Natural Features Inventory and Management Recommendations for Saranac-Lowell State Game Area

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Cover Photo: Ziibiqua Woods, Flat River, and eastern Kent County. Photo by Jesse M. Lincoln, 2020.

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Ziibiqua Woods, August 2019. Photo by Jesse M. Lincoln.

Executive Summary

The Saranac-Lowell State Game Area (SGA) is a block of semi-contiguous public land in southwest Michigan, consisting of 2,334 acres in Kent and Ionia Counties. Saranac-Lowell SGA is important ecologically because it provides critical habitat for a myriad of game and non-game species and supports 1,850 acres of upland forest. The Flat River and steep forested slopes along its course are prominent features of Saranac-Lowell SGA and the forests within the game area support a diversity of insect, herptile, avian, mammalian, plant, mussel, and fish species.

Michigan Natural Features Inventory (MNFI) conducted Stage 1 Michigan Forest Inventory (MiFI) in 2015 and surveys for high-quality natural communities were conducted in in 2019 and for rare animals in 2021 as part of the Integrated Inventory Project. This project is part of a long-term effort by MNFI to document areas of high conservation significance on state lands and provide information to the Michigan Department of Natural Resources, Wildlife Division regarding sustainable management of those important areas.

MNFI scientists documented 3 new natural community Element Occurrences (EOs), 11 new rare animal EOs, 2 new rare plant EOs, and provided information for updating 6 existing EOs. In total, 22 EOs and 13 species of greatest conservation need (SGCN) have been documented in Saranac-Lowell SGA including 15 animal EOs, 4 plant EOs, and 3 natural community EOs.

No natural communities had been documented from Saranac-Lowell SGA prior to the MiFI surveys. Based on initial MiFI data from 2015, MNFI ecologists identified and documented 3 new natural communities, including dry southern forest, dry-mesic southern forest, and southern wet meadow. Together, these represent 8.9% of the game area, harbor populations of rare plants, and are where many of the rare birds and turtles were found.

Surveys for rare avian species included point-counts for raptors and forest songbirds. Hooded warblers (*Setophaga citrina*, State Special Concern) were recorded at 3 survey points and included in an existing EO. Cerulean warblers (*Setophaga cerulea*, State Threatened) had been documented in the game area prior to 2019 surveys and were documented again in 2019 and the existing EO was updated. We recorded one singing Louisiana waterthrush (*Parkesia motacilla*, State Threatened) along the Flat River for a new EO. Two new EOs for red-headed woodpecker (*Melanerpes erythrocephalus*, State Special Concern) were documented in the game area. Rare raptor surveys were completed at 34 points within the game area and no red-shouldered hawk (*Buteo lineatus,* State Threatened) nests were seen.

Aquatic surveys were performed at three sites in the Flat River within Saranac-Lowell SGA. Conditions for performing aquatic surveys were favorable with high water clarity and wadable habitat. A total of eight unionid mussel species were found including five species of State Special Concern and greatest conservation need: elktoe (*Alasmidonta marginata*, State Special Concern), rainbow (*Cambarunio iris*, State Special Concern), creek heelsplitter (*Lasmigona compressa*, State Special Concern), flutedshell (*Lasmigona costata*, State Special Concern), and ellipse (*Venustaconcha ellipsiformis*, State Special Concern).

MNFI scientists conducted visual encounter surveys for rare amphibians and reptiles. Seven eastern box turtles (*Terrapene carolina carolina*, State Special Concern) were found during the 2021 surveys. One adult Blanding's turtle (*Emydoidea blandingii*, State Special Concern) was submitted to Michigan Herp Atlas in 2015 and is the basis of a new EO for this species in the game area. A blue racer (*Coluber constrictor foxii*, SGCN) was also observed in the game area.

Four types of rare insect surveys were conducted at Saranac-Lowell SGA targeting butterflies and spittlebugs; odonates; regal fern borer; and bumble bees. We documented a total of 141 occurrences of 7 bumble bee species, including new records of black and gold bumble bee (*Bombus auricomus*, State Special Concern) and Sanderson's bumble bee (*B. sandersoni*, State Special Concern). No other rare insects were documented.

Saranac-Lowell SGA supports 1,850 acres of forest, including 185 acres of dry-mesic southern forest along the Flat River. These forests are critical for stabilizing the steep slopes and maintaining water quality of the Flat River and the Grand River downstream. Such extensive blocks of forest once characterized the landscape but are now small and isolated. These forests provide a variety of ecosystem services, including sediment trapping, removal of contaminants from water through physical and biological processes, carbon storage, groundwater recharge, erosion control, water temperature regulation, and protecting small feeder streams that run into the Flat River. These services provide water quality protection of the Flat River, Grand River, and Lake Michigan. By extension, these services benefit the local economies surrounding recreation and the fisheries that rely on the health of those bodies of water.

Land management in an area developing as rapidly as West Michigan requires the careful prioritization of stewardship efforts in the most critical ecosystems. It will be increasingly important to consider the game area in the context of urban interface and regional conservation goals. We recommend that management efforts to maintain ecological integrity be focused in natural communities to maintain ecosystem services and provide maximum benefit for the numerous rare species documented in the area. We also recommend the prioritization of oak savanna restoration in the southern portion of the game area.

We provide the following management recommendations to protect native biodiversity and ecosystem integrity in order of importance: 1) minimize forest fragmentation along the river and around priority areas identified in this report; 2) implement prescribed fire in high-quality forests and areas identified as having potential to recover oak savanna habitat; 3) implement restoration efforts in areas identified as historic and recoverable oak savanna; 4) control invasive species within high-quality natural communities and partner with organizations to target serious infestations outside of high-quality forests when possible; 5) actively protect populations of herptiles; 6) investigate improving aquatic connectivity along the Flat River; and 7) monitor these activities to facilitate adaptive management.

AmeriCorps volunteer Zack Pittman assists with natural community surveys. Photo by Jesse M. Lincoln.

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Introduction

The Saranac-Lowell State Game Area (SGA) is a large block of semi-contiguous public land in southwest Michigan, consisting of 2,334 acres in Kent and Ionia Counties (Figure 1). Owned and managed by the Wildlife Division of Michigan's Department of Natural Resources (DNR), Saranac-Lowell SGA is important ecologically because it provides critical habitat for a myriad of game and non-game species and supports 1,850 acres of upland forest. The Flat River is a prominent feature of Saranac-Lowell SGA and is characterized by forests along its margins. The Flat River has been designated as a Natural River and is a substantial tributary of the Grand River watershed, the second largest watershed in Michigan and one of Michigan's most species-rich river systems in terms of native unionid mussels. The Flat River drains 564 square miles before feeding into the Grand River near Lowell, Michigan.

Michigan Natural Features Inventory (MNFI) is Michigan's natural heritage program and maintains a geospatial database of populations of rare and declining species and benchmark natural communities. As part of the DNR's Integrated Inventory Project, in 2015 MNFI conducted habitat cover type mapping as part of the Michigan Forest Inventory (MiFI) process. Surveys for high-quality natural communities and rare animals were conducted in Saranac-Lowell SGA in 2019 and 2020, respectively. This project is part of a long-term effort by MNFI to document areas of high conservation significance on state lands and provide the Michigan DNR Wildlife Division with information to inform the sustainable management of those areas.

The primary goal of this survey effort is to provide resource managers and planners with standardized, baseline information on each natural community and rare species occurrences and identify the most critical places on state lands for biodiversity stewardship. This baseline information is vital for informing landscape-level biodiversity planning efforts; prioritizing protection, management, and restoration objectives; facilitating site-level decisions about biodiversity stewardship; and monitoring the success of management and restoration.

This report provides an overview of the landscape and historical context of Saranac-Lowell SGA, summarizes the findings of MNFI's surveys for high-quality natural communities and rare animal species, and identifies stewardship priorities within the game area. Because the landscape surrounding Saranac-Lowell SGA has extensive agricultural and rural development, the large area of natural cover within the game area serves as an important reservoir of biodiversity for the local region. Saranac-Lowell SGA supports several rare plant, avian, mussel, reptile, and insect species. Management recommendations are provided for rare species, specific natural communities, and the game area in general.

The Saranac-Lowell State Game Area features extensive natural cover along the Flat River. Photo by Jesse M. Lincoln.

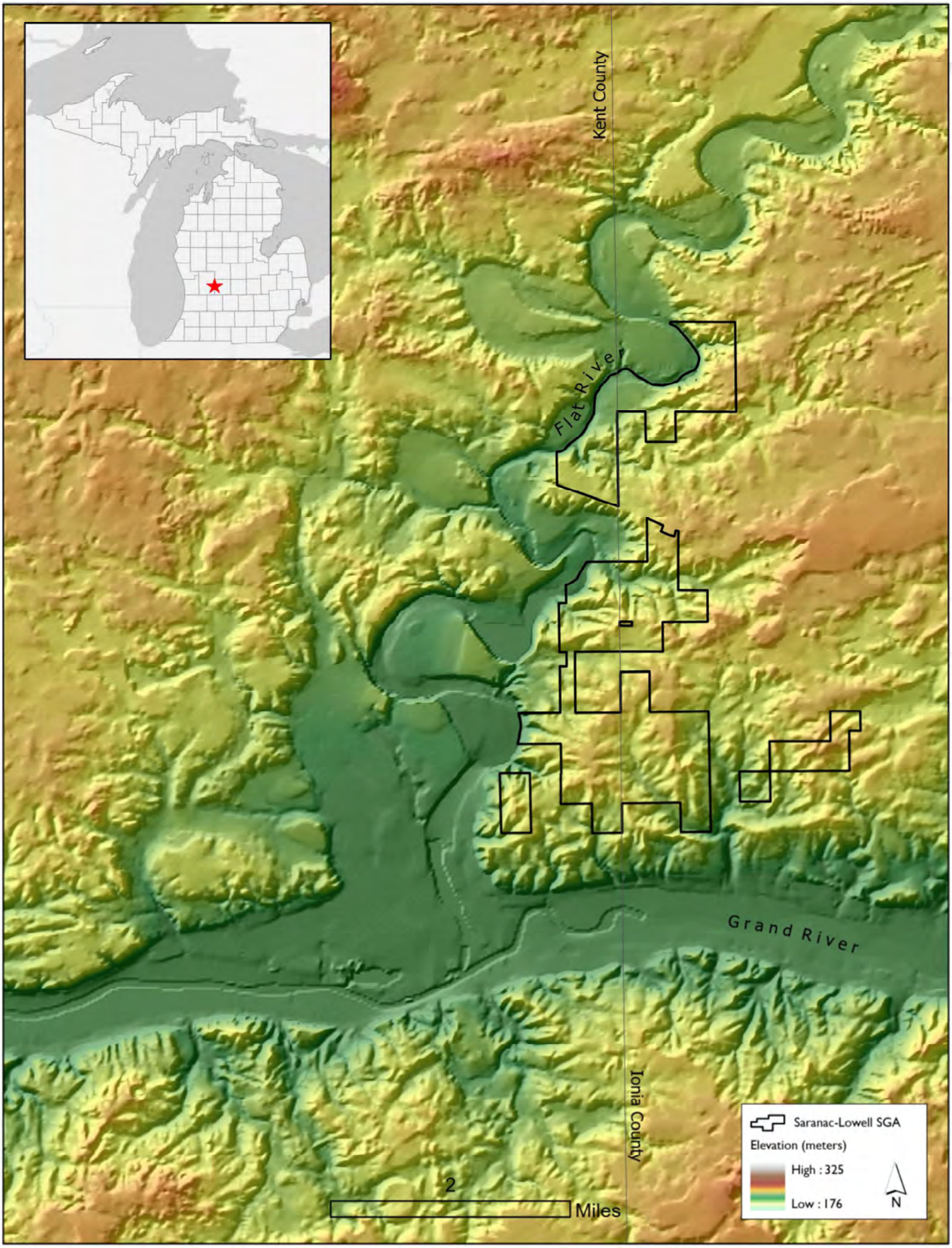


Figure 1. A digital elevation map of the Saranac-Lowell State Game Area.

