
Allegan State Game Area

Natural Features Summary of Compartment 11



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Michigan Natural Features Inventory

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Cover photo: Compartment 11, Allegan State Game Area. Photo by Aaron Kortenhoven.

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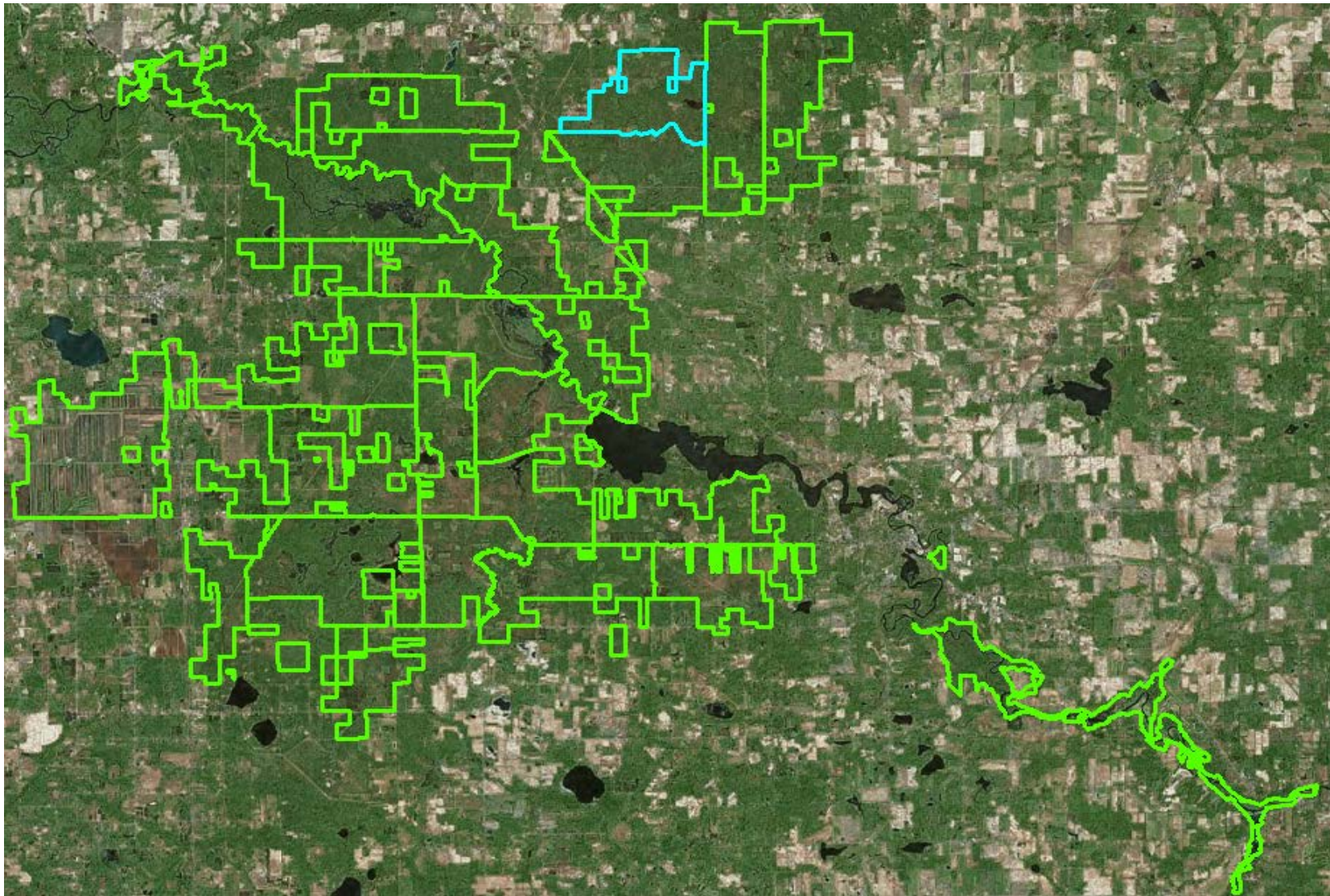


Figure 1: Compartment 7 of Allegheny State Game Area is highlighted in blue.

Introduction

Project Background

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

During 2011 and 2012, the Department of Natural Resources (DNR) and Michigan Natural Features Inventory (MNFI) conducted the Stage 1 survey of ASGA as part of the DNR’s Michigan Forest Inventory (MiFI). This project is part of a long-term effort by the DNR Wildlife Division (WLD) to document and sustainably manage areas of high conservation significance on state lands. The survey collected information on basic stand data and also helped target the locations of previously undocumented exemplary natural community Element Occurrences (EOs).

This game area is in the central portion of Allegan County. There are 25 compartments in ASGA (Figure 1). Compartment 11 consists of 2522 acres in the central portion of the game area. This review of Compartment 11 is intended to complement the management plans already underway by WLD. This report will provide an overview of the historical and ecoregional context of ASGA and Compartment 11, an overview of the known element occurrences and significant natural communities in Compartment 11, and management recommendations for the significant natural features therein. Much of the information in this report was synthesized from MNFI’s Biotics database and the MNFI website which provides descriptions of natural communities and rare plants and animals.

The goal of this document is to help identify and prioritize the most significant intact natural areas in an effort to promote biodiversity in the context of a public hunting area that is mandated to be managed for game species.

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**.

Allegan SGA lies primarily within the **Allegan** subsection (Subsection VI.3), and within two sub-subsections, the **Southern Lake Michigan Lake Plain** (Sub-subsection VI.3.2) and the **Berrien Springs** (Sub-subsection VI.3.1). The majority of the game area occurs in the **Southern Lake Michigan Lake Plain** and small portions

of the eastern game area occur in the **Berrien Springs** (Figure 2).

The **Allegan** subsection is bounded by Lake Michigan to the west and the typical land forms are flat lake plain, coastal sand dunes, gently

rolling till plain, and rolling to steep end moraines. Several of the state's major rivers cross the subsection, including the Kalamazoo, St. Joseph, Grand and Muskegon (Albert 1995).

