low-intensity fires, periodic drought, frost, and windthrow maintained these ecosystems. The extent to which barren remnants were present during the early part of the 20th century can be seen in 1938 aerial photos in (Figure 4).

Today there are only a few stands in Section 7 that contain some patchy oak-pine barrens (Figure 5, Figure 6). Currently section 7 is a mix of white oak/black oak dominant forest. White pine is present in the sub-canopy, but rarely as a canopy tree. Some of the forested stands in section 7 have small open areas within a matrix of forest. These open areas contain lupine (*Lupinus perennis*), little bluestem (*Schizachyrium scoparium*), black oatgrass (*Piptochaetium avenaceum*), and goat's rue (*Tephrosia virginiana*). These plants are relics of historical barrens. There is a combination of these barrens species found in the herbaceous layer of stands 3, 4, 7, 11, 16, 32, 42, 69 and 71 (Figure 7).

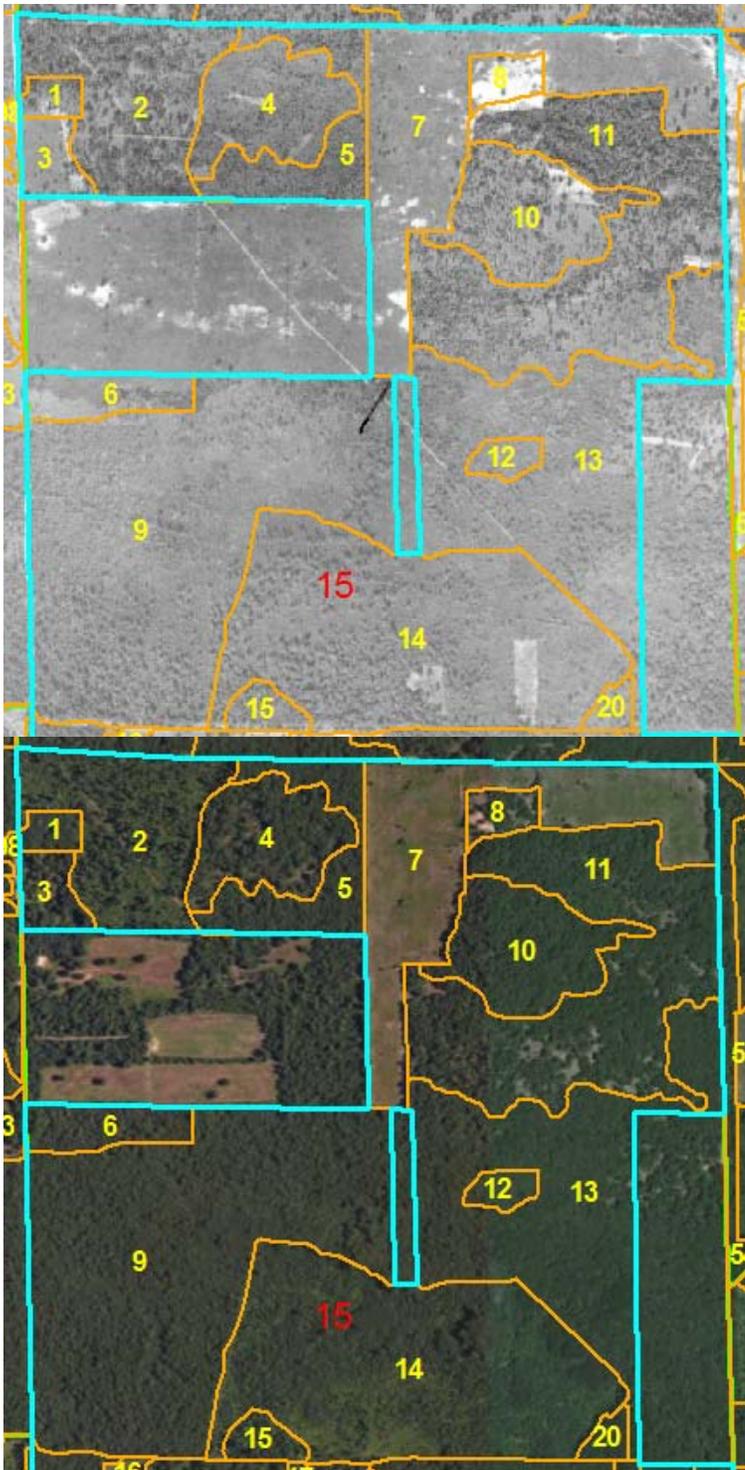


Figure 5. Aerial imagery of Section 7 from 1938. Notice the open canopy in Stands 3, 4, 10, and 11 in 1938 and how there has been a shift to greater canopy closure in ESRI world imagery.