Landscape and Historical Context

Ecoregions

Michigan has been subdivided into ecoregions based on climate, glacial features, physiography, soils, and characteristic ecosystems (Albert 1995). This classification system provides a framework for understanding the distribution patterns of species, natural communities, natural disturbance regimes, and anthropogenic activities. The classification is structured with three levels, from broad landscape regions called Sections, down to smaller Subsections and Sub-subsections. Saranac-Lowell SGA occurs in southern lower Michigan in Section VI within the Lansing Sub-subsection (VI.4.1) of the Ionia Subsection (VI.4) (Albert 1995).

The confluence of the Grand and Flat Rivers occurs just southwest of the game area at the village of Lowell (Figure 2). Outwash channels occur along these rivers and were formed by periodic flood events that occurred as receding glaciers melted and sediment-laden floodwaters bisected end moraines of fine-textured till. The undulating topography of the fine-textured end moraine forms well-drained rises and featured extensive fire-adapted natural communities. The game area occurs primarily on end moraine and the steep slopes along the Flat River occur where the end moraine transitions to outwash channel (Figure 2). The Flat River has been dammed in numerous locations near the game area, creating artificial lakes in low-lying areas that may have historically been forested wetlands along the river at the base of morainal slopes.

The Flat River is dammed in Lowell, creating a large artificial lake in the downtown area. Photo by Jesse M. Lincoln.

Extensive forest occurs on the steep slopes along the Flat River. Photo by Jesse M. Lincoln.

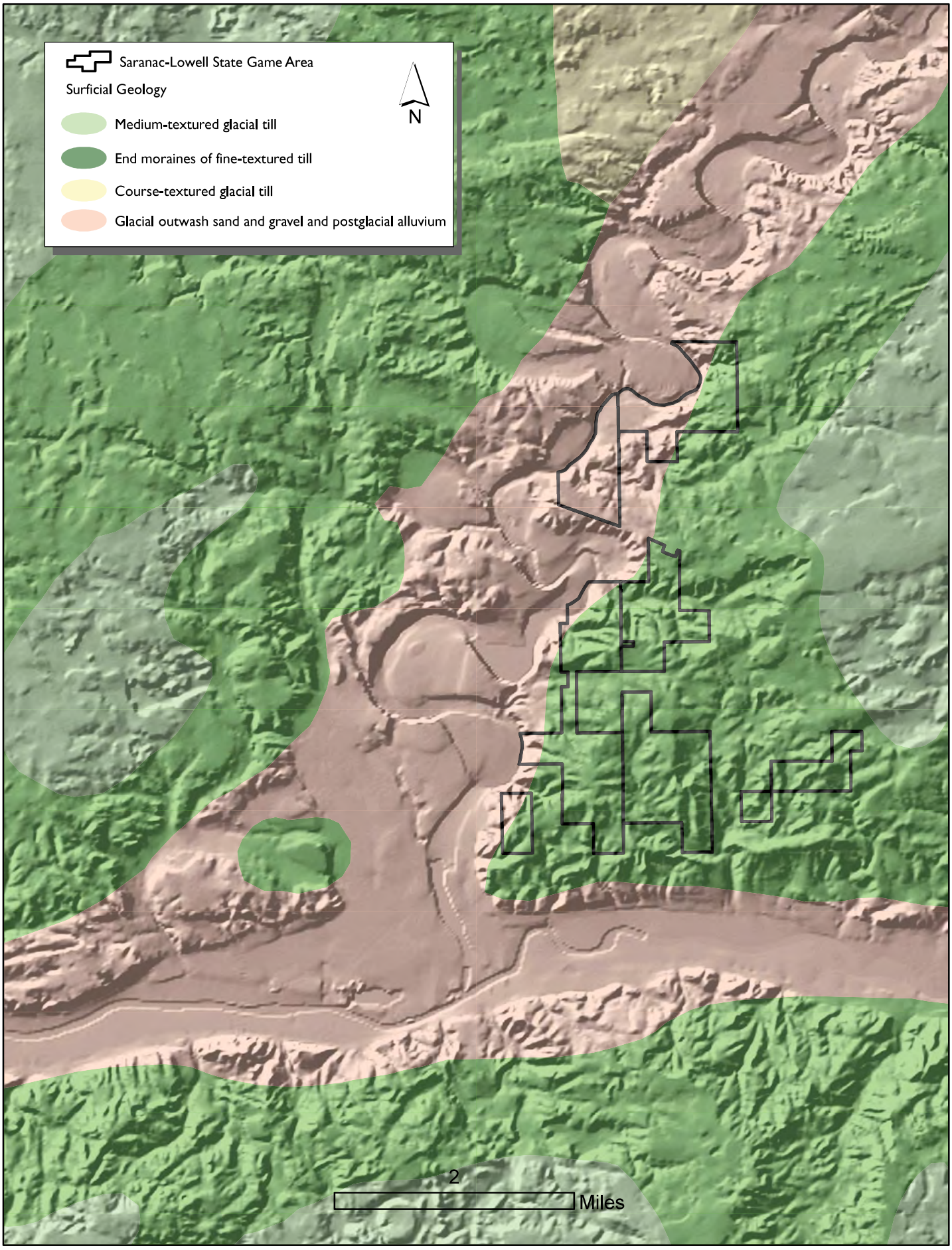


Figure 2. Surficial geology of the Saranac-Lowell State Game Area.

Vegetation Circa 1800

Interpretations of the General Land Office (GLO) surveyor notes by MNFI ecologists indicated that the Saranac-Lowell SGA and surrounding area contained several distinct vegetation assemblages (Comer et al. 1995; Figure 3). The GLO survey notes of eastern Kent County were recorded in July 1837 by Noah Brookfield (Michigan Library and Historical Center, accessed January 2022). The surveys record information on tree species composition, tree size, and general condition of the lands within and surrounding Saranac-Lowell SGA. The game area was predominantly forested at the time of the surveys in 1830s, with an estimated 62% of the game area supporting upland forested ecosystems. The predominant cover types included Oak-Hickory Forest (62%), Oak Openings (32%), and River (2%).

Oak-Hickory Forest or dry-mesic southern forest was the most abundant cover type and the upland forest type occurred on the slopes along the Saranac-Lowell outwash channel and on the surrounding end moraine. White oak (*Quercus alba*; 74%) was overwhelmingly the most prevalent tree species recorded by GLO surveyors in this area. Other species mentioned are bur oak (*Q. macrocarpa*; 5%) chinquapin oak (*Q. muehlenbergia*; 5%), hickory (*Carya* spp.; 3%), and black oak (*Quercus velutina*; 3%). Within the areas classified as upland forest, recorded diameters of trees ranged widely from 18 to 79 cm (7-30 in) with an average of 38 cm (14.9 in; N = 62). The surveyors were selecting the closet tree to the section corners and section lines and not recording diameters representative of the largest trees.

Early surveys mentioned extensive “oak openings” in the southern portion of the game area with “Lands rolling, soil thin, thinly timbered with yellow, white, and black oak” and an “Indian trail”. In the early 1800s there was an Indigenous American village of Ottawa people along the Flat River at the site of present-day Lowell (McClurken 2009). The broader region had been occupied by Indigenous Peoples for thousands of years and fire was likely used to manage the vegetation across much of the local region.

Old, open-grown oaks or wolf trees occur throughout the game area and are canopy vestiges of oak savannas. Often such trees are the last remaining indicator of a system that was once characteristic of the region. Photo by Jesse M. Lincoln.

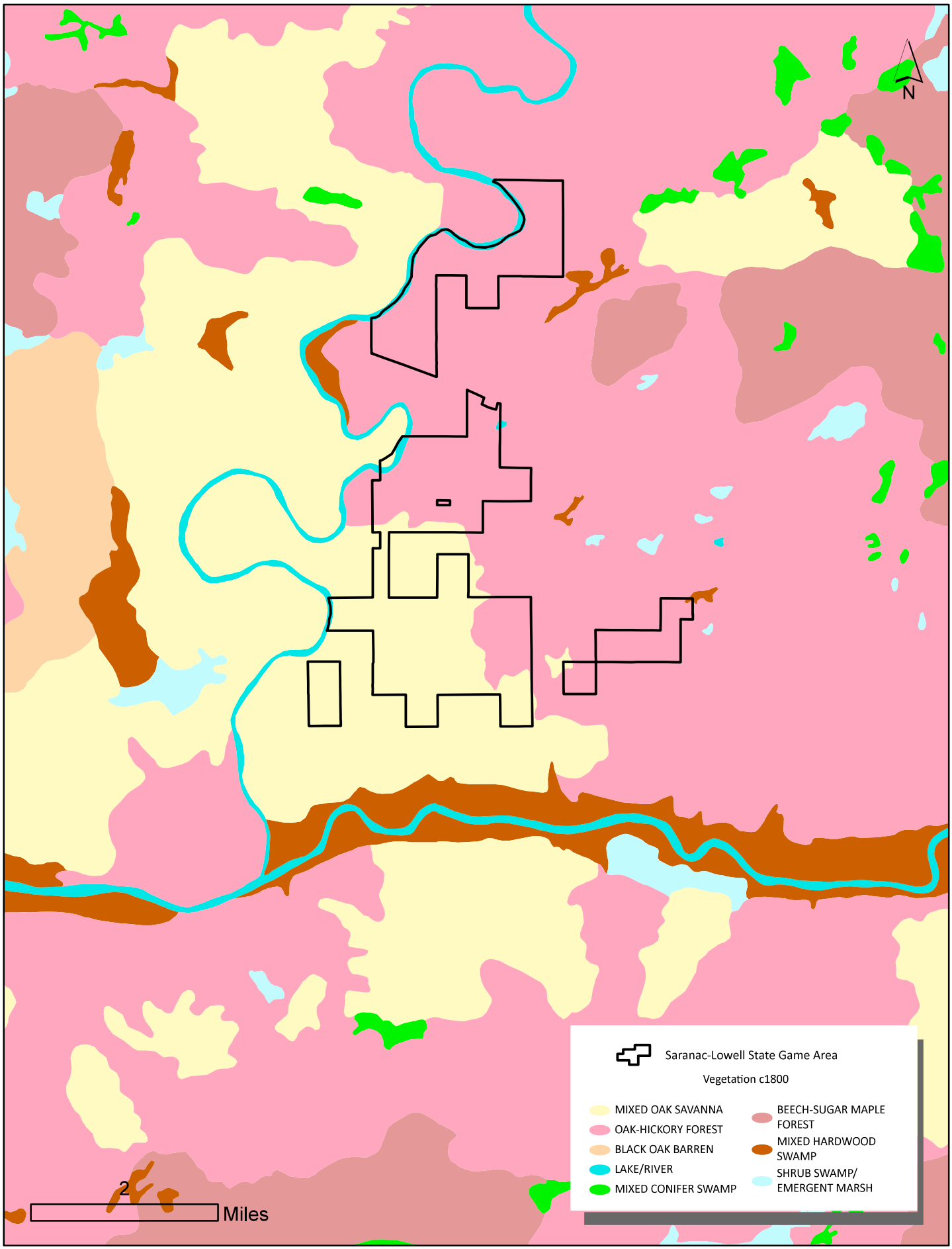


Figure 3. Vegetation of Saranac-Lowell State Game Area circa 1800 (Comer et al. 1995).

Early surveyors described several areas as oak openings, now a specific type of natural community recognized by MNFI. Throughout this report, we will refer to the areas described as "oak openings" by the broader, more encompassing term, "oak savanna". Oak savannas systems are characterized by an open canopy of 5 to 60% coverage, frequent fire, and ground flora characterized by woodland and prairie species. Savannas, oak openings, and oak barrens historically covered more than 1 million acres in southern Michigan but more than 99.9% have been lost to development and agriculture and those that remain generally persist in a degraded state. Locally, areas of oak savanna were closest to the village near the river and the open, sparse canopy savanna conditions were likely maintained by frequent fire set by Indigenous People for several cultural purposes. Savannas were often the first areas converted into agriculture during European Colonization and savanna remnants that were not enlisted into the service of that effort converted to closed-canopy forest in the absence of cultural fire.

Wetlands are almost entirely absent from notes taken in areas that became the game area. The GLO surveys were a coarse-scale assessment and some small expressions of natural communities such as swamps along streams and other small wetland openings were often not captured in the GLO notes. Small wetlands occurred sporadically throughout the game area, particularly along the Flat River, at the margins of small streams, and zones of seepage along steep slopes.