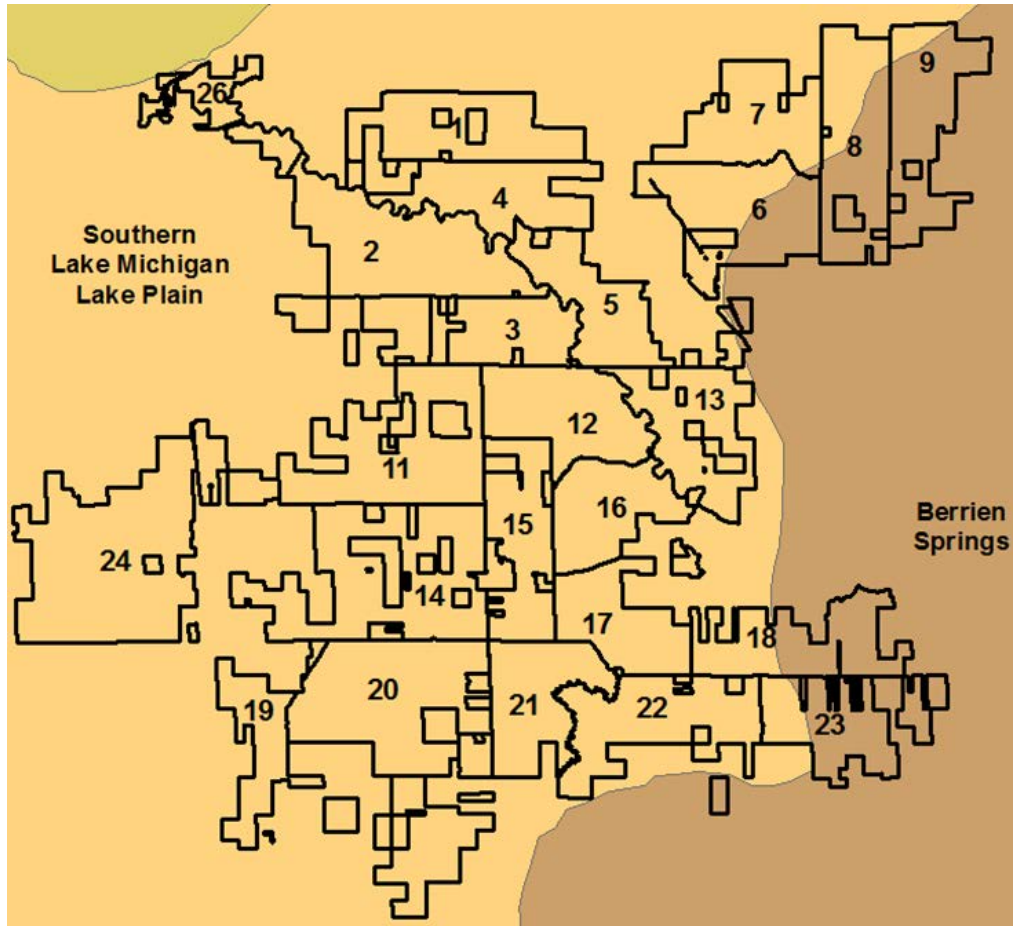


Figure 2: Ecoregions of Allegan State Game Area (Albert 1995).

Compartment 11 falls entirely within the **Southern Michigan Lake Plain**. The **Southern Lake Michigan Lake Plain** is characterized by extensive lake plain features associated with historic levels of Lake Michigan that were much higher during periods of glacial recession. Sand dunes inland from present-day lake Michigan shoreline are associated with historic shoreline. Deep sands were deposited over the lake plain

during outwash events that formed the Kalamazoo, Grand, and Muskegon River channels (Figure 2). Coastal sand dunes are concentrated at the mouths of these and other river systems along the extent of the subsection.

There are a few small kettle lakes on the sand lake plain. The water level of many of these lakes fluctuates greatly, leaving them almost dry in

some summers and totally inundated in spring. These fluctuations, the fluctuations of the Great Lakes historically, and the abundance of migrating waterfowl result in a distinctive disjuncts flora from the Atlantic and Gulf Coastal Plains along the margins of many

lakes. Throughout the lake plain, sandy soils are excessively drained and fire prone, while other areas have lenses that restrict drainage and allow for periodic inundation. (Albert 1995).

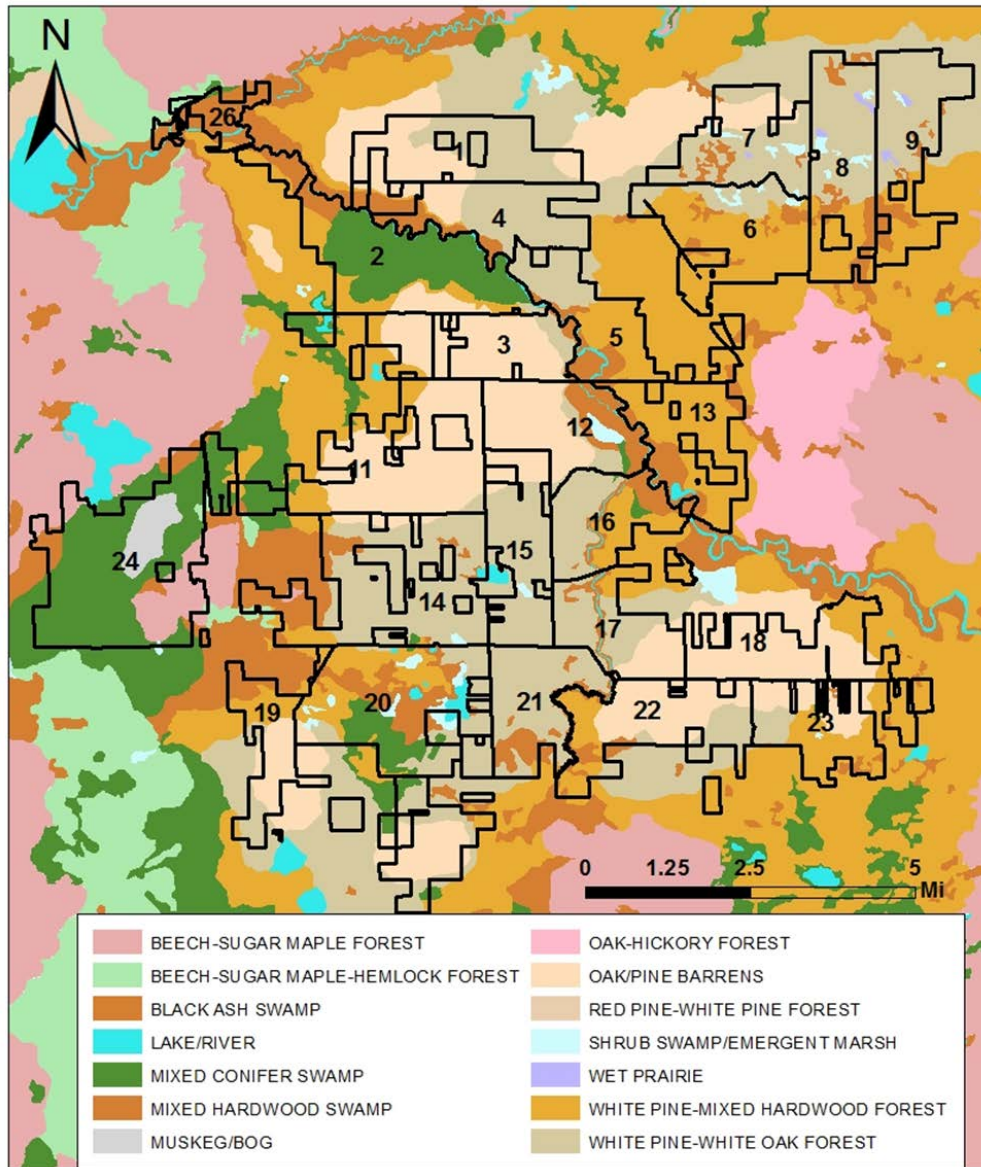


Figure 3: Circa 1800 vegetation cover of Alleghen State Game Area (Comer et al. 1995).

Interpretations of the General Land Office surveyor notes by MNFI ecologists indicated that the Alleghen contained several distinct vegetation assemblages circa 1800 (Comer et al. 1995, Figure 3). Surveyors recorded tree

species composition, tree size, and general condition of the region. Historically, much of the game area was a mosaic of oak-pine forest and barrens (savanna) ecosystems characterized by large open-grown oaks and pines with an

herbaceous layer consisting of both prairie and forest species (Figure 4). Forests consisted largely of white pine and mixed oak with the white pine forming a supercanopy. Wetlands occurred in kettle depressions, outwash channels, and extensive tracts of floodplain forests associated with the Kalamazoo River. Lakes, marshes, bogs, inundated shrub swamps,

intermittent wetlands, coastal plain marshes, and vernal pools would have occupied the low areas influenced by fluctuating ground-water levels or depressions created by blocks of ice left by the retreating glaciers. Outwash channels formed from glacial melt-waters were occupied by wet prairies, shrub swamps, and forested swamps (Cohen et al. 2014).