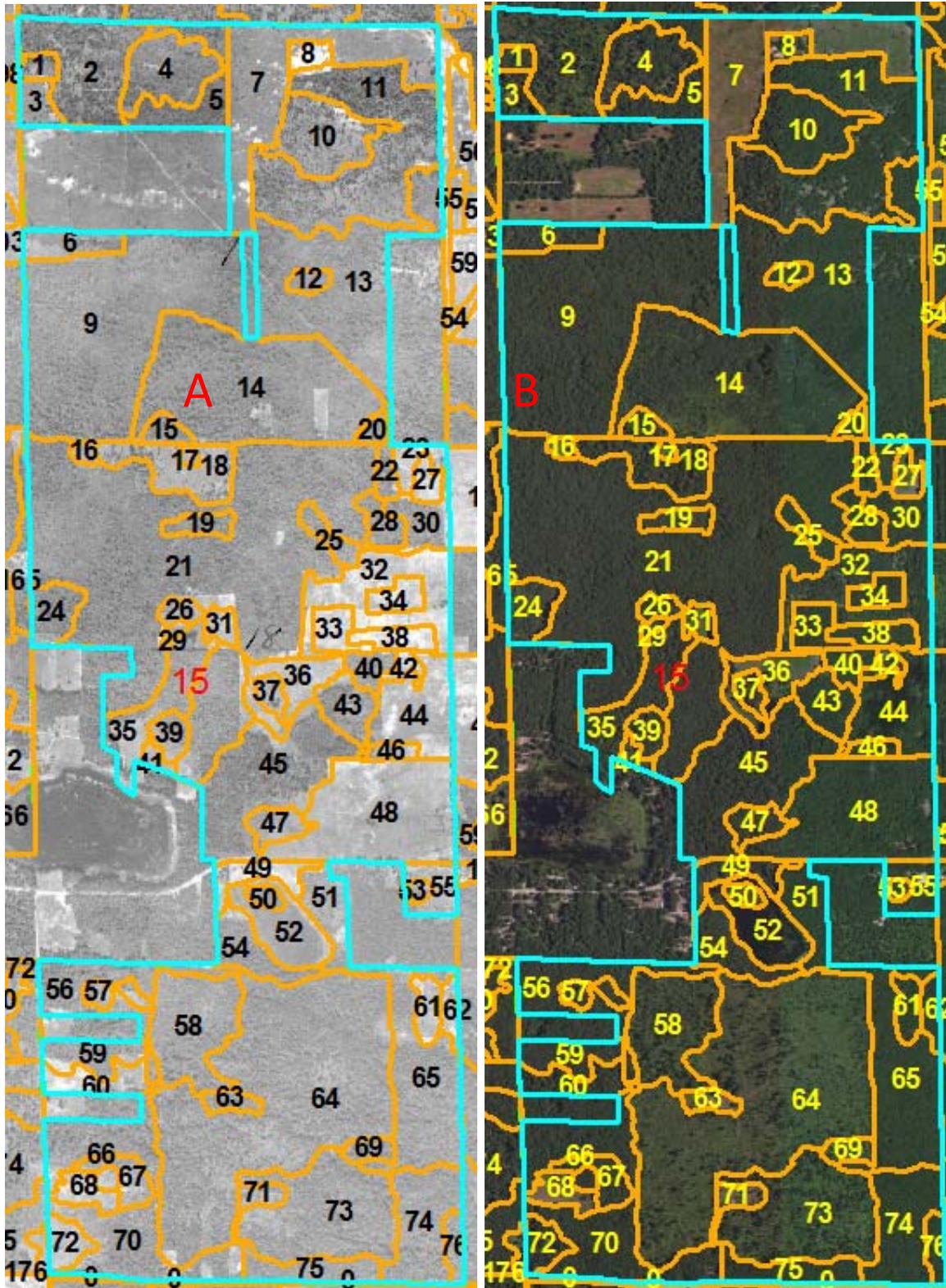


Figure 6. Aerial imagery of Compartment 15 from 1938 (A) in comparison with current aerial imagery (B).