Changes in Land Cover

The landcover within Saranac-Lowell SGA (Figures 4 and 6) has changed significantly since the early 1800s due to land clearing, agriculture, and fire suppression. Imagery from 1938 (Figure 4) shows that much of the game area was at one time cleared for agriculture and subsequently reverted to forest after the state took ownership. These forested stands that were cleared tend to have the greatest concentrations of invasive species. The imagery from 1938 is also particularly useful for the identification of important forest remnants. Areas that were forested in the imagery that have not since been logged have the lowest proportion of invasive species, the oldest trees, the greatest concentration of rare taxa, and tend to correspond to high-quality forested natural communities.

Currently, upland forest is the most predominant land cover type in Saranac-Lowell SGA (86.2% of the game area; 1,850 ac) (Figure 6). This is a substantial increase in forest and decrease in oak savanna in composition over the past 200 years as the historic composition was 62% (1,326 ac) Oak-Hickory Forest and 36% (784 ac) of Oak Openings. Much of the oak savanna converted to agriculture and then reverted to closed-canopy conditions after the farms failed on the droughty soils. Some areas of historic savanna had extremely droughty soils that failed to revegetate after abandonment and even still feature open sands with almost no vegetation, despite planting of pine trees to mitigate the degraded sites. No areas recognizable as oak savanna remain on the game area and only the tiniest of fragments remain on the surrounding landscape.

Areas of Saranac-Lowell SGA with especially droughty soils where agriculture was attempted after clearing often remain unvegetated, despite the planting of pine. These areas were likely historically oak savanna, based on interpretation of GLO surveys and vegetation persisting at the margins. Beach-heath (*Hudsonia tomentosa*) was occassionally found in these situations and though not rare, these were the first populations documented in Kent County in 2015. Compartment 2, Stand 38. Photo by Jesse M. Lincoln.

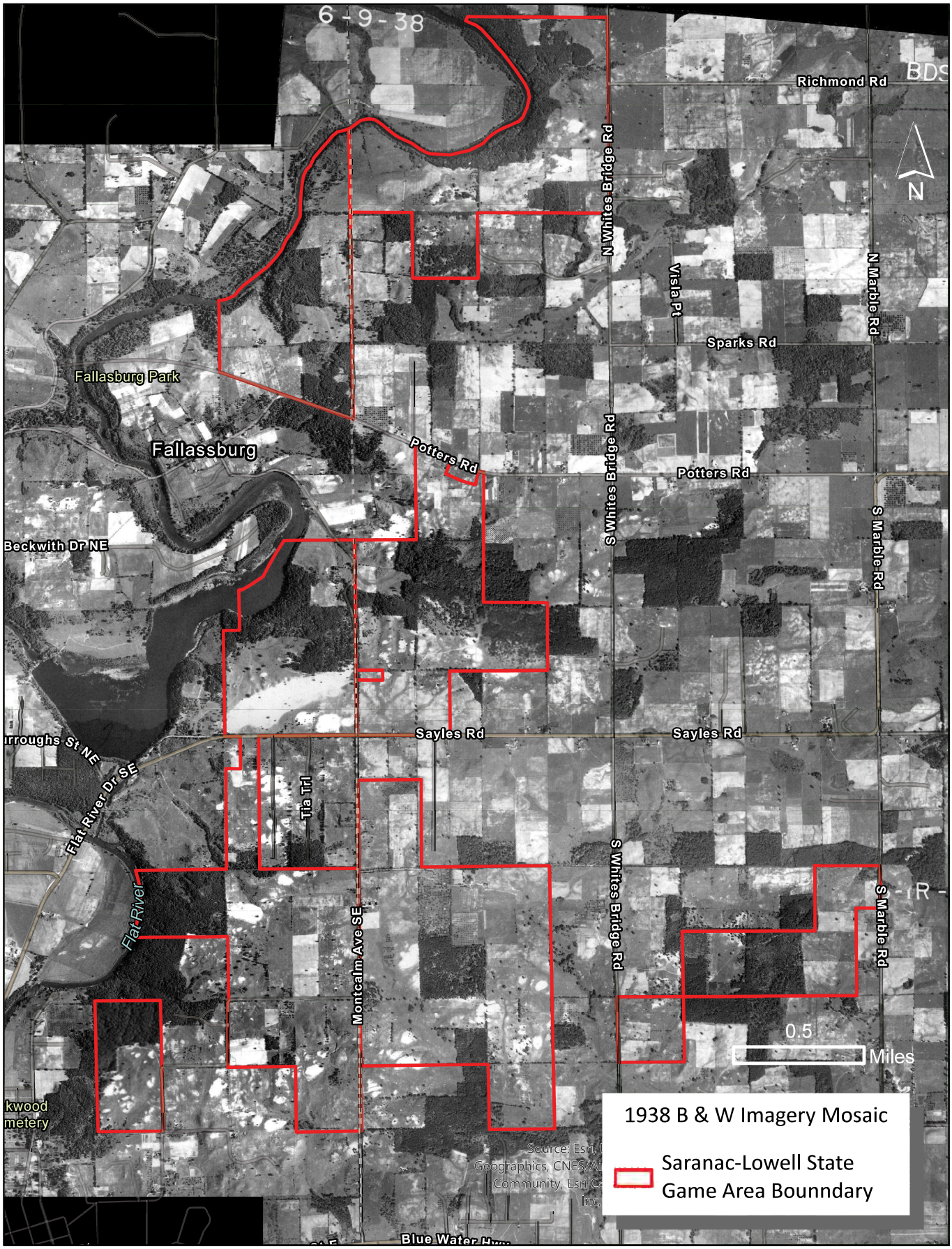


Figure 4. The mosaic of 1938 aerial photographs of Saranac-Lowell State Game Area. This resource can inform managers about important conservation targets because areas that were forested in the picture tend to be dominated by native vegetation, have the oldest trees, and lowest levels of invasive species. Therefore, these areas generally have the highest conservation value for native biodiversity.

Despite the dramatic shifts in composition because of anthropogenic disturbance, abundant natural cover remains within Saranac-Lowell SGA with 8.9% documented as high-quality natural communities, including 204 acres of high-quality forest. In addition, Saranac-Lowell SGA remains relatively unfragmented compared to the surrounding private land (Figure 5). To gauge landscape integrity, MNFI developed a land use integrity index that is based on the proportion of land use in a buffer surrounding an area of interest. Stands surrounded by intensive land use (e.g., row crops and residences) receive lower scores and stands surrounded by natural cover (e.g., extensive oak forest) receive higher scores (Figure 5). Saranac-Lowell SGA is characterized by high land use index scores across the game area and especially in contrast to the city of Lowell and private lands away from riparian corridors of the Flat and Grand Rivers.

Saranac-Lowell SGA is a prominent block of unfragmented natural cover in a rapidly developing area. Combining the thorough inventory process with understanding past land uses allows managers to catalog natural resources and prioritize actions to protect native biodiversity on the game area. The partnership between WLD and MNFI has been an important driver for identifying and understanding the remaining natural features of our public lands.

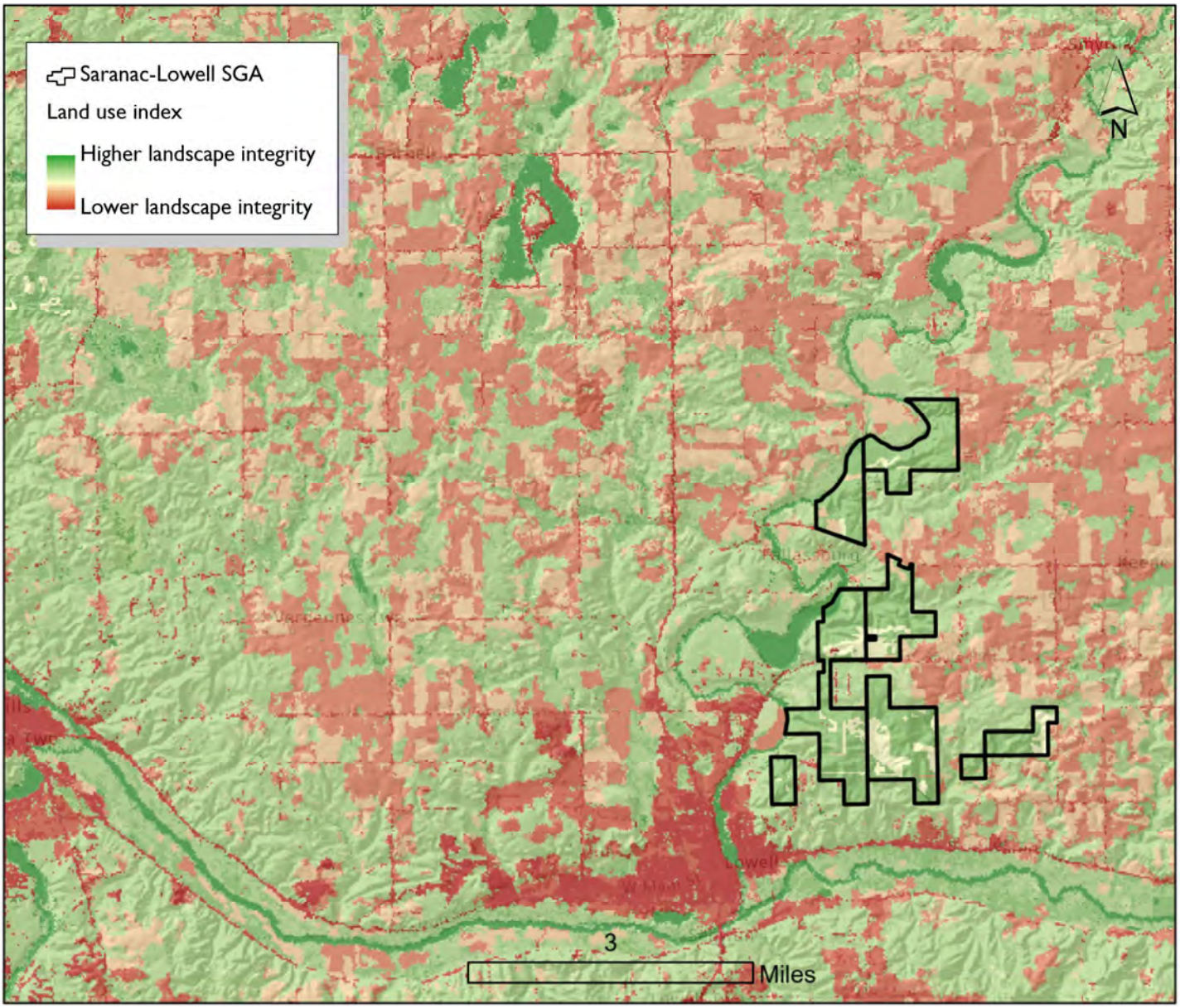


Figure 5. A land use index of Saranac-Lowell State Game Area. The land use index is based on the proportion of land use and natural cover surrounding an area of interest. Saranac-Lowell SGA is characterized by high land use index scores across the game area and especially in contrast to the city of Lowell and private lands away from riparian corridors of the Flat and Grand Rivers.