Vegetation Patterns of Compartment 11

Historically, much of the game area was a mosaic of forested and non-forested uplands, with the non-forested areas supporting savanna ecosystems characterized by large open-grown oaks and pines with an herbaceous layer consisting of both prairie and forest species. Forests were predominantly dry-mesic northern forest. Wetlands were restricted to outwash channels, kettle depressions, and lowlands associated with the Kalamazoo River, which is bordered by extensive tracts of floodplain forests. Lakes, marshes, bogs, inundated shrub swamps, intermittent wetlands, coastal plain marshes, and vernal pools within forested systems would have occupied the kettle depressions created by large blocks of ice left

mixed hardwood forests. Only a small portion was lowland, which included an area of mixed conifer swamp and what would best be described as a coastal plain marsh pocket less than an acre in size.

by the retreating glaciers. Outwash channels formed from glacial melt-waters would have been occupied by wet prairies, shrub swamps, and forested swamps. Due to gaps in surveyor's notes, aspects of the historic vegetation maps may not precisely reflect the extent of certain small-scale systems; particularly emergent wetlands and hardwood swamps. The majority of the upland areas of Compartment 11 were dominated by oak-pine barrens with a few small areas of white pine-

Historically the area now encompassed by Compartment 11 was dominated by oak-pine barrens. 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 6). These barrens were lost to both fire suppression and clearing followed by farming. Given the poor soil quality these farms were soon abandoned reverting to old field and in many cases through succession and fire suppression are the closed canopy forests we see in the compartment today, which are best described as a variant of Dry-Mesic Northern forest. Based on aerial imagery from 1938, however, it looks as though large swaths of compartment 11 were not tilled as of 1938 and much of the barrens were lost to the natural succession that occurs in a landscape absent of fire.

At present only a few stands that contain patchy oak-pine barrens remain in areas where this community occurred historically (Table 1, Figure 5). Compartment 11 is a mix of white oak/black oak dominated forest. White pine is present in the sub-canopy, but rarely as a canopy tree. Currently, most forests in this compartment

are characterized by a significant hardwood. Hardwood associates include white oak (*Quercus alba*), black oak (*Q. velutina*), red oak (*Q. rubra*), and red maple (*Acer rubrum*). Bracken fern (*Pteridium aquilinum*) and huckleberry (*Gaylussacia baccata*) often dominate the ground layer and low shrub, respectively.

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

Some of the forested stands have small open areas which contain little bluestem (*Schizachyrium scoparium*), black oatgrass (*Piptochaetium avenaceum*), and goat's rue (*Tephrosia virginiana*). Patches with these barrens species are found in the herbaceous layer of stands highlighted in Figure 5 and 7.

The few lowland forested areas in Compartment 11 were largely dominated by mixed conifer swamp historically. Now these areas are secondary hardwood swamps. Today this community type is characterized by canopy dominance of red maple (*Acer rubrum*), pin oak (*Quercus palustris*), swamp white oak (*Q. bicolor*), and green ash (*Fraxinus pennsylvanica*).

Natural Communities

Currently Oak-Pine Barren is the only forest type in Compartment 11 that fits into MNFI's natural community classification.

The two other forest types present resemble Dry-Mesic Northern and Southern Hardwood Swamp. (Table 1).

Table 1: Stands of interest in Compartment 11, their EO status and possible actions for improving the ecological integrity of these unique communities (EO = Element Occurrence; RP = Restoration Potential).

Hydrologic regime	Ecological Group	Community Type	Stand	Quality	Action
Terrestrial	Savanna	Oak-Pine Barrens	57	EO	Burn
		Oak-Pine Barrens	62	EO	Burn
		Oak-Pine Barrens	67	EO	Burn
		Oak-Pine Barrens	68	EO	Burn
		Oak-Pine Barrens	43	RP	Burn
	Forest	Dry-Mesic Northern	34	RP	Burn/Thin
		Dry-Mesic Northern	43	RP	Burn/Thin
		Dry-Mesic Northern	48	RP	Burn/Thin
		Dry-Mesic Northern	49	RP	Burn/Thin
		Dry-Mesic Northern	50	RP	Burn/Thin
		Dry-Mesic Northern	56	RP	Burn/Thin
		Dry-Mesic Northern	63	RP	Burn/Thin
		Dry-Mesic Northern	69	RP	Burn/Thin
		Dry-Mesic Northern	70	RP	Burn/Thin
		Dry-Mesic Northern	72	RP	Burn/Thin
		Dry-Mesic Northern	73	RP	Burn/Thin
		Dry-Mesic Northern	74	RP	Burn/Thin
		Dry-Mesic Northern	75	RP	Burn/Thin
		Dry-Mesic Northern	76	RP	Burn/Thin
		Dry-Mesic Northern	78	RP	Burn/Thin
Dry-Mesic Northern	82	RP	Burn/Thin		
Palustrine	Forested wetland	Southern Hardwood Swamp	33	RP	Maintain

Oak-Pine Barrens

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). 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. 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 less than 50 % canopy cover in the 1930s currently have over 80 %

canopy (Figure 6 and 7). Stands 54, 57, 61, 62 and 67 are current EOs (Figure 5). Ten stands in Compartment 11 contain features of oak-pine barrens, stands: 54, 57, 58, 62, 64, 67, 68, 70, 73 and 79, (Figure 8). Stands 43 and 70 have some barrens species and show restoration potential, but are currently closed canopy forest.

Stands 57, 62, 67, 68 have already had prescribed burns and are responding positively to this management. 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 (See Photo 1 below).



Photo 1: Woody encroachment in Stand 57 after initial burn which has been top-killed by a second burn in subsequent years.



Photo 2: Barrens habitat in Stand 62.