Figure 7. Compartment 15 with stands of interest highlighted in blue.

Element Occurrences

Natural Communities

No natural communities have been documented in this block. However, information gathered from the Stage 1 inventory suggests that restorable oak-pine barrens might occur within compartment 15. We recommend that future surveys targeting this community type be carried out in stands 3, 4 10, and 11.

Compartment 15 did not contain any high quality forest. Most of the forested areas in this compartment had autumn olive as a medium to high understory component. All the forested stands (with the exception of popular stands) are fire resistant and should be included in any burns that might take place in the compartment.

Plants

There is one historic record of an element occurrence plant in compartment 15. Black-fruited spike-rush (*Eleocharis melanocarpa* Sate Special Concern) was recorded in 1942 in what is now stand 45. There are no recent records of this plant.

No recent element occurrence plants have been recorded in this block. This, however, does not mean none occur here and future surveys should target remnant oak-pine barrens.

Insects

Karner Blue butterfly (*Lycaeides melissa samuelis*, Federally and State Endangered) have been reported in stands 3, 7, 16, 33, 38, and 42 (Figure 8). Karner blue has been identified as a Focal Species by the WLD. Karner blues were not observed during the IFMAP survey, likely a result of survey timing. The Karner blue butterflies are usually associated with landscapes composed of sandy soils, which supported oak or oak-pine savanna or barrens prior to European settlement. Since their historical habitat suffers from fire suppression, the butterfly often occurs where wild lupine (*Lupinus perennis*) persists in openings, old fields, and right-of-ways surrounded by close-canopied oak forest. Karner blue larvae feed exclusively on wild lupine. Adults visit a wide variety of flowering plants for nectar. These and other species, benefit from the presence of ants that have a symbiotic relationship with the butterflies. The larvae secrete a sugary substance for the ants in exchange for protection from parasitic wasps (Rabe 2001).

Frosted elfin (*Incisalia irus*, State Threatened) was recorded in Stand 42 in 1997 (Figure 8) and also to the northeast of the compartment. Frosted elfin has been identified as a Priority Species by the WLD. The frosted elfin utilizes early-successional, open habitats such as oak savanna, oak-pine barrens, open areas, and forest edges (Nielsen 1999, Glassberg 1999). When disturbances are eliminated and the savanna areas form closed canopies, the frosted elfin can be found in the transitional areas between closed canopy oak areas and sand prairies (Nielsen 1994). Roadsides, power-line and railroad rights-of-ways can provide habitat if adequate food plants are available (i.e., wild lupine, wild indigo, and blueberry for nectaring) (Gehring 2006).

Additional rare insect species associated with prairies and barrens have been documented in the vicinity of the compartment and include persius dusky wing (*Erynnis persius persius*, state threatened) and Sprague's pygarcia (*Pygarcia spraguei*, State Special Concern). Both of these rare insects have been identified as Priority Species by the WLD.

Herptiles

Blanchard's cricket frog (*Acris crepitans blanchardi* State Threatened) was recorded in stand 50 in 1990 (Figure 8). Blanchard's cricket frog has been reported in about 40 sites in seven counties in southwest Michigan (Allegan, Barry, Berrien, Calhoun, Kalamazoo, Kent and Van Buren). Since the 1980s their population has been in steady decline. Blanchard's cricket frogs inhabit a variety of open edge habitats found along permanent ponds, lakes, floodings, bogs, seeps, and slow-moving streams and rivers and they prefer open or partially vegetated mud flats and muddy or sandy shorelines. They require a permanent water source that does not dry up seasonally (Lee et al. 2000).

Few herptiles were observed during surveys in compartment 15, possibly a result of the survey taking place in early spring. However, in adjacent compartments several reptile species (five-lined skink, blue racer, and eastern hog-nosed snake) were observed during prior surveys and surveys taking place later in the same year.