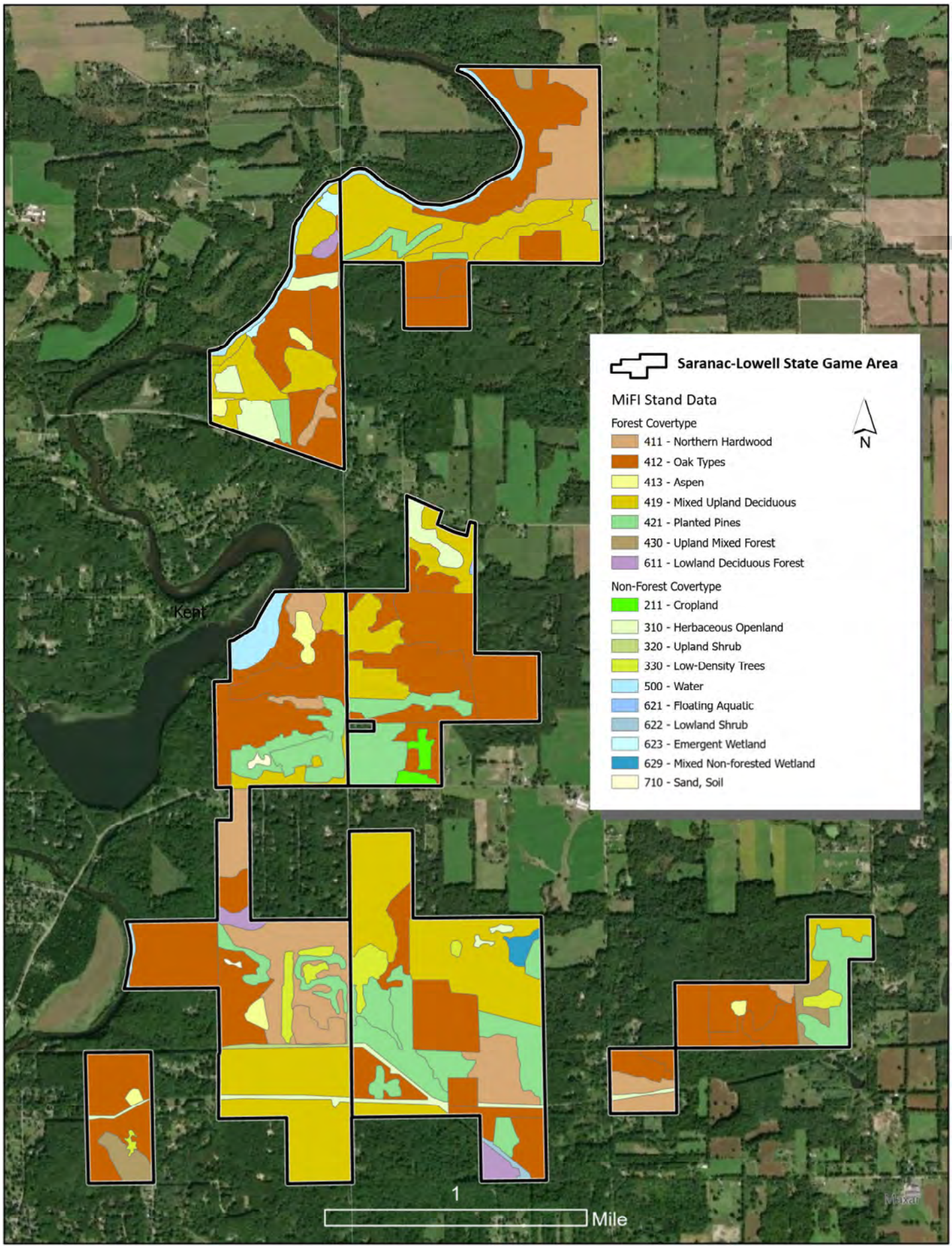


Figure 6. MiFI stand data for Saranac-Lowell State Game Area.

Methods

Throughout this report, natural community types and state- and federally-listed rare species are referred to as elements and their documented occurrence at a specific location are referred to as an element occurrence or "EO". Ecological and rare species surveys relied on a variety of data resources to determine if potential habitat occurs within the game area, including existing natural community EOs, MiFI cover types, aerial photography, and on-the-ground observations. The documentation of new high-quality natural communities was especially dependent on areas identified during the 2015 MiFI surveys and the combination of MiFI surveys and targeted natural community surveys helped inform subsequent rare species surveys.

Target species for rare animal surveys were identified using historical distribution within Michigan, past occurrences in or near Saranac-Lowell SGA, and the presence of potential habitat as determined by MiFI and natural community surveys. Based on these criteria, rare animal surveys focused on woodland raptors, forest interior songbirds, unionid mussels, herptiles, and numerous insect groups. Surveys for target animal species were conducted in appropriate potential habitats during time periods when targeted elements were expected to be most active and detectable (e.g., breeding season). Surveys were conducted to identify new occurrences, update or expand existing occurrences, and revisit historical occurrences of select rare species. Michigan's Wildlife Action Plan (Derosier et al. 2015) identifies species of greatest conservation need (SGCN) and observations of these species were recorded when encountered.

Natural Community Surveys

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, such as timber harvest, alterations to hydrology, and fire suppression. Historically, Indigenous Peoples were an integral part of Michigan's natural communities with many natural community types being maintained by Indigenous management practices such as prescribed fire. MNFI's natural community classification recognizes 77 natural community types in Michigan (Kost et al. 2007, Cohen et al. 2015). The natural community EOs were evaluated employing Natural Heritage and MNFI methodology, which considers three factors to assess a natural community's ecological integrity or quality: size, landscape context, and condition (Faber-Langendoen et al. 2008, 2015).

If a site meets defined requirements for these three criteria (MNFI 1988), it is categorized as a high-quality example of that specific natural community type, entered into MNFI's database as an EO, and given a rank of A to D based on how well it meets the above criteria. MNFI scientists utilized a combination of field surveys, aerial photographic interpretation, and Geographic Information System (GIS) analysis to assess natural community size and landscape context.

Natural community surveys detailed the vegetative structure and composition, ecological boundaries, and landscape and abiotic context of exemplary natural communities. These surveys also assessed the current ranking, classification, and delineation of these occurrences. Ecological field surveys of Saranac-Lowell SGA were implemented over the growing season of 2019. Qualitative meander surveys were conducted to assess the natural community classification, ecological boundaries, and ranking of the target sites. Vegetative structure and composition, soils, landscape and abiotic context, threats, management needs, and restoration opportunities were all assessed. This information is critical for informing landscape-level planning efforts, facilitating site-level decisions about prioritizing management objectives to conserve native biodiversity, and evaluating the success of restoration actions.

Methods employed during this survey followed the methodology developed during the initial evaluation of Ecological Reference Areas on State Forest land in 2006 and 2007 by MNFI ecologists (Cohen et al. 2008; Cohen et al. 2009).

The ecological field surveys involved:

- compiling comprehensive plant species lists and noting dominant and representative species and opportunistically documenting rare plant populations
- describing site-specific structural attributes and ecological processes
- measuring tree diameter at breast height (DBH) of representative canopy trees and aging canopy dominants
- analyzing soils and hydrology
- noting anthropogenic disturbances
- evaluating potential threats to ecological integrity
- ground-truthing aerial photographic interpretation using GPS
- taking digital photos and GPS points at significant locations
- surveying adjacent lands when possible to assess landscape context
- evaluating the natural community classification and mapped ecological boundaries
- assigning element occurrence ranks
- noting management needs and restoration opportunities or evaluating past and current restoration activities

Following completion of the field surveys, the collected data were analyzed and transcribed to create new EO records in MNFI's statewide biodiversity conservation database (MNFI 2022). Natural community boundaries were established and information from these surveys was used to develop site descriptions, threat assessments, and management recommendations.

Floristic data were compiled into the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014, Freyman et al. 2016) to determine the Floristic Quality Index (FQI) for each natural community EO. The floristic quality assessment is derived from a mean coefficient of conservatism and floristic quality index. Each native species is assigned a value of 0 to 10 based on probability of its occurrence in a natural versus degraded habitat. Species restricted to a specialized or undisturbed habitat are assigned a value of 10, implying the species has extremely strong fidelity to a specific habitat. Native species that are not particular or indicative of natural conditions are assigned a low value of 0 to 2. From the total list of plants for an area, a mean C value is calculated and then multiplied by the square root of the total number of plants to calculate the FQI. Michigan sites with an FQI of 35 or greater possess sufficient conservatism and richness that they are considered floristically important from a statewide perspective (Herman et al. 2001). FQI scores greater than 50 indicate exceptional sites with extremely high conservation value (Herman et al. 2001). Species lists for each site are provided in the Appendix.

AmeriCorps volunteer Zack Pittman during natural community surveys. Photo by Jesse M. Lincoln.

Rare Bird Surveys

We focused bird surveys in the game area on rare forest songbirds and raptors based on the presence of mature forest and existing bird EOs. Rare raptor surveys targeted red-shouldered hawk (*Buteo lineatus*, State Threatened), a DNR featured species. Rare songbird surveys targeted prothonotary warbler (*Protonotaria citrea,* State Special Concern), cerulean warbler (*Setophaga cerulea*, State Threatened), hooded warbler (*Setophaga citrina*, State Special Concern), and Louisiana waterthrush (*Parkesia motacilla*, State Threatened).

Forest stands covering at least 4 hectares (10 acres) were considered potential habitat for target species. We generated a 250 m X 250 m grid of points overlaid on the survey area. Points were assigned unique identification numbers and uploaded to tablet computer for field location. Points falling within the survey stands were visited during raptor and songbird surveys. During field surveys some points were deemed "unsuitable" habitat and surveys did not occur at these points. We did not survey points falling within pine plantations, young aspen stands, or farmstead forests. In addition to surveying for rare raptors and songbirds, point-count sampling was used to gather baseline information about the forest bird community, including relative abundance and species richness.

We conducted two-minute raptor surveys at systematically located point count stations (Figure 7; Mosher et al. 1990, Anderson 2007, Bruggeman et al. 2011). Each two-minute point count consisted of one-minute broadcasts of red-shouldered hawk calls and one minute of silent listening. Surveys were conducted between March 18 and May 16, 2021. At each station the following data were recorded: whether a red-shouldered hawk was detected; all other raptor sightings or vocalizations; other bird observations; and other rare animal species detections or potential habitats. If a rare raptor was observed, the vicinity surrounding the point was searched for potential nests. While walking and driving between station locations, we visually inspected trees for stick nests.

Forest songbird point counts were conducted at the same systematically located points used for raptor surveys (Figure 7). Ralph et al. (1995) noted that it is usually more desirable to increase the number of independent point-count stations than to conduct repeated surveys at a smaller number of locations, so we visited each point only once. Surveys were conducted from June 1 to June 9, 2021, from sunrise to 6 hours after sunrise, or until weather condition made it unlikely to detect birds. In addition to documenting observations of the targeted rare species, we collected data on all birds seen or heard during each 10-minute point count. We recorded the species and number of individuals observed during three independent periods (2 minutes, 3 minutes, and 5 minutes) for a total of 10 minutes at each station (Ralph et al. 1995). Use of the three survey periods provides flexibility in making comparisons with other surveys (e.g., North American Breeding Bird Surveys) which use these survey protocols. Each bird observation was assigned to one of four distance categories (0-25 m, 25-50 m, 50-100 m, and >100 m) based on the estimated distance of the bird from the observer to facilitate future distance analyses and refinement of density and population estimates. At each point-count station, we noted if the site appeared suitable for prothonotary warbler, cerulean warbler, hooded warbler, and Louisiana waterthrush.

Several songbirds were detected during surveys, including this great crested flycatcher (*Myiarchus crinitus*). Photo by Aaron P. Kortenhoven.