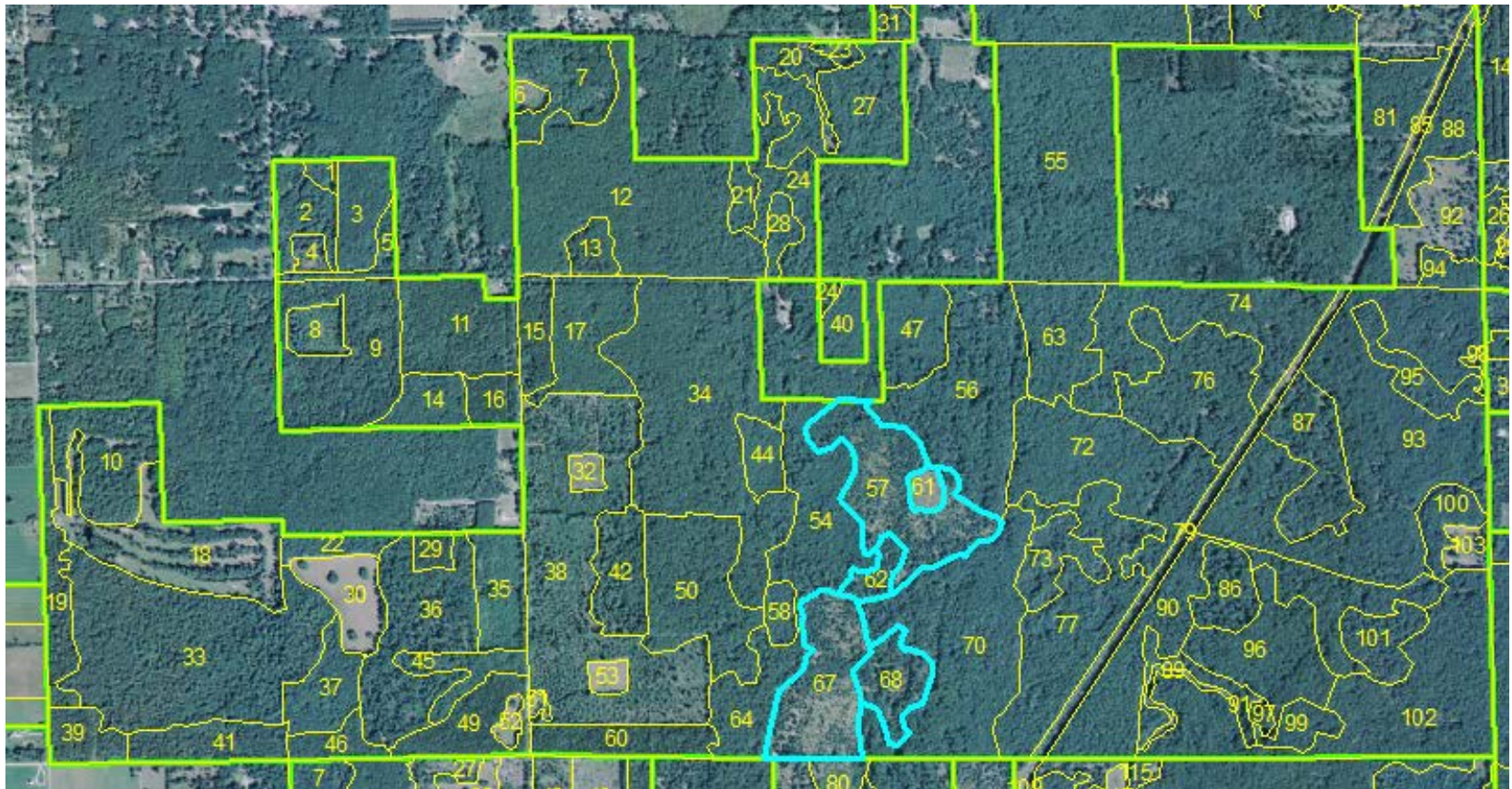


Figure 5: The highlighted stands depict areas in Compartment 11 that are an oak-pine barrens element occurrence.

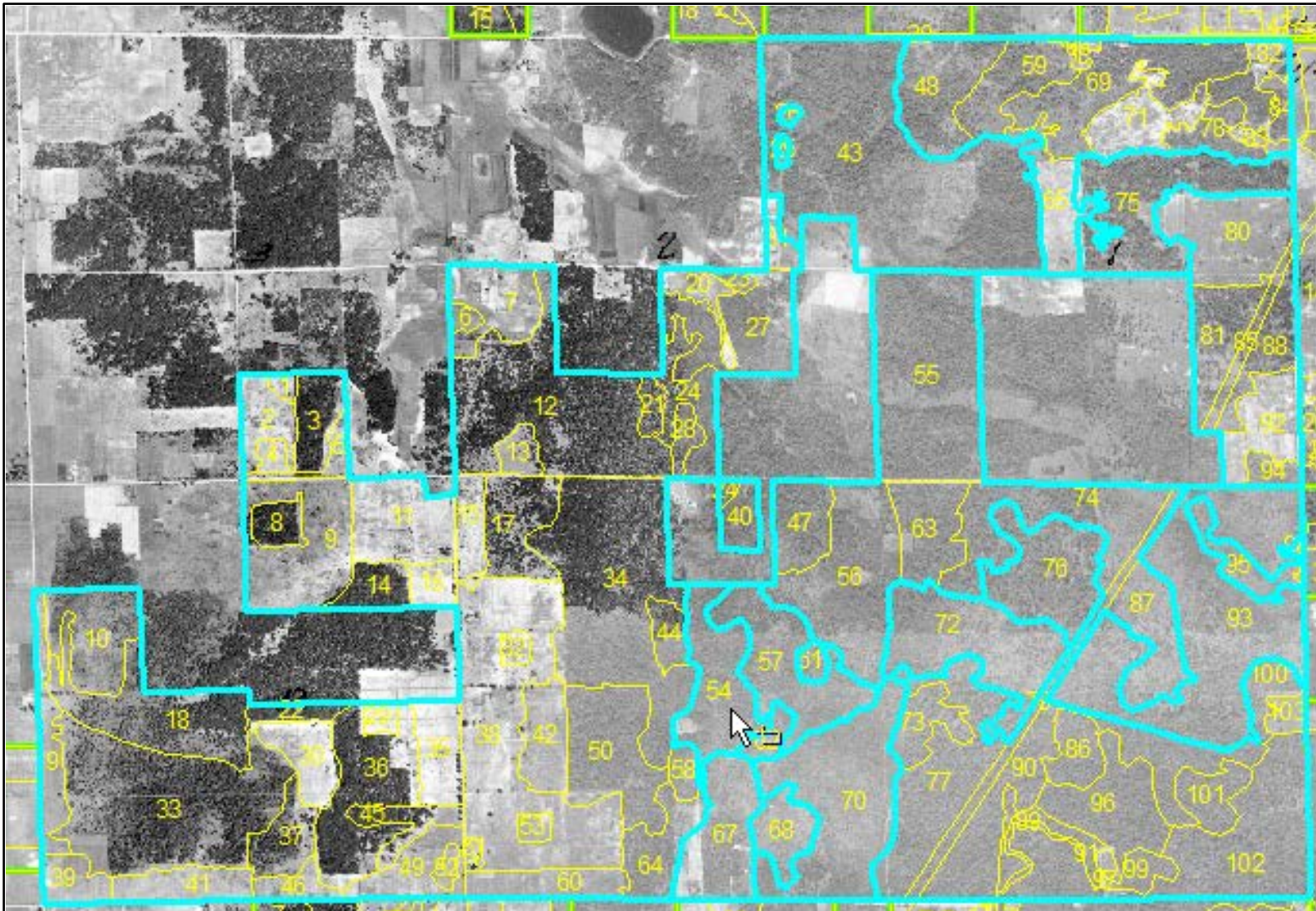


Figure 6: Aerial imagery from 1938, highlighted stands depicts areas in Compartment 11 that may have contained oak-pine barrens remnants and appear to have a relatively open canopy.