An eastern massasauga (*Sistrurus catenatus catenatus*, State Special Concern) was found just west of Compartment 15. Massasaugas have been identified as Focal Species by the WLD. Massasaugas occur in a variety of wetland habitats and populations in southern Michigan are typically associated with open wetlands, particularly prairie fens and wet meadows. Eastern

massasaugas also utilize open uplands and forest openings for foraging, basking, gestation and giving birth to young. Massasaugas usually hibernate below the frost line in crayfish or small mammal burrows, tree root networks or rock crevices in or along the edge of wetlands or in upland areas with presumably high water tables. Massasauga habitats are generally characterized by open, sunny areas intermixed with shaded areas for thermoregulation, presence of the water table near the surface for hibernation, and variable elevations between adjoining lowland and upland habitats.

Eastern box turtle (*Terrapene carolina carolina*, State Special Concern) have been documented in the vicinity of the compartment. Eastern box turtle have been identified as a Focal Species by WLD. 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. 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. This compartment falls within a large area identified by MNFI as a potential Focal Area for management for eastern box turtle (Cohen et al. 2014). Efforts to restore oak-pine barrens habitat will likely benefit eastern box turtle and eastern massasauga.

Birds

A high number of avian species that are on Michigan's featured species list for habitat management were recorded in Compartment 15 during IFMAP surveys. Featured species that were seen or heard during the survey include: red-shouldered hawk (*Buteo lineatus*), red-headed woodpecker (*Melanerpes erythrocephalus*), pileated woodpecker (*Dryocopus pileatus*), American woodcock (*Scolopax minor*), wood thrush (*Hylocichla mustelina*), wild turkey (*Meleagris gallopavo*), ruffed grouse (*Bonasa umbellus*), eastern bluebird (*Sialia sialis*), and eastern meadowlark (*Sturnella magna*). Additionally, several species of greatest conservation need were recorded. These included: Cooper's hawk (*Accipiter cooperii*), killdeer (*Charadrius vociferus*), yellow-billed cuckoo (*Coccyzus americanus*), common nighthawk (*Chordeiles minor*), northern flicker (*Colaptes auratus*), Acadian fly-catcher (*Empidonax vireescens*), eastern kingbird (*Tyrannus tyrannus*), brown thrasher (*Toxostoma rufum*), and northern parula (*Parula americana*).

Mammals

With the exception of white-tailed deer, chipmunks, and fox squirrels, few mammals were observed during the survey in this block. We recommend small mammal surveys be conducted in this compartment. It would be good to conduct thorough bat surveys in select areas to determine if northern long-eared bats (*Myotis septentrionalis*), eastern pipistrelle (*Perimyotis subflavus*) or Indiana bat (*Myotis lucifugus*) occur in the area.

Indiana bats can occur in bur oak plains, oak openings, flood plains and southern hardwood swamps (MNFI 2007). Indiana bats roost and form maternity colonies under loose bark or in hollows and cavities of mature trees in the floodplain forest. In Michigan, savanna habitats adjacent to riparian corridors may have been historically important for roost sites, as the bats are thought to prefer sun-exposed trees for maximum warmth at the northern limit of their range (MNFI 2007). The Indiana bat requires large blocks of mature floodplain forest, including standing snags and other suitable living roost sites. A primary limiting factor in their summer range has been the deforestation of riparian habitats, which usually occurs from the cutting of large, dead trees for firewood. Cutting of snags, canopy removal, and general land clearing activities along streams and rivers for development, agriculture, utility corridors, river or drain dredging and other purposes should be avoided. The species would likely benefit from restoration of floodplain forests and adjacent savannas through tree planting efforts (MNFI 2007).

The eastern pipistrelle is primarily known from the western UP and extreme southwest lower Michigan (Berrien Co.). It hibernates primarily in caves, mines, and deep crevices, but it also has been found hibernating at a hydroelectric facility in Manistee Co. In summer, it forages over the open water of streams and ponds, as well as forest edges. Summer roosts are usually within 30 miles (48 km) of hibernacula and may include buildings, tree hollows, and bridges. Eastern pipistrelles can be found in open woods near the edges of water, as well as over water. They are not usually found in open fields, deep forests, or buildings (MNFI 2007).

Northern long-eared bats generally roost in trees but have been known to roost in man-made structures. This species frequently roosts under bark in tree trunk crevices. They favor maples and ashes (Foster and Kurta 1999). Northern long-eared bats favor tall trees for roosting in

forests with heterogeneous forest structure including old growth and some young trees (Foster and Kurta 1999). Northern long-eared bats frequently forage within the forest and below the canopy in upland forests found on hillsides and ridges, but have also been noted to forage along paths, ponds and streams, and at forest edges. All roost reported by Foster and Kurta (1999) were close to wetlands

All three of these bat species have been identified as Focal Species by WLD. This compartment falls within a large area identified by MNFI as a potential Focal Area for management for northern long-eared bat (Cohen et al. 2014).