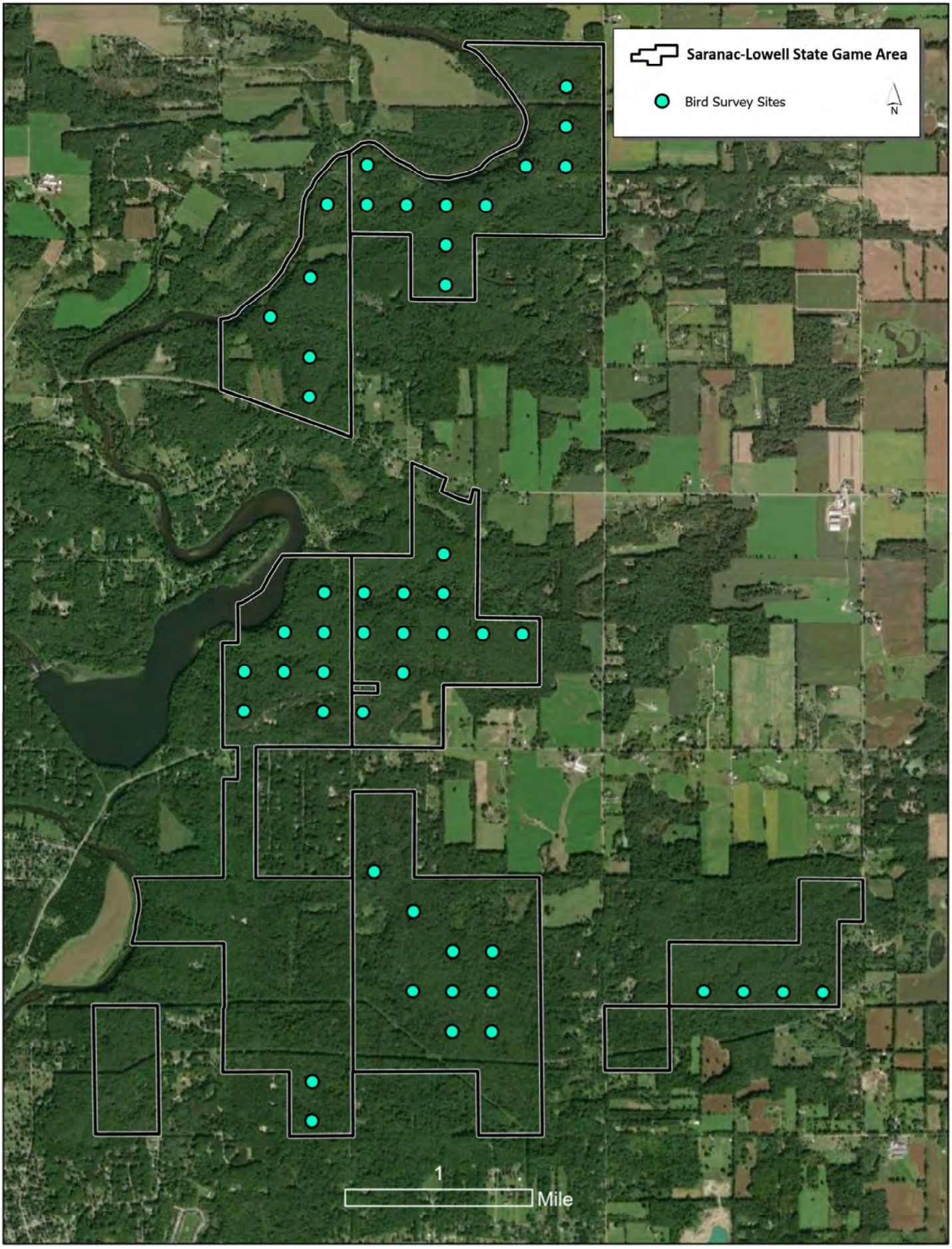


Figure 7. Location of songbird and raptor surveys in Saranac-Lowell State Game Area.

Rare Mussel Surveys

Unionid mussels were chosen as a survey target because of the potential for new occurrences of special concern and listed mussel species. Records for six mussel species of special concern, one state threatened, and one state endangered mussel species have been documented in the Flat River watershed, outside of areas accessible from the game area. The federally endangered snuffbox (*Epioblasma triquetra*) occurs just upstream from the mouth of the Flat River below the King Mill dam in Lowell. Recent surveys by Central Michigan University did not locate any snuffbox in the river reach between the Lowell and Burroughs (Fallasburg) dams. There was a lack of survey data from the stretch of the Flat River upstream of the Burroughs dam and within the Saranac-Lowell SGA.

Mussel surveys took place in wadable habitats (less than approximately 70 cm deep). Survey site locations were determined by looking for signs of extant mussel populations (e.g. shells in muskrat middens on the river bank) and by distributing roughly evenly over the river reach within the state game area. Water depths in the Burroughs dam impoundment area made mussel surveys unfeasible within the scope of this project (i.e., a dive team would be needed to survey habitats that are too deep to wade). Also, the type of habitat in this stretch is less likely to support rare mussel species. The search area at sites was measured to standardize sampling effort among sites and allow unionid mussel density estimates to be made. Live unionid mussels and shells were located with a combination of visual and tactile means. Glass bottom buckets were used to facilitate visual detection. Tactile searches through the substrate were made to help ensure that buried individuals were being detected, including smaller sized unionid mussels. Live individuals were identified to species and placed back into the substrate anterior end down (siphon end up) in the immediate vicinity of where they were found.

Shells were also identified to species. The number of live individuals was determined for each unionid mussel species at each site. The number of shells of species of special concern found were counted and recorded. The riverbanks were scanned visually for mussel shell middens created by muskrats or other mammalian predators. Shells found in middens were identified to species, counted, and returned to where they were found. Aquatic snails, fish, and non-native bivalves including zebra mussels (*Dreissena polymorpha*) and Asian clams (*Corbicula fluminea*) were noted and identified to species when opportunistically encountered during mussel surveys. Fingernail/pea clams (Sphaeriidae) were noted as present or absent as a group. Sphaeriids are a family of native bivalves and an indicator of water quality generally high enough to support native unionid mussels.

Aquatic mussel survey Site 3. Photo by Jesse M. Lincoln.

Aerial view of aquatic survey Site 3. Photo by Jesse M. Lincoln.

Aquatic survey Site 2 where a muskrat midden was found along the edge of the river. Photo by Peter J. Badra.

Latitude and longitude of each survey site was recorded with a handheld Garmin GPS unit. Habitat data were recorded to describe and document stream conditions at the time of the surveys. Substrate within each search area was characterized by estimating percent composition of particle size classes (Table 1) (Hynes 1970). Woody debris, aquatic vegetation, exposed solid clay substrate, and eroded banks were noted when observed. The percentage of the search area with pool, riffle, and run habitat, and a rough characterization of current speed were estimated visually (Table 2). Conductivity and pH of Flat River water were recorded with an Oakton handheld meter. Alkalinity and total water hardness were measured with LaMotte kits (models 4491-DR-01 and 4824-DR-LT-01). Water chemistry measures were taken at aquatics survey site 1 on September 1, 2021. Total alkalinity was 152 ppm, total water hardness 160 ppm, pH 7.86, and conductivity 383 µS. All of which were within normal ranges generally suitable for aquatic species

Stream substrate at aquatic survey sites was favorable for native mussels and was comprised of a mix of particle size classes from boulder to silt (Table 1). Large woody debris and aquatic vegetation were generally present, providing cover and habitat structure for potential host fish (Table 2).

Liver elimia (*Elimia livescens*) grazing on algae. This freshwater snail was documented at aquatic survey Site 2, part of a high-quality river ecosystem. Photo by Peter J. Badra.

Table 1. Percentage of each substrate particle size class estimated visually at each aquatic survey site. Diameter of each size class: boulder (>256mm), cobble (256-64mm), pebble (64-16mm), gravel (16-2mm), sand (2-0.0625mm), silt/clay (<0.0625mm).

Site #	Boulder	Cobble	Pebble	Gravel	Sand	Silt
1	10	15	15	15	35	10
2				10	60	30
3	3	17	25	25	20	10

Table 2. Habitat characteristics recorded at aquatic survey sites.

Site #	Current speed (m/second)	Aquatic vegetation?	Woody debris?	Eroded banks?	%Pool	%Riffle	%Run
1	0.5	Y	Y	N		50	50
2	0.5	N	Y	N			100
3	1.0	Y	Y	N			100

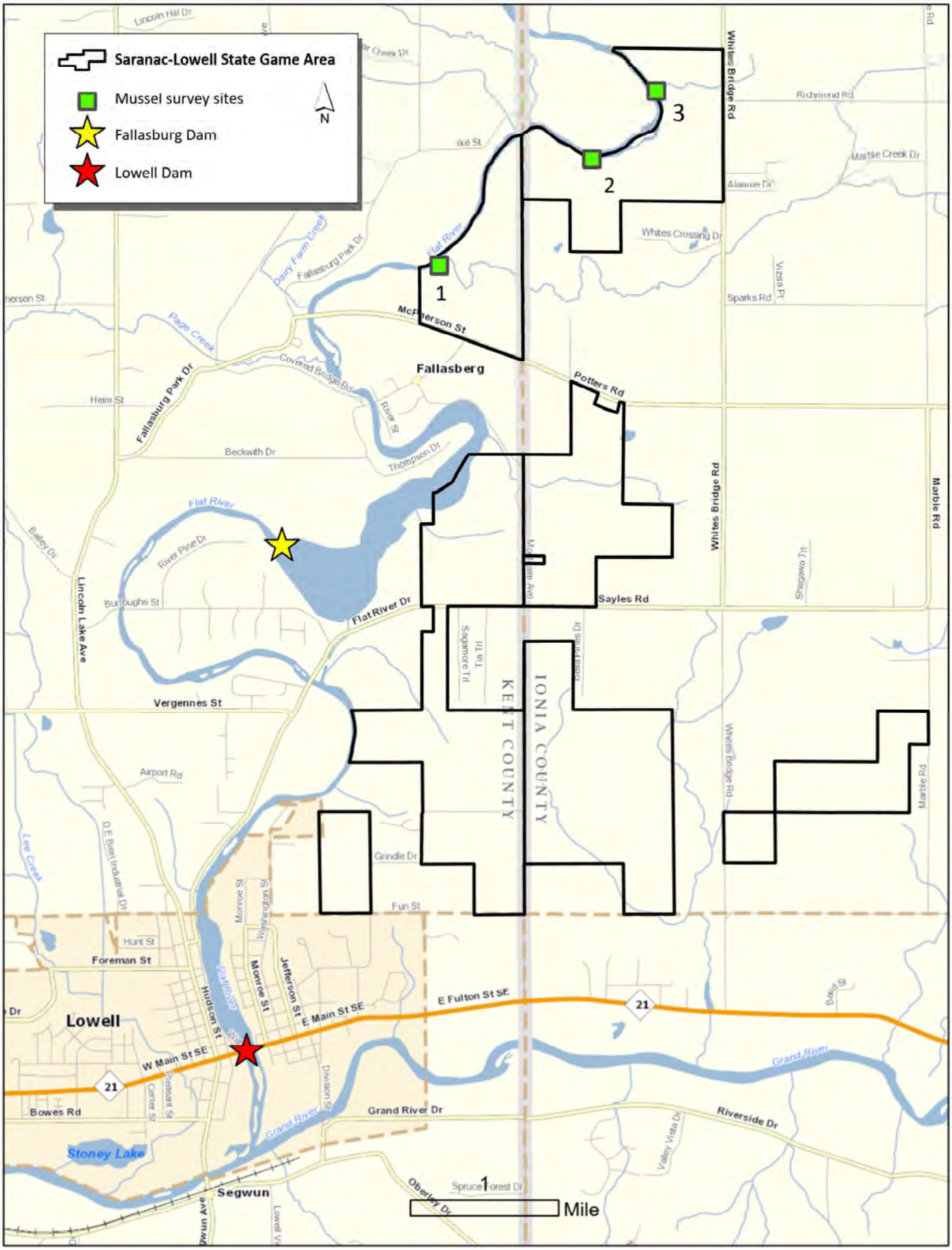


Figure 8. Location of dams on the Flat River and aquatic survey sites in Saranac-Lowell State Game Area.

Rare Reptile and Amphibian Surveys

Surveys for rare amphibian and reptile species (i.e., herptiles) in the Saranac-Lowell SGA in 2021 primarily focused on the following species: Blanding's turtle (*Emydoidea blandingii*, State Special Concern), eastern box turtle (*Terrapene carolina carolina*, State Special Concern), wood turtle (*Glyptemys insculpta*, State Special Concern), Fowler's toad (*Anaxyrus fowleri*, State Special Concern), and marbled salamander (*Ambystoma opacum*, State Endangered). These species also have been identified as Species of Greatest Conservation Need (SGCN) in Michigan's Wildlife Action Plan (Derosier et al. 2015). These species were targeted for surveys because they had been previously documented in or near the game area, or they had potential to occur within the game area based on the species' range and presence of potential suitable habitat (Appendix 7). Surveys in 2021 also had potential for detecting additional rare herptile species and SGCN, including gray ratsnake (*Pantherophis spiloides*, State Special Concern), queen snake (*Regina septemvittata*, State Special Concern), blue racer (*Coluber constrictor foxii*), northern ribbonsnake (*Thamnophis sauritus septentrionalis*), northern ring-necked snake (*Diadophis punctatus edwardsii*), and smooth green snake (*Opheodrys vernalis*) (Derosier et al. 2015).