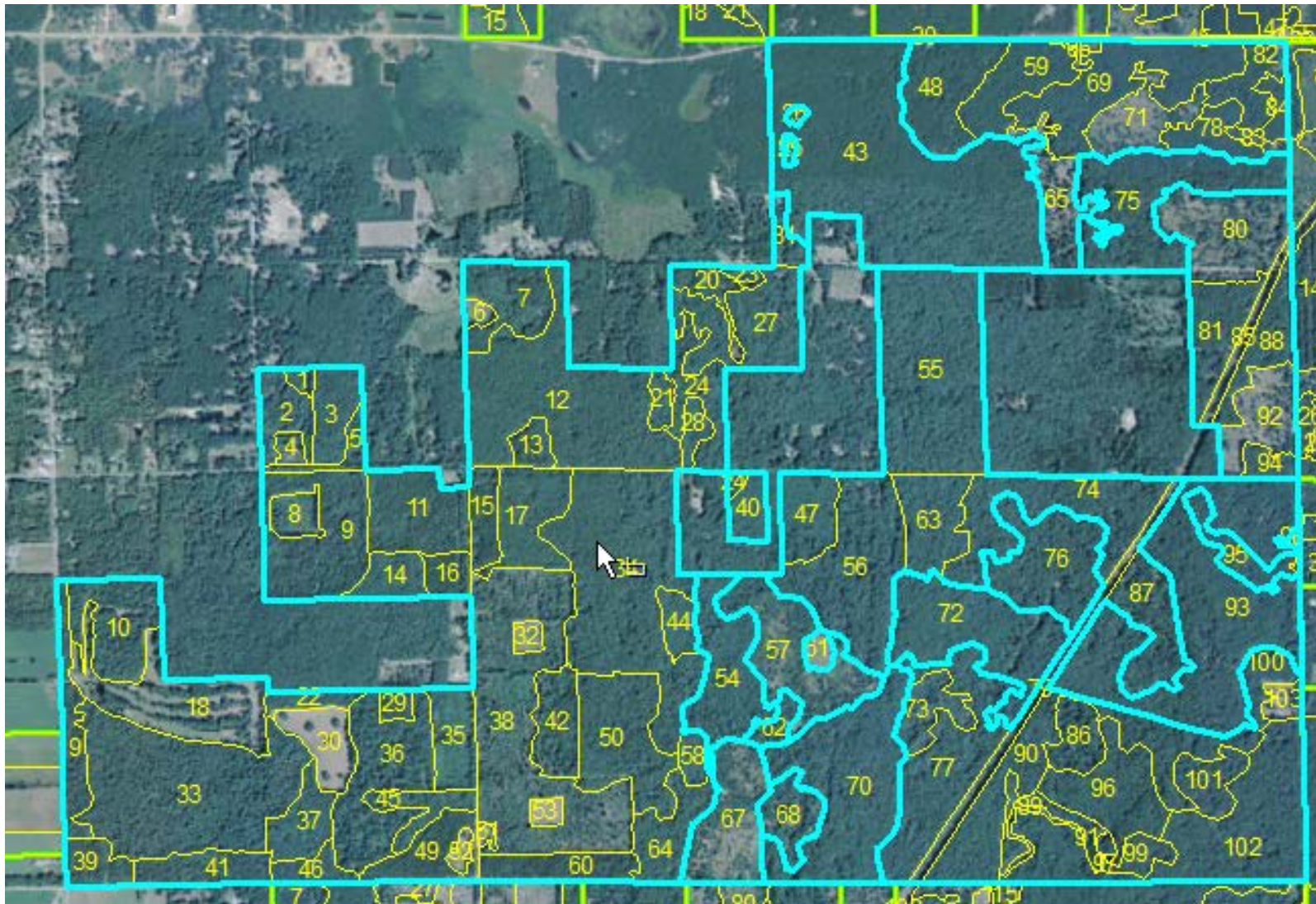


Figure 7: Current aerial imagery, highlighted stands depict areas in Compartment 11 that contained oak-pine barrens remnants in 1938 are now closed canopy forest with some barrens species present in the sub-canopy.

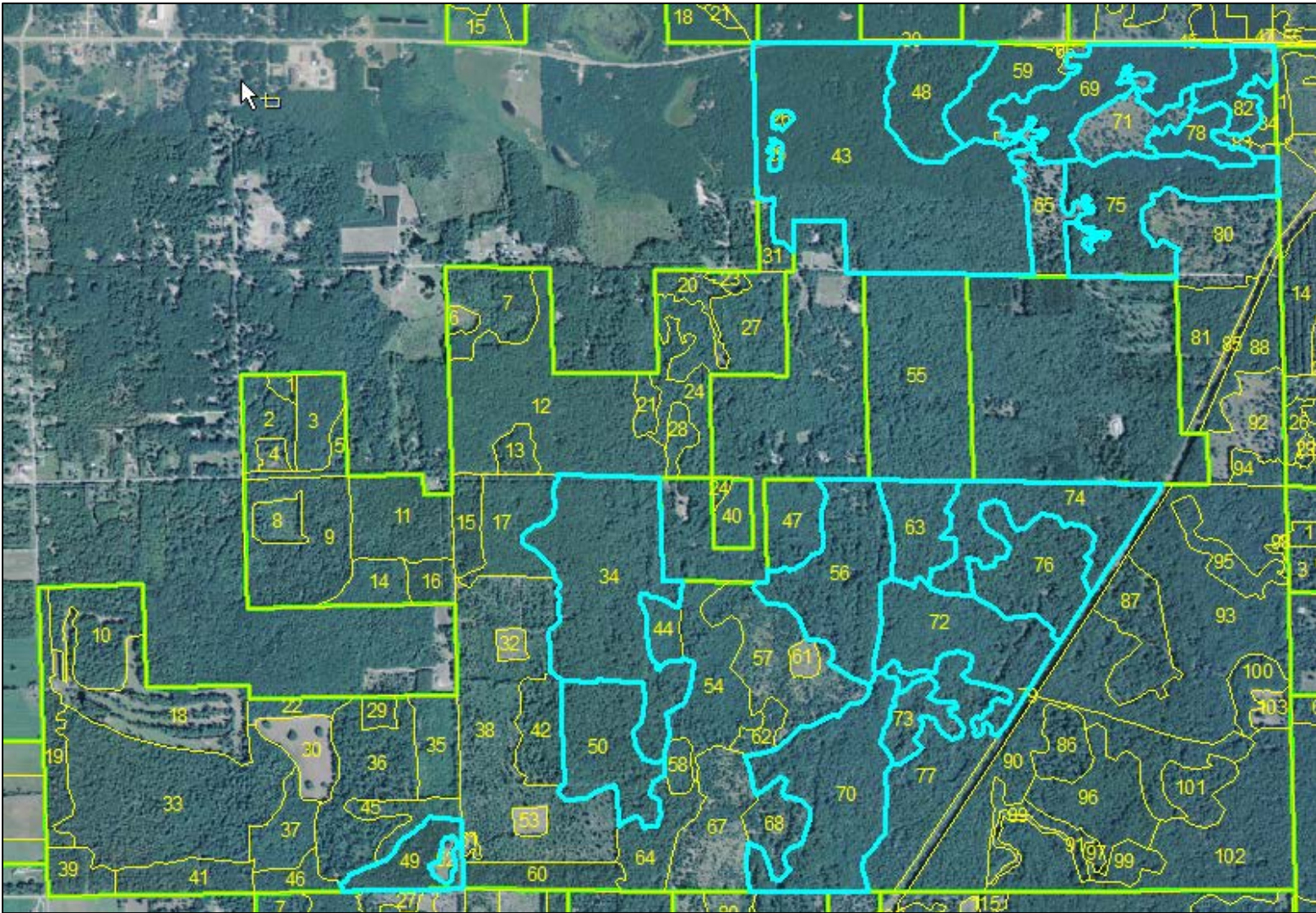


Figure 8: The highlighted stands depict areas in Compartment 11 that contain closed canopy forest and should be targeted for future thinning and burning.

Important Lowland Forest

Stand 33 is the only forest in Compartment 11 that has components of Southern Hardwood Swamp. The canopy of Stand 33 is comprised of red maple (*A. rubrum*), green ash (*Fraxinus pennsylvanica*), swamp white oak (*Quercus bicolor*), American elm (*Ulmus americana*), beech (*Fagus grandifolia*) and bigtooth aspen (*Populus grandidentata*). The understory vegetation very closely resembles the understory of hardwood swamp and does not currently have a heavy invasive species component.

Given the lack of this forest type in the landscape this stand provides critical habitat for a variety of animal species associated with lowland forest which includes state-listed species, such as spotted turtle (*Clemmys guttata*), Kirtland's snake (*Clonophis kirtlandii*), and Blanding's turtle (*Emydoidea blandingii*), red-shouldered hawk (*Buteo lineatus*), barred owl (*Strix varia*) and pileated woodpecker (*Dryocopus pileatus*). Indiana bat (*Myotis sodalists*, Focal Species) also nest and/or roost in southern hardwood swamp, where they utilize large, mature trees and snags