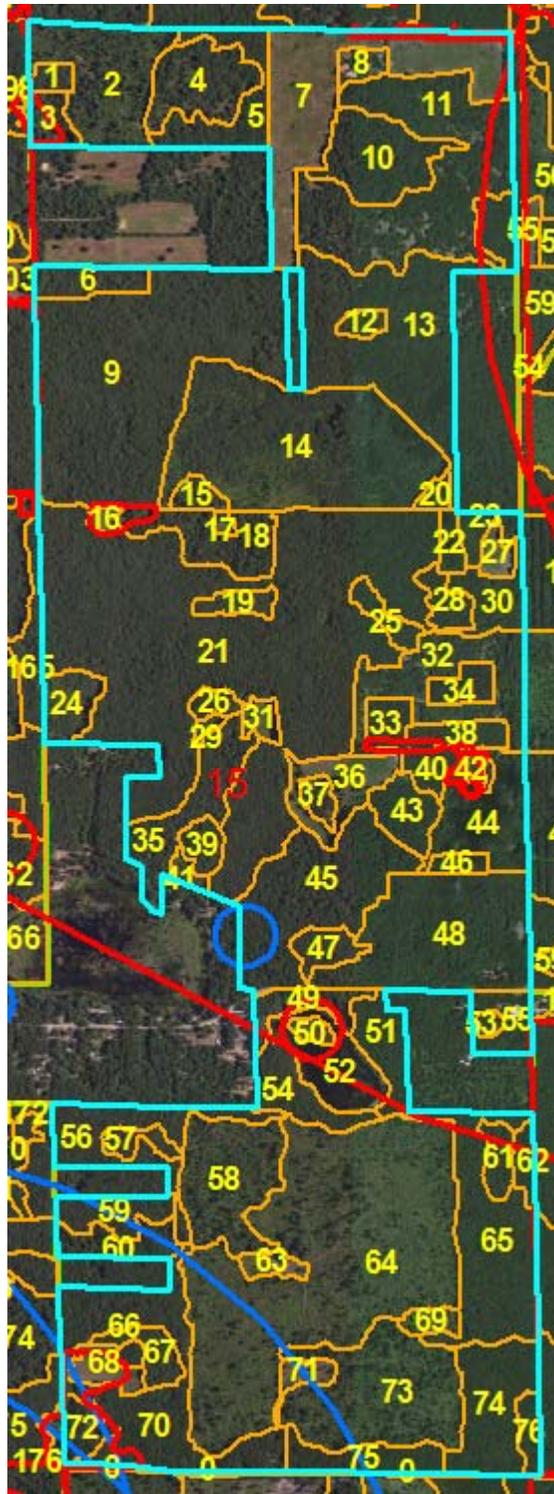


Figure 8. Element occurrences in and around Compartment 15; plant EOs are shown blue, animal EOs in red and community EOs in green.

Management Considerations

Barrens Habitat

The oak-pine barrens in Michigan have faced continuing decline over the last 150 years. This decline is largely due to agricultural and forestry practices as well as the lack of fire in the landscape over the last century. Oak-pine barrens natural community type has a state rank of S2, designating it as imperiled in the state due to restricted range and limited occurrences (less than 20 sites). Fire is the most significant factor in preserving oak-pine barrens landscapes (Cohen 2000). The absence of fire over the last century and natural succession has led to barrens in the area converting to closed canopy forests. Areas of barrens in this compartment that had approximately 50 percent canopy cover in the 1930s currently have over 80 percent canopy cover.

Fire as a Management Tool

Where remnants of oak-pine barrens persist, the use of prescribed fire is an essential management tool for maintaining open canopy, promoting high levels of grass and forb diversity, deterring the encroachment of woody vegetation and invasive species, and limiting the success of canopy dominants (Cohen 2000). Because Karner blue are a management concern, burning strategies should allow for ample refugia to facilitate effective post-burn re-colonization. Fire intervals of one to three years bolster graminoid dominance, increase overall grass and forb diversity, and remove woody cover of saplings and shrubs. Burning at longer time intervals will allow for woody plant seedling establishment and persistence.