Visual encounter or meander surveys were conducted in areas with potentially suitable habitat for the target herp species (Figure 9). Surveys were conducted from June 23 through September 24, 2021 using standard methods for surveying amphibians and reptiles (Campbell and Christman 1982, Corn and Bury 1990, Crump and Scott 1994, Graeter et al. 2013). Visual encounter surveys were conducted primarily in upland forest stands including dry-mesic and mesic southern forest stands; open uplands including historic oak savanna, abandoned or degraded agricultural fields, and powerline corridors; and open wetlands and waterbodies including the Flat River and vernal pools (i.e., dry/mostly dry vernal pools for marbled salamanders). Surveyors walked slowly through areas with suitable habitat for survey targets, overturning cover (e.g., logs, rocks, etc.), inspecting retreats, and looking for basking, resting, or active individuals on the surface or under cover objects. A subset of these visual surveys was conducted in June in areas with open sandy habitat to look for nesting turtles and active turtle nesting areas. Although targeted auditory surveys for breeding frogs and toads were not conducted, frog species heard calling during visual encounter surveys were documented. Surveys were conducted under appropriate weather conditions when target species were expected to be active and/or visible. These conditions include temperatures between 60-80°F (16-27°C); winds less than 15 mph; and no or light precipitation. Survey sites were visited one to three times during the field season.

Survey data forms were completed for all herptile surveys using the ArcGIS Survey123 mobile application. Survey locations and routes and locations of rare herptile species were recorded using the ArcGIS Survey123 and FieldMaps mobile applications on a smartphone or tablet. We documented all reptiles and amphibians encountered during surveys. The species, number of individuals, age class, location, general habitat, behavior, and time of observation were noted. Weather conditions and survey times also were recorded. Whenever possible, we took photos of observed species for supporting documentation. All rare species observations were entered into the Michigan Natural Heritage Database.

A garter snake (*Thamnophis sirtalis*) found during reptile and amphibian surveys. Photo by Yu Man Lee.

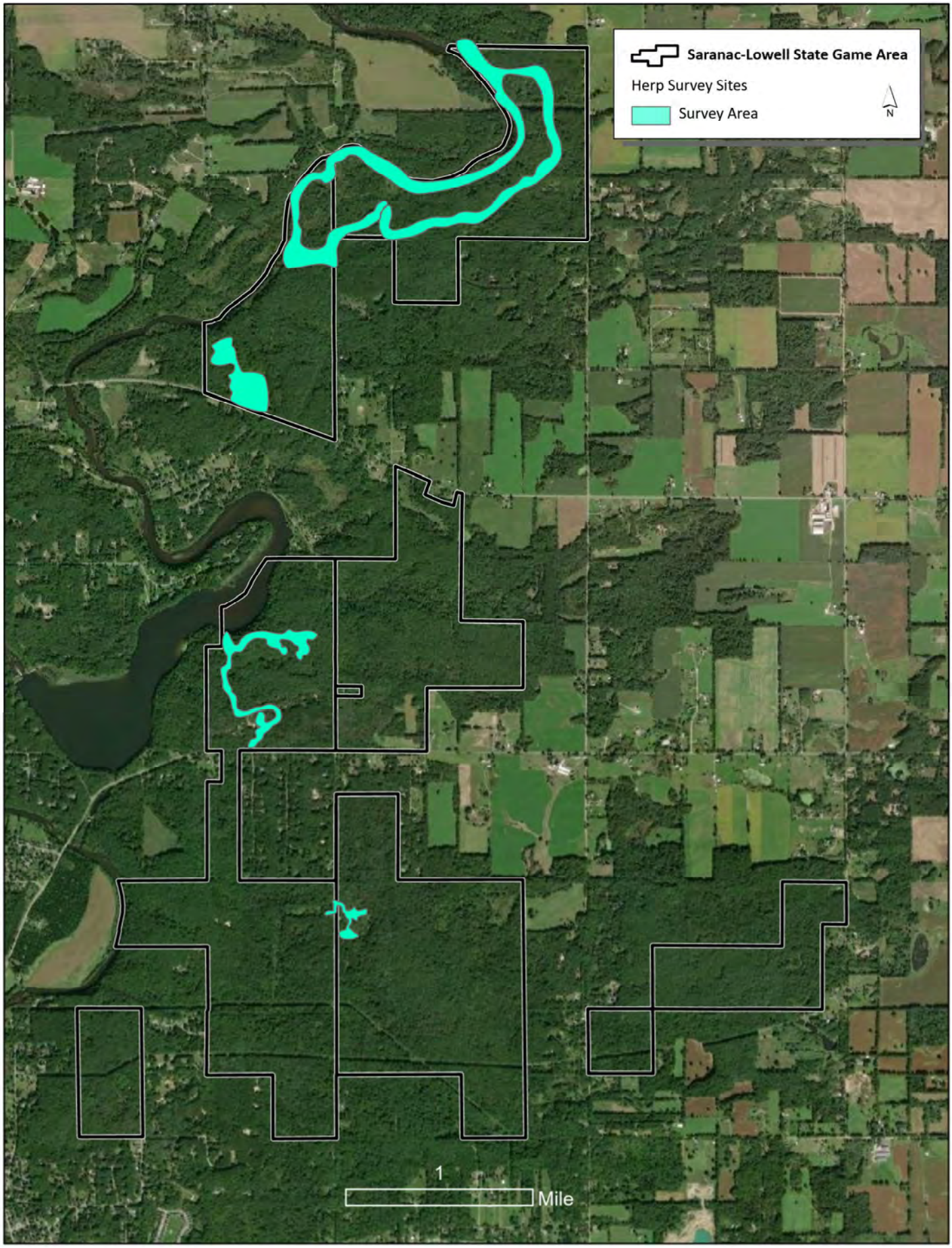


Figure 9. Location of reptile and amphibian surveys in Saranac-Lowell State Game Area.

Rare Insect Surveys

Four types of rare insect surveys were conducted targeting butterflies and spittlebugs; odonates; regal fern borer; and bumble bees. We identified and prioritized species for surveys using historical distribution within Michigan, natural community element occurrences, aerial photography, and the presence of potential habitat within the SGA using MiFI results (Table 3). We conducted surveys for target insect species in potential habitat during time periods when species were expected to be most active and detectable (e.g., adult flight period). Surveys were conducted to identify new occurrences of rare insects. In addition to documenting rare species, we also recorded observations of SGCN identified in Michigan's Wildlife Action Plan (Derosier et al. 2015; e.g., monarch butterfly).

Butterfly and spittlebug surveys were informed by developing habitat suitability models using MiFI data, geospatial models, and data from the Michigan Natural Heritage Database (MNFI 2022). We evaluated suitability of habitat for the swamp metalmark (*Calephelis mutica*, State Special Concern), Henry's elfin (*Incisalia henrici*, State Threatened), bumble bees (*Bombus* spp.), regal fritillary (*Speyeria idalia*, State Endangered), rare moth borers (*Papaipema* spp.), angular spittlebug (*Lepyronia angulifera*, State Special Concern), and Great Plains spittlebug (*Lepyronia gibbose*, State Special Concern).

We also modeled for suitable habitat for the following rare lepidopterans that occupy oak savanna habitat, where they feed on wild lupine (*Lupinus perennis*), false indigos (*Baptisia* spp.), or New Jersey tea (*Ceanothus americanus*): Karner blue (*Lycaeides melissa samuelis*, State Threatened, Federally Endangered), frosted elfin (*Callophrys irus*, State Threatened), dusted skipper (*Atrytonopsis hianna*, State Special Concern), mottled duskywing (*Erynnis martialis*, State Special Concern), and Persius duskywing (*Erynnis persius persius*, State Threatened).

Diurnal insect surveys (butterflies, dragonflies, spittlebugs, bumble bees) were conducted between 9 am and 5 pm during warm, sunny, low-wind conditions. We used visual meander surveys for rare skippers and butterflies in July and August of 2020 and 2021 when adults are flying. Surveys consisted of one to two surveyors slowly walking through areas with suitable habitat looking for butterflies in flight or perched on vegetation. Surveyors gently disturb the tops of vegetation to flush adults perched in vegetation. For rare spittlebug surveys, we conducted sweep net surveys once we located host plants (prairie grasses). All specimens and litter were collected in a plastic bag and frozen until spittlebug specimens were sorted from litter and identified in the laboratory.

Bumble bee survey habitat at Saranac-Lowell State Game Area (Compartment 2, Stand 26). Photo by Logan Rowe.

Based on known ranges and the presence of suitable habitat, surveys aimed to detect four species of odonates. The elusive snaketail (*Stylurus notatus,* State Special Concern) is found in clear rivers with moderate current (MNFI 2022). Laura's snaketail (*S. laurae*, State Special Concern) habitat comprises rivers and streams with sandy substrate (MNFI 2022). The riverine snaketail (*S. Amnicola*, State Special Concern) has been documented in Ingham County (2013) and is found in clear rivers with moderate current and gravel or sandy benthos (MNFI 2022). The pygmy snaketail (*Ophiogomphus howei*, State Threatened) has been documented in two counties in Michigan, including Ingham County in 2019. This dragonfly requires big rivers with high water quality and stable flow, where males patrol over stream riffles (MNFI 2022).

We conducted surveys for rare odonates (dragonflies and damselflies) along the Flat River in Saranac-Lowell SGA in 2021. Surveys were conducted at each site for approximately 90 minutes, focusing on areas with potential habitat, including woody debris, the confluence of streams flowing into the Flat River. Insects were identified through binoculars or netted specimens. We completed eight surveys along the Flat River in August of 2021 during sunny, calm, dry conditions.

Table 3. Species targeted for insect surveys and description of habitat.

Survey Targets	Compartment	Stand	Habitat	Follow-up
Mottled duskywing, lupine feeders	1	30	Lupine absent, canopy closed, New Jersey tea present but in low densities	No
Mottled duskywing, lupine feeders	1	32	Lupine sparse, but NJ tea present; Stand has very open understory with a few barrens-like areas	Yes
Mottled duskywing	2	2	Dry-mesic southern forest, high-quality stand	No
Mottled duskywing, lupine feeders	2	4	Habitat present with both lupine and New Jersey tea	Yes
Great Plains spittlebug	2	4	Host plants present	Yes
Lupine feeders	2	11	Powerline right-of-way, good pollinator habitat (e.g., *Liatris* spp), sparse lupine	No
Great Plains spittlebug	2	11	Host plants present	Yes
Monarch	2	26	Old field, some nectar sources, low diversity	No
Great Plains spittlebug	2	26	Old field, no host plants for spittlebugs	No
Lupine feeders, Mottled duskywing	2	41	Habitat shaded	No
Lupine feeders, Mottled duskywing	2	44	Degraded oak barrens, could be managed to decrease shrub. Ant mounts present	No
Mottled duskywing	2	51	Some sandy areas with NJ tea, but canopy too closed	No

We surveyed for regal fern borer moth (*Papaipema speciosissima*, State Special Concern) at a single location within Saranac-Lowell State Game Area in September of 2020. Potential survey locations were determined by examining the aerial imagery and stand level data collected by MNFI Ecologists during ecological inventory work in 2015 and 2019. The final survey location was selected by visiting potential survey locations and conducting ground surveys for regal fern borer moth host plants, including royal fern (*Osmunda regalis*), cinnamon fern (*O. cinnamomea*) and interrupted fern (*O. claytoniana*). The survey for regal fern borer moth utilized the technique of blacklighting, which consisted of standard mercury-vapor and UV lights powered by a portable generator. A large white sheet was used as a collecting surface. This frame was placed in a central location with larval host plants on all sides to maximize the likelihood of collecting adults.

The final group of insects targeted for rare insect surveys were bumble bees. There are three state listed species of bumble bees with current distributions that overlap with Saranac-Lowell SGA. These include black and gold bumble bee (*Bombus auricomus*, State Special Concern), American bumble bee (*B. pensylvanicus*, State Special Concern), and Sanderson's bumble bee (*B. sandersoni*, State Special Concern). A fourth species, rusty patched bumble bee (*B. affinis*, Federally Endangered, State Special Concern), hasn't been observed in Michigan since 1999, but historically would have likely occurred within boundaries of Saranac-Lowell SGA. Each of these species inhabits areas with abundant floral resources and dense ground cover, which are necessary for forage and overwintering, respectively.