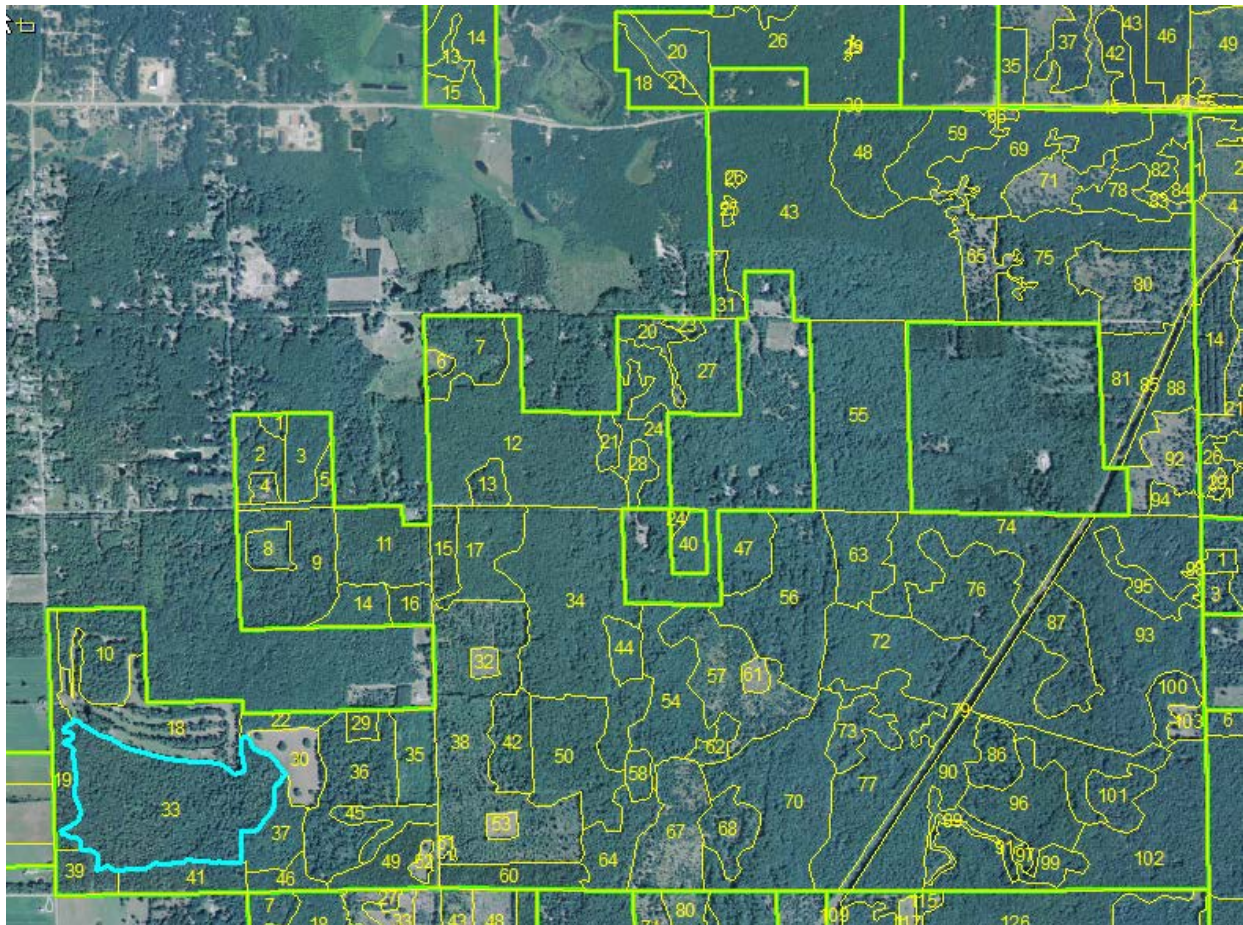


Figure 9: The highlighted stand depicts the area in Compartment 11 that contain lowland forest.

Dry-Mesic Northern Forest

Dry to dry-mesic northern forest was the most prevalent covertype within Compartment 11 and a prevalent community type in this region. The proximity of the game area to Lake Michigan means that the systems are buffered from extreme temperatures and forests here are a regional variant of the dry-mesic northern forest community type with components that are typical of both northern and southern systems. Further, protracted fire suppression and a history of aggressive logging have altered the successional trajectory of the entire area from one that includes abundant oak-pine barrens to a predominantly closed-canopy oak forest. For the sake of simplicity, we are describing the community type as dry-mesic northern forest while acknowledging the complexity of the area.

Principal hardwood associates of dry-mesic northern forest include white oak (*Quercus alba*), black oak (*Q. velutina*), red oak (*Q. rubra*), and red maple (*Acer rubrum*) with white pine (*Pinus strobus*) an important constituent, often forming a supercanopy. Hemlock (*Tsuga canadensis*) was historically present as a codominant in the canopy or supercanopy, especially along steep, north-facing slopes and mesic areas that were less fire prone. Characteristic species of the shrub layer of this forest type include serviceberries, sassafras (*Sassafras albidum*), bush honeysuckle (*Diervilla lonicera*), huckleberry, witch hazel (*Hamamelis virginiana*), American fly honeysuckle (*Lonicera canadensis*), choke

cherry, and blueberries (*Vaccinium* spp.). The ground layer of dry-mesic northern forests is often dominated by bracken fern (*Pteridium aquilinum*). Additional species include, wild sarsaparilla (*Aralia nudicaulis*), pipsissewa (*Chimaphila umbellata*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*), trailing arbutus (*Epigaea repens*), wintergreen (*Gaultheria procumbens*), partridge berry (*Mitchella repens*), gay wings (*Polygala paucifolia*), and starflower (*Trientalis borealis*). The presence of chlorophyll-free, parasitic and saprophytic seed plants such as Indian pipes (*Monotropa* spp.), and coral root orchids (*Corallorhiza* spp.) is a common feature of dry-mesic northern forest. Dry-mesic northern forests provide summer nesting habitat for many neotropical migrants, especially interior forest obligates such as black-throated blue warbler (*Dendroica caerulescens*), black-throated green warbler (*Dendroica virens*), scarlet tanager (*Piranga olivacea*), and ovenbird (*Seiurus aurocapillus*) (Cohen 2000; Kost et al. 2007).

Stands 34, 43, 48, 49, 50, 56, 63, 69, 70, 72, 73, 74, 75, 76, 78, 82 and 84 in Compartment 11 are Dry Mesic Northern Forest (Figure 8).

All these stands would benefit from periodic, low-intensity ground fires that would stimulate oak and pine regeneration while reducing the dominance of mesophytic species (i.e. red maple and black cherry) in the subcanopy.

Special Plants and Animals in Compartment 11

Compartment 11 has only a few ecological communities, yet it still contains several EOs. In all there are 7 element occurrences:

two rare invertebrate EOs, two vertebrate EOs, 1 natural community EO, and two rare plant EOs (Table 2 and Figure 10).

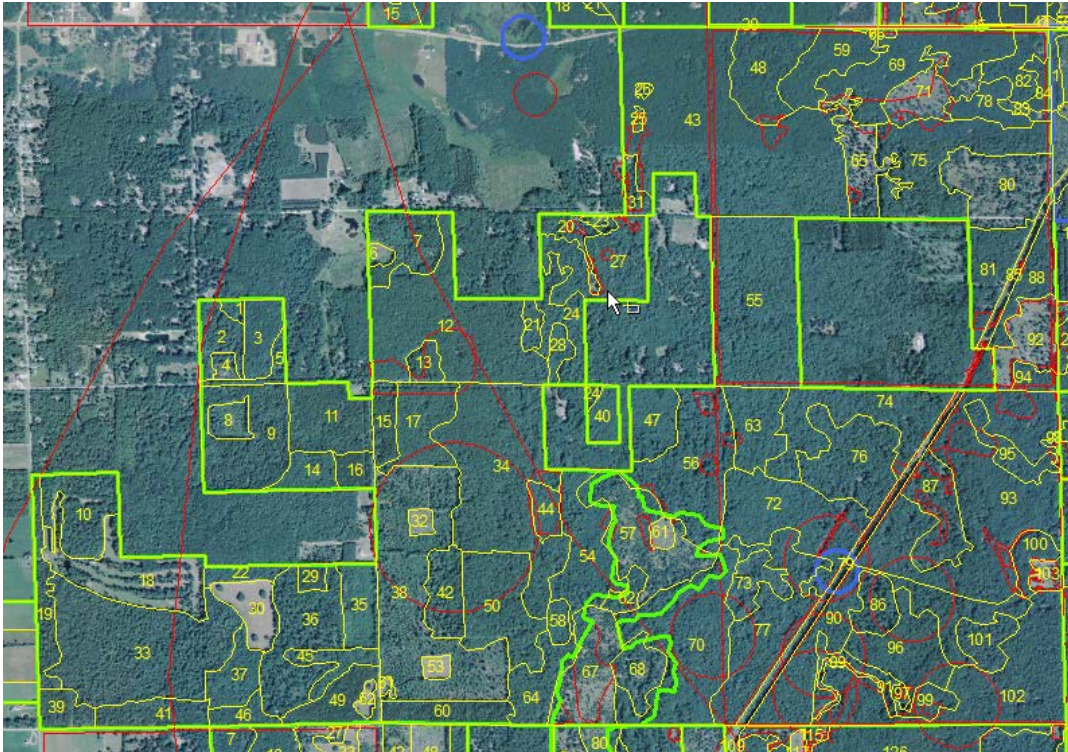


Figure 10: Element Occurrence polygons for Compartment 11. Plants are outlined in blue, ecological communities are green, and animals are red.