Managing for open barrens will benefit Karner blues, frosted elfin, ottoe skippers, persius dusky wing, Sprague's pygarctia, eastern box turtles, eastern massasauga, red-headed woodpeckers, northern flickers eastern kingbirds, and brown thrashers. Additionally game species, particularly wild turkey, will utilize these areas for foraging. White-tailed deer will utilize barrens as browsing areas in early spring when forested stands have less food to offer. Barren grasses will also provide essential cover for fawns during the first few months of their life.

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 these species. Historically, fires burned in a variety of seasons, including spring, during the growing season, and fall. Many of the natural communities found at ASGA including oak-pine barrens and dry-mesic northern forest likely burned in late summer and early fall in the past. 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. In other words, pyrodiversity (that is, a diversity of burn seasons and fire intensity) leads to biodiversity (Cohen et al. 2009).

Repeated early spring burns are of particular concern in oak-pine barrens and dry-mesic northern forest where a goal for prescribed burning is to control woody species. Prior to bud break and leaf flushing, the vast majority of energy in a woody plant is stored in roots as carbohydrate reserves. As plants expand 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 depleted, and resprouting vigor is lower, particularly for clonal species like sassafras, sumac, and black locust (Cohen et al. 2009).

Resource managers restrict prescribed fire to the early spring for numerous reasons including ease of controlling burns, greater windows of opportunity for conducting burns because suitable burning conditions are often most prevalent this time of year, and to reduce the probability of detrimentally impacting fire-sensitive animal species, such as herptiles (i.e., eastern box turtle). While these are all legitimate reasons, we feel that the long-term benefits of diversifying burn seasonality outweigh the costs and that ultimately, successful restoration of oak-pine barrens ecosystems will depend on expansion of the burn season beyond early spring. Protocol can be set

in place to reduce risk to fire-sensitive species. These steps would include the avoidance of burning within and around known hibernacula, vernal pools, and seepage areas. Impacts on fire sensitive species can also be mitigated by establishing rotating refuge areas within large burn units (Cohen et al. 2009).

Barrens Restoration

Stands 3, 42, and 71 are barrens areas that need little more than fire to maintain the community structure and improve the composition and structure of vegetation (Figure 5). In addition to fire, these stands can be maintained with winter mowing to reduce encroaching sassafras, black cherry, oak saplings (grubs), and other woody species that rapidly colonize open areas in the absence of fire.

Many of the areas that were historically open barrens have become forested and could be thinned to expand barrens habitat. Stands 4, 10, 11, 32 and 42 are candidates for conversion from oak forests to barrens (Figure 5). These stands are adjacent to areas in Compartment 12 where management activities aimed at creating oak barrens is already set to take place in 2015. Work on barrens restoration in Compartment 15 will complement current efforts and set the stage for oaks barrens establishment at a landscape level. These two areas can be easily connected creating more potential Karner blue habitat. More habitat for these endangered species will have the long-term impact of mitigating local events that may impact species recruitment from one site to the next. This barrens landscape may also become a stronghold for several featured species such as frosted elfin, persius duskywing, Sprague's pygarctia, eastern kingbird, and red-headed woodpecker that depend on open areas to meet habitat requirements.

Target canopy closure for restored barrens should be between 5 and 60 percent. This can be achieved by leaving both individual trees and scattered clumps of mature oaks within a given stand. We recommend leaving wooded buffers around current openings in these stands to avoid damaging the intact barrens vegetation and ant mounds in these openings. These buffers will emulate natural oak barrens structure over time with senescing trees and possible recruitment. We also recommend cutting trees low to facilitate mowing.

It is also important to avoid damaging ant mounds with logging equipment. The survivorship of butterflies is often increased by the presence of ants. Consequently, consideration and protection should be given to the large ant colonies that exist in the area.

Understory plants will flourish after canopy tree removal and this creates the potential for accelerated loss of barrens areas if fire is not employed in barrens maintenance to control woody encroachment. For this reason, fire must be considered a critical management tool, particularly in the first 5 to 10 years after thinning. Repeated fires will be required to prevent the formation of dense undergrowth. Additional mowing and herbicide application may be needed if fire does not succeed in impeding woody vegetation growth.