We conducted a standardized meander based *Bombus* community survey at a single location in Saranac-Lowell SGA on July 21st, 2021, with the intent of locating a population of one of these rare bumble bee species. The survey site was selected for its abundant floral resources, its proximity to forest and wetland systems, and groundcover dominated by tufts of dead vegetation. A two-hour meander survey with aerial netting was completed in an open field dominated by a mix of wildflowers and grasses, nested within a matrix of dense forested vegetation. During the survey, any bumble bee observed was collected, placed in a vial with the associated floral species, and stored until the end of the survey. After the survey, each bumble bee was identified to species. If we were unable to accurately identify a specimen in the field, it was stored in a cooler and processed in the lab.

Blacklight set-up for regal fern borer moth surveys in Saranac-Lowell SGA. Royal fern shown in the foreground. Photo by Logan Rowe.

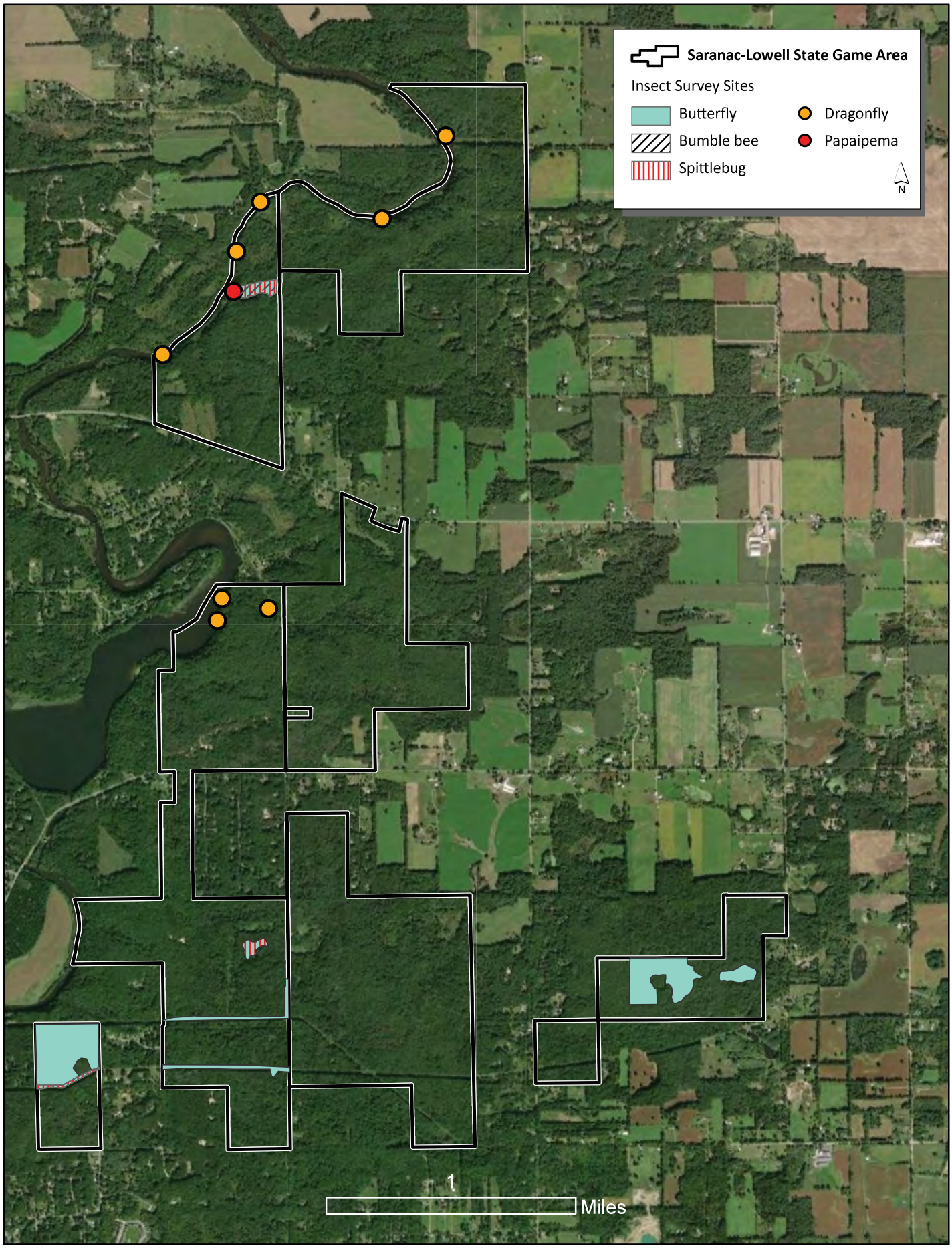


Figure 10. Location of insect surveys in Saranac-Lowell State Game Area.

Results

MNFI conservation scientists have documented 22 element occurrences (EOs) from Saranac-Lowell SGA. These element occurrences are composed of three natural community and 19 rare species occurrences with four plant, eight bird, five mussel, two herptile, and two insect EOs. During surveys completed for the Integrated Inventory project at Saranac-Lowell SGA, MNFI scientists documented three new natural community EOs (Table 4, Figure 11), two new rare plant EOs (Table 5, Figure 18), three new bird EOs (Table 6, Figure 19), five new rare mussel EOs (Table 8, Figure 20), one new herptile EO (Table 11, Figure 21), two new insect EOs (Table 13, Figure 22) and provided information for updating six existing EOs. Data compiled on these EOs were entered into MNFI's Natural Heritage Database (MNFI 2022).

Natural Communities

MNFI ecologists documented three new high-quality natural communities in the Saranac-Lowell SGA (Table 4, Figure 11). The following three natural community types have been surveyed and documented: dry southern forest (1 EO), dry-mesic southern forest (1 EO), and southern wet meadow (1 EO). These high-quality natural communities cover 8.9% of the game area. The following site summaries contain a detailed discussion for each of the three natural community EOs organized alphabetically by community type.

Table 4. Natural community element occurrences for the Saranac-Lowell State Game Area. All natural communities described in Saranac-Lowell SGA were newly documented during the Integrated Inventory process.

Site Name	EO ID	Rank	Size (Ac)	First Visited	Last Visited	Compartment	Stands
Dry Southern Forest							
Sparks Woods	24247	C	19.7	2019	2019	1	14
Dry-Mesic Southern Forest							
Ziibiqua Woods	23909	BC	3.9	2019	2020	1 and 2	Stand 20 in Cmpt 1 1, 2, 20, 35, and 36 in Cmpt 2
Southern Wet Meadow							
Fallass Wet Meadow	23908	C	3.5	2020	2020	2	57

The Ziibiqua Woods dry-mesic southern forest EO is especially diverse. Photo by Jesse M. Lincoln.

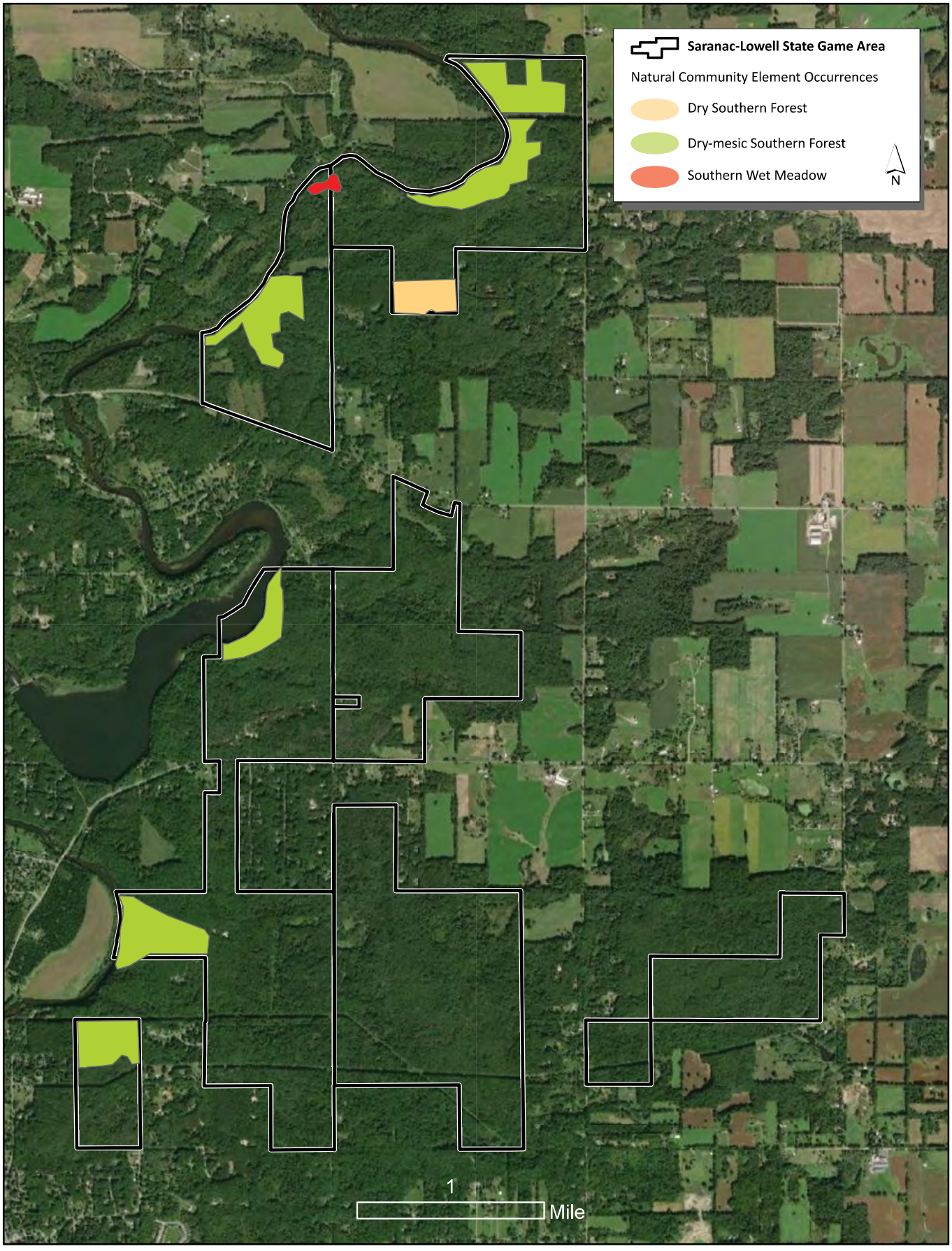


Figure 11. Natural community element occurrences in Saranac-Lowell State Game Area.

1. Sparks Woods
Natural Community Type: Dry Southern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: CD
Size: 19.7 acres
Location: Compartment 1; Stand 14
Element Occurrence Identification Number: 24247 (New)

This is a second-growth oak forest that occurs on variable topography of rolling moraine. Soils were generally covered with thick oak litter to approximately 2 cm depth. The top layer of soil consists of slightly acidic (pH 6.0) medium-textured sands with dark organics to a depth of 3 cm over coarse sand with small gravel (pH 6.0-5.5) to a depth of about approximately 15 cm. Below that is fine sand with gravel (pH 5.5) to a depth of at least 1 m.

The forest is dominated by large black (*Quercus velutina*) and white (*Q. alba*) oaks. Tree sizes range from 40 to 80 cm dbh. A 67.8 cm dbh white oak had 109 rings observed and most trees appear to be part of a single cohort that established after clearing in the late 1800s or early 1900s. Black cherry (*Prunus serotina*) and red maple (*Acer rubrum*) were rare in the canopy. The second-growth oak forest features large, maturing trees but the system is fire suppressed and red maple is dominating the subcanopy and understory and thereby limiting oak recruitment and suppressing herbaceous vegetation. Deer herbivory was obvious across the landscape and is also contributing to a depauperate shrub and ground layer.

The subcanopy and understory is dominated by red maple. Black cherry and sassafras (*Sassafras albidum*) occur occasionally throughout. The understory and low shrub layer feature witch-hazel (*Hamamelis virginiana*), sassafras, choke cherry (*Prunus virginiana*), maple-leaved viburnum (*Viburnum acerifolium*), white ash (*Fraxinus americana*), autumn olive (*Elaeagnus umbellata*), prickly gooseberry (*Ribes cynosbati*), common blackberry (*Rubus allegheniensis*), flowering dogwood (*Cornus florida*), alternate-leaved dogwood (*C. alternifolia*), pasture rose (*Rosa carolina*), white oak, juneberry (*Amelanchier arborea*), and shrubby St. John's-wort (*Hypericum prolificum*).