Rare Plants

Two rare plant species, meadow beauty (*Rhexia virginica*) and Missouri rock-cress (*Boechera missouriensis*) have been documented in Compartment 11 (Table 2).

Both of these plants are found in coastal plain marshes, but are not limited to this habitat. Missouri rock-cress is also associated with oak-pine barrens and savanna habitat.



Photo 3: A small population of meadow beauty that was found in a small coastal plain pocket in Stand 26 in 2016.

Table 2: Rare plant and animal element occurrences that have been recorded in Compartment 11, with their state rarity rank, stand and year recorded. E = endangered, T = threatened. SC = special concern.

Common Name	Type	EOID	Listing	State Status/ Rank	EO Rank	Last Observed	Stands
Meadow Beauty	Plant	na		T/S3	D	2016	43
Missouri rock-cress	Plant	15720		SC/S2	D	2005	79
Karner blue	Insect	7959	LE	T/S2	A	2015	47, 56
		4544			E	1999	12, 13
		2534			A	2015	34, 54, 57, 61, 62, 67, 68, 72, 79
Ottoe skipper	Insect	4381		T/S1	H	1989	74
Hooded warbler	Vertebrate	13325		SC/S3	E	2010	77
Prairie warbler	Vertebrate	13330		E/S3	E	1999, 2012	38
Oak-pine Barrens	Ecological community	15909		S2	C	2016	57, 61, 62, 67, 68

Special Animals

Insects

Compartment 11 is a Karner blue (*Lycaeides melissa samuelis*, State threatened, Federally endangered) strong hold and these butterflies have been recorded at three sites encompassing 13 stands in the compartment (Figure 11). Karner blue has been identified as a featured species by the WLD to promote savanna habitats in Southwestern Michigan. The Karner blue utilizes oak and oak pine savanna areas and are dependent on wild lupine (*Lupinus perennis*) which is the only food source

for their larvae. Throughout much of their range in Michigan Karner Blue habitat suffers from fire suppression (Rabe 2001). The past and planned burns in Compartment 11 will greatly enhance current Karner Blue habitat by converting forested areas to suitable habitat and promoting the establishment of wild lupine.

The state threatened Ottoe Skipper (*Hesperia ottoe*) was recorded in 1989 in stand 79. Habitat requirements for the Ottoe skipper are very similar to those of the Karner blue and managing for open savanna systems with fire will benefit both of these species.

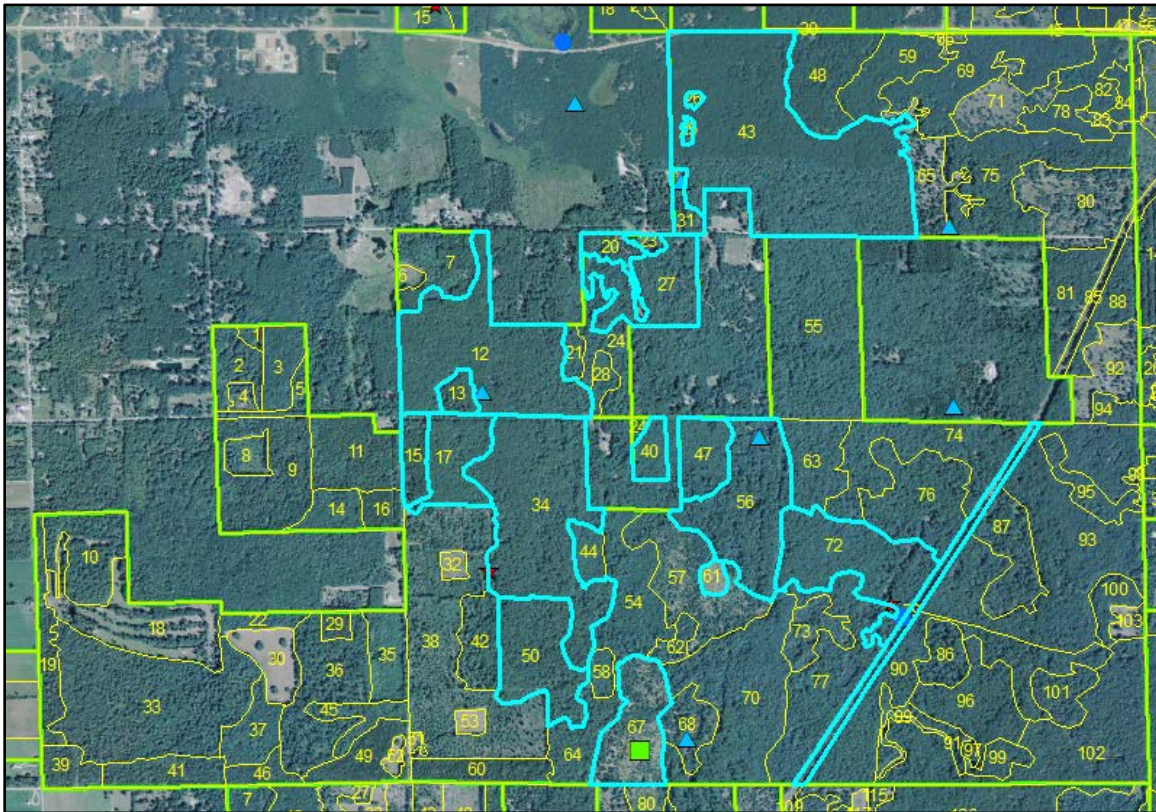


Figure 11: Highlighted stands in compartment 11 are locations where Karner blue have been recorded.

Herptiles

Few herptiles were recorded during MiFI surveys in compartment 11; however most of the compartment is likely habitat for eastern box turtle (*Terrapene carolina carolina*, State Special Concern/ S2S3). Eastern box turtle 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).

Birds

There are two avian EOs in Compartment 11 (Table 2). A number of avian species that are on Michigan's featured species list for habitat management were recorded in Compartment 11 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*), eastern bluebird (*Sialia sialis*), eastern meadowlark

(*Sturnella magna*) and black-throated blue warbler (*Setophaga caerulescens*).

Additionally, several species of greatest conservation need were recorded. These included: Cooper's hawk (*Accipiter cooperii*), yellow-billed cuckoo (*Coccyzus americanus*), northern flicker (*Colaptes auratus*), Acadian fly-catcher (*Empidonax vireescens*), eastern kingbird (*Tyrannus tyrannus*), and brown thrasher (*Toxostoma rufum*).

In 1999 a male prairie warbler (*Dendroica discolor*, State Endangered/S1) was documented in stand 38 singing where there is suitable nesting habitat. Prairie warblers nest in mixed scrub areas that are often associated with poor soils. Prairie warblers prefer upland scrub areas including early-successional habitat for breeding. As a result of breeding habitat rapidly changing, prairie warblers use areas for brief periods before moving to different sites (Cooper 2000). Suitable habitat for prairie warblers is likely generated by prescribed burning. Areas that have recently burned within the compartment may entice prairie warblers to utilize these areas for breeding.