Threats

The primary threat to both wildlife and plants in compartment 15 is illegal off road vehicle use. While compartment 15 did not have significant issues with ORV use, continued monitoring is necessary to stop it when it first starts. The current management practice of placing signs and stumps in areas where ORV use has been observed is the best course of action.

Management Recommendations

The following management recommendations for Compartment 15 are provided for your consideration:

- Important Barrens to Maintain and Expand
 - Stands 3,42, and 71.
 - Avoid disturbing soil, don't use openings for staging areas during timber harvest
 - Mow in winter to complement burning if necessary
 - Burn frequently and vary the seasonality of burns to include spring, growing season, and fall burns; allow for refugia for Karner blue and other fire-sensitive species.
 - Connect quality barrens areas
 - Avoid damaging ant colonies, particularly during mowing and timber harvest
 - Prevent ORV use
 - Survey for rare species including frosted elfin, ottoe skipper, persius duskywing, Sprague's pygrarctia, and eastern box turtle
- Converting Forests to Barrens
 - Stands 4, 10, 11, and 32.
 - Maintain openings with barrens species (lupine and others)
 - Avoid damaging ant colonies
 - Thin to 25 to 75 percent canopy cover, leave existing openings intact
 - Connect existing barrens areas within stands
 - Burn (and/or mow) repeatedly to prevent subcanopy and understory from aggressively rebounding; without burning, there is a high probability that loss of barrens areas will be accelerated
- Thin and burn pine plantations to promote regeneration of oak and natural vegetation
- Trap/kill raccoons and other mesopredators to reduce predation on herptiles and birds

Conclusion

Managing these stands towards the restoration of oak-pine barrens will provide greater habitat heterogeneity within Compartment 15. By so doing, key featured species such as white-tailed deer and wild turkey will likely benefit. In addition, barrens restoration can potentially benefit numerous Focal and Priority Species including Karner blue, eastern box turtle, eastern massasauga, frosted elfin, persius dusky wing, ottoe skipper, and Sprague's pygarcia. The creation of oak-pine barrens in a matrix of forested surroundings will provide edge habitat. Edge effect often increases species diversity in an area. Restoring barrens will enhance habitat for both game and non-game wildlife species in a holistic management approach that meets the criteria laid out in Michigan's Wildlife Action Plan.

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Appendix A

Table 1. List of element occurrences found in Compartment 15 with their EO ID number, rank, site, and last observed date.

Common Name	Type	EOID	Rank	Site/Stand	Last Observed
Frost elfin	Invertebrate Animal	8381	CD	42	05/16/1995
Karner blue	Invertebrate Animal	11157, 2534	A	3, 7, 16, 33, 38, 42	08/12/2009
Blacnhard's cricket frog	Vertabrate	11764	Historical	50	03/28/1990

Links to Michigan Department of Natural and Resources Featured Species and Species of Greatest Conservation Need.

Plants

Black-fruited spike-rush

<http://mnfi.anr.msu.edu/explorer/species.cfm?id=15313>

Birds

Coopers Hawk:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Accipiter_cooperii.pdf

Red-shouldered Hawk:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Buteo_lineatus.pdf

American woodcock:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Scolopax_minor.pdf

Red-headed woodpecker:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Melanerpes_erythrocephalus.pdf

Northern Flicker:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Colaptes_auratus.pdf

Acadian flycatcher:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Empidonax_virescens.pdf

Eastern kingbird:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Tyrannus_tyrannus.pdf

Wood thrush:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Hylocichla_mustelina.pdf

Brown thrasher:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Toxostoma_rufum.pdf

Northern Parula:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Parula_america.pdf

Field sparrow:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Spizella_pusilla.pdf

Eastern Meadowlark:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Sturnella_magna.pdf

Amphibians

Blanchard's cricket frog:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Acris_crepitans_blanchardi.pdf

Insects

Forested elfin:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Callophrys_irus.pdf

http://mnfi.anr.msu.edu/abstracts/zoology/Incisalia_irus.pdf

Kaner blue:

http://www.michigandnr.com/publications/pdfs/HuntingWildlifeHabitat/WCS/SGCN/Lycaeides_melissa_samuelis.pdf

http://mnfi.anr.msu.edu/abstracts/zoology/Lycaeides_melissa_samuelis.pdf

Natural communities

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