This site was re-visited in May of 2012 and no birds were heard or seen, but the area still remains suitable breeding habitat and we recommend continued monitoring of the site. In 2012 a prairie warbler was heard singing in stand 67.

In 1999 and 2010 a hooded warbler (*Setophaga citrina*, State special concern/S3) was recorded in stand 77. Hooded warblers were not heard during 2012 surveys.

Hooded warblers nest in a variety of forest types that all have a mature forest canopy and a dense understory of small trees and shrubs. Management should focus on preserving these characteristics in large contiguous blocks to reduce the threat of brood parasitism by Brown-headed cowbirds and nest predation by small

mammals like raccoons. Occasionally overstory trees may be selectively logged to encourage shrub or sapling growth, where the birds nest, but this activity should be conducted in the fall or winter when the warblers are on their wintering grounds to avoid direct impacts to nesting birds (MNFI 2007).



Photo 4: Male prairie warbler *Dendroica discolor* (State Endangered/S1). Photo by Jackie Elmore



Photo 5: Hooded warbler *Wilsonia citrina* (State special concern/S3). Photo by Aaron Kortenhoven

Mammals



Photo 6: White-tailed deer (*Odocoileus virginianus*). Photo by Aaron Kortenhoven

With the exception of white-tailed deer, chipmunks, and fox squirrels, few mammals were observed during the survey of Compartment 11. 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* state threatened/S1), eastern pipistrelle (*Perimyotis subflavus* state special concern/S2) or Indiana bat (*Myotis lucifugus* state endangered/S1) occur in the area.

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

Northern long-eared bat 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).

Management Recommendations

Oak-Pine Barrens

Fire suppression in Compartment 11 has led to most of the area converting to closed canopy forest. The primary management recommendation for Compartment 11 is to continue current prescribed burns and each subsequent year adding as many additional burn areas as resources allow. Frequent burns will help in diversifying the forb layer as well as aide in establishing graminoid species. In addition to burns, active thinning will speed up the process of converting closed canopy forest to barrens habitat. Taking into account the state of Karner blue butterflies and their dependence on barrens habitat, it is imperative to work on creating as much Karner blue habitat as possible in Compartment 11. Especially given the present high number of Karner blue sites in Compartment 11. The establishment of more barrens habitat will facilitate connecting individual sites and hopefully leading to a larger population of Karner blue in the SGA. Barrens management will also potentially benefit other rare savanna species, including Ottoe Skipper.

Much of Compartment 11 that was historically oak-pine barrens have become closed canopy forest and could be thinned and burned to expand barrens habitat. Stands 34, 43, 48, 49, 50, 56, 63, 69, 70, 72, 73, 74, 75, 76, 78, 82 and 84 are candidates for conversion from oak forests to oak-pine barrens. If a single stand were to be chosen, in addition to areas already slated for burns,

Stand 43 would provide excellent opportunity to increase Karner blue habitat near the Karner site in Stand 31. Target canopy closure for restored barrens should be between 5 and 60 %. This can be achieved by leaving both individual trees and scattered clumps of mature oaks within a given area. We recommend leaving wooded buffers around current openings to avoid damaging the intact barrens vegetation and ant mounds in these openings. These buffers will emulate the structure of natural oak barrens with both senescing trees and potential recruitment. We also recommend cutting trees close to the ground to facilitate mowing.

The survivorship of butterflies is often increased by the presence of ants. Consequently, the large ant colonies that exist in the area should be protected and care should be taken to avoid damaging them with logging equipment.



Photo 7: Ant mounds in foreground at a Karner blue site in Stand 57.

Understory trees and shrubs will flourish after canopy tree removal. This creates the potential for accelerated loss of barrens areas, unless prescribed burns are

implemented to control woody encroachment. For this reason, continued use of 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. Burning during the growing season will also help limit sprouting of woody vegetation. Additional mowing and herbicide application may be needed if fire does not succeed in impeding woody vegetation growth.

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 at ASGA including oak-pine barrens and dry-mesic northern forest likely historically burned primarily in late summer and early fall. Varying the seasonality of prescribed burns to match the full range of historical variability better mimics the natural disturbance regime and leads to higher biodiversity: pyrodiversity facilitates biodiversity.

Repeated early spring burns are of particular concern in oak-pine barrens and dry-mesic northern forest where a goal for prescribed

burning is to control woody species (Photo 1). 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 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, greater windows of opportunity for conducting burns because suitable burning conditions are often most prevalent this time of year, and the belief that doing so reduces the probability of detrimentally impacting fire-sensitive animal species, such as herptiles (i.e., eastern box turtle). While these are all legitimate reasons, we feel that the long-term benefits of diversifying burn seasonality outweigh the costs and that ultimately, successful restoration of oak-pine barrens ecosystems will depend on expansion of the burn season beyond early spring. Techniques for reducing the risk to fire-sensitive species can be employed during burns throughout the year and include avoiding burning within and around known hibernacula and establishing rotating

refugia within large burn units (Cohen et al. 2009). The primary threat to barrens restoration is illegal off-road vehicle use. While compartment 11 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 has proven to be an effective course of action.

Southern Hardwood Swamps

The southwestern portion of Compartment 11 contains a 93-acre southern hardwood swamp (Figure 6). While not exemplary of southern hardwood swamp, stand 33 does have restoration potential. For this community type, allowing natural processes to take place will lead to mature higher quality forest. During the time of this survey ash trees in the canopy were still alive, but this may no longer be the case given the

prevalence of emerald ash borer in the area. The trajectory of succession in southern hardwood swamps after canopy gaps occur from the loss of ash should be monitored. Care should be given to not alter hydrology as this can lead to tree die-off and or the establishment of invasive species. Allow fire from adjacent upland areas to extinguish naturally as this will create a natural transition zone that will be utilized by wildlife species for both browse and cover as pioneer vegetation matures. Such transition zones would provide excellent feeding habitat for insectivorous birds such as the hooded warbler (*Wilsonia citrina*) and cerulean warbler (*Dendroica cerulea*) as well white-tailed deer.

The following management recommendations for compartment 11 are provided for your consideration:

The following management recommendations for compartment 11 are provided for your consideration:

- Important oak-pine barrens habitat
 - Continue to burn Stands 57, 61, 62, 67, and 68.
 - Add winter mowing to Stands 57, 61, 62, 67, and 68.
 - Avoid damaging ant hills in these stands.
- Ideal stands for white pine management objectives.
 - Stand 48 and 59 have white pine in the canopy at a decent density and have full white pine coverage of varying age groups in the sub-canopy and would provide excellent opportunity for white pine management objectives in Compartment 11.
- Closed-canopy dry forest (degraded oak-pine barrens)

- Thin and burn stands 34, 43, 49, 50, 56, 63, 69, 70, 72, 73, 74, 75, 76, 78, 82 and 84 as resources permit
- Stand 43 is a good stand to start with given the prevalence of barrens vegetation within the stand.
- Vary seasonality and intensity of burns
- Actively seed burned areas with lupine
- Maintain large diameter trees to function as nesting and roosting locations for species such as red-shouldered hawk and Indiana bat
- Survey for prairie warbler, hooded warbler, and listed bats
- Important lowland forest
 - Stands 33
 - Prevent alterations to hydrology
 - Allow fire to carry into forest
 - Allow forests to continue maturing and avoid fragmentation
 - Excellent habitat for several species of greatest conservation need
 - Good for Indiana bat which feeds on aquatic insects
 - Maintain large diameter trees to function as nesting and roosting locations for species such as red-shouldered hawk and Indiana bat
 - Survey for cerulean warbler, hooded warbler, and listed bats
 - Monitor for invasive species

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