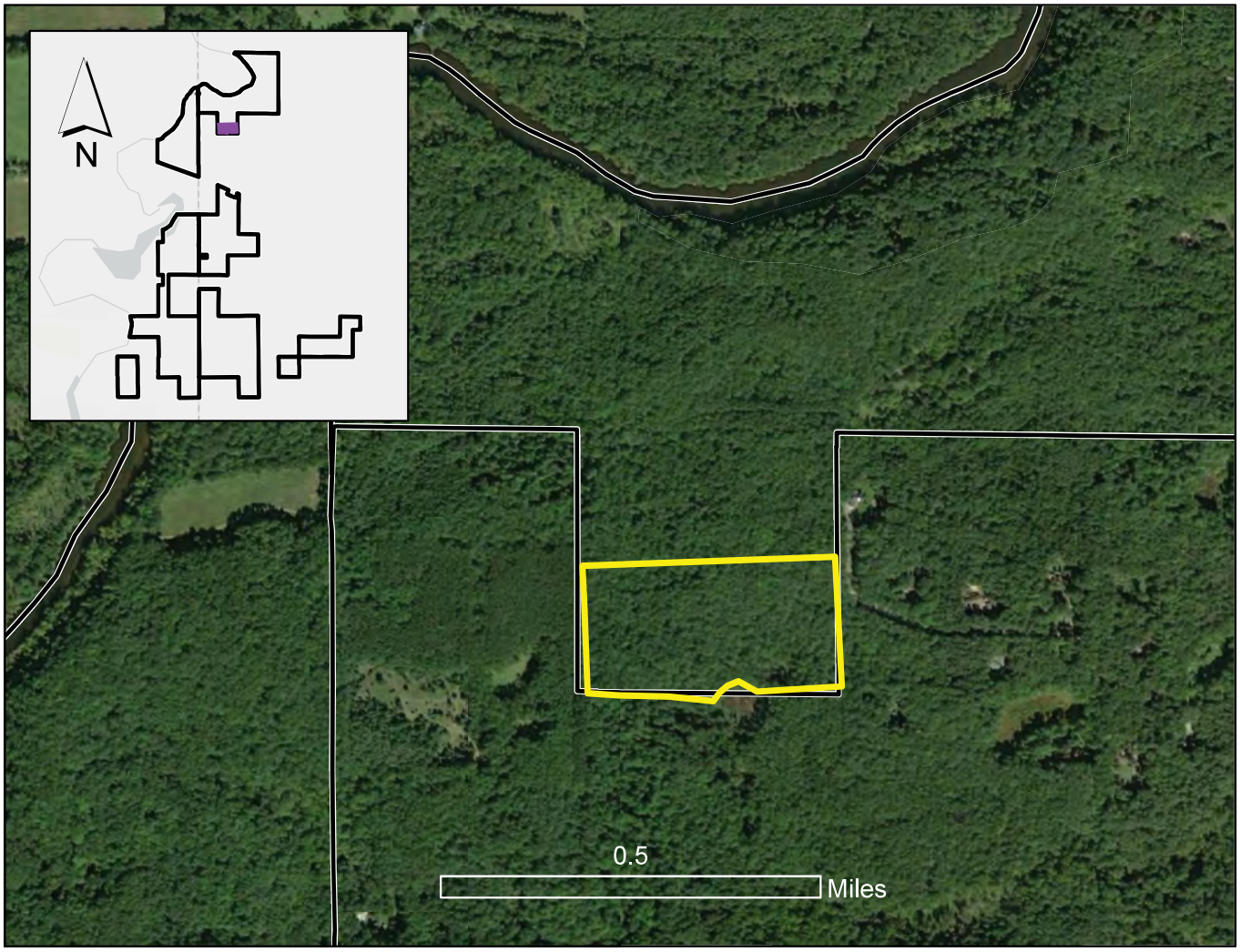
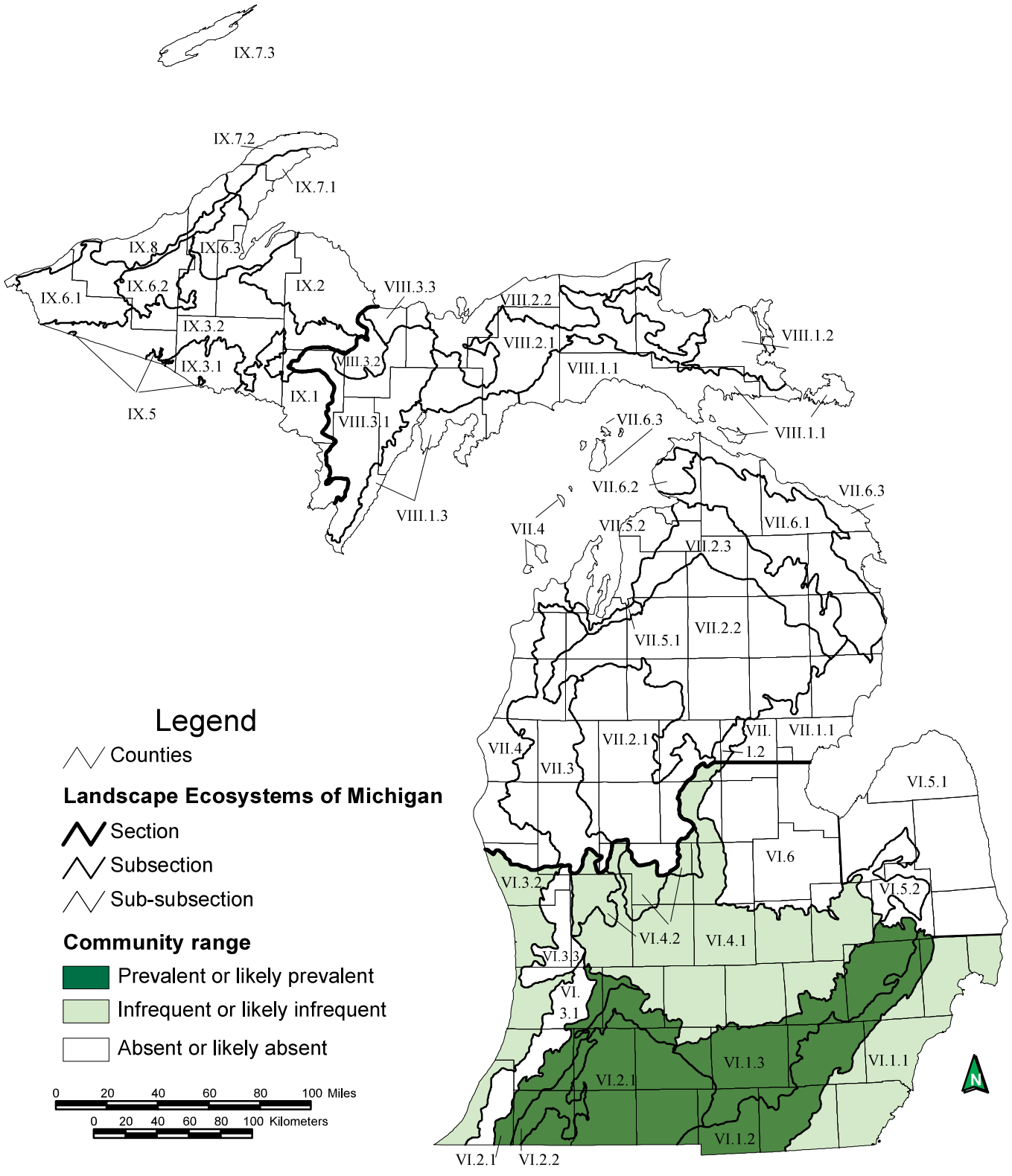


Figure 12. Location of Sparks Woods dry southern forest (ESRI 2022).



MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Dry Southern Forest

Albert, D.A., J.G. Cohen, M.A. Kost, B.S. Slaughter, and H.D. Enander. 2008. Distribution Maps of Michigan's Natural Communities. Michigan Natural Features Inventory, Report No. 2008-01, Lansing, MI. 166 pp.

Figure 13. Statewide distribution of dry southern forests.

The herbaceous layer is sparse to patchy with areas of continuous native vegetation, primarily the sedge *Carex pensylvanica*, which forms extensive lawns. Areas with dense red maple subcanopy are sparsely vegetated. Other herbaceous species found in the forest include *Carex cephalophora*, wild geranium (*Geranium maculatum*), bluestem goldenrod (*Solidago caesia*), hog-peanut (*Amphicarpaea bracteata*), naked tick-trefoil (*Hylodesmum nudiflorum*), silky wild-rye (*Elymus villosus*), old-field cinquefoil (*Potentilla simplex*), sweet-cicely (*Osmorhiza claytonii* and *O. longistylis*), may-apple (*Podophyllum peltatum*), early figwort (*Scrophularia lanceolata*), Virginia creeper (*Parthenocissus quinquefolia*), big-leaved aster (*Eurybia macrophylla*), wild strawberry (*Fragaria virginiana*), American vetch (*Vicia americana*), heart-leaved aster (*Symphyotrichum cordifolium*), white wild licorice (*Galium circaezans*), curly-styled wood sedge (*Carex rosea*), nodding fescue (*Festuca subverticillata*), garlic mustard (*Alliaria petiolata*), poke milkweed (*Asclepias exaltata*), yellow violet (*Viola pubescens*), and false melic (*Schizachne purpurascens*). Problematic invasive species are autumn olive, garlic mustard, multiflora rose (*Rosa multiflora*), and Canada bluegrass (*Poa compressa*).

Sparks Woods was visited once in the 2019 field season. A total of 63 plant species were observed with 59 native species and 4 non-native species recorded. The total FQI is 30.2 and the Total Mean C was 3.8. Conservation metrics for Sparks Woods are available in Appendix 1 and the comprehensive species list is in Appendix 2.

Threats and Management Recommendations

The primary threats to the Sparks Woods dry southern forest are logging and habitat fragmentation, fire suppression, deer herbivory, and invasive species, particularly the non-native shrubs autumn olive and multiflora rose. Our primary management recommendations are to prevent logging within the EO and provide a 150 ft buffer around the forest where intensive silvicultural actions such as clearcutting are avoided. Additional management recommendations are to apply prescribed fire at a rate of one to two burns per decade, treat autumn olive and multiflora rose, and reduce local deer densities if possible.

Pasture rose was observed in Spark Woods blooming in canopy gaps. Decades of fire suppression has led to a dense subcanopy of red maple and likely contributes to decreased flowering of understory and ground cover species that are stressed by light competition from mesophytic invaders. Photo by Jesse M. Lincoln.

American vetch observed in Sparks Woods. This is one of many species found in the forest that have an affinity for fire-adapted communities. Photo by Jesse M. Lincoln.

Sparks Woods dry southern forest is dominated by black and white oak and features a subcanopy dominated by red maple. The herbaceous layer is relatively continuous with many fire-adapted species. Photos by Jesse M. Lincoln.

2. Ziibiqua Woods
Natural Community Type: Dry-Mesic Southern Forest
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: BC
Size: 185 acres
Location: Compartment 1; Stand 20. Compartment 2; Stands 1, 2, 20, 35, and 36
Element Occurrence Identification Number: 23909 (New)

Ziibiqua Woods was named for an Ottawa woman that married Rix Robinson, one of the earliest permanent white settlers in the area. Her name means River Woman and she worked to stop the removal of the local tribes that had called this area home for generations (McClurken 2009). Ziibiqua Woods is an oak-dominated forest occurring as six separate blocks of mature forest on the slopes of end moraine above the Flat River outwash channel. The EO is restricted to the steepest slopes along the Flat River where the forests could not be cleared for agriculture and were only grazed to a minimal extent. Ecological processes that govern composition are driven by the dramatic elevation changes from the river to the top of the slopes. These processes include slope position and aspect which influence the distribution of wetland obligates and drought-tolerant and fire-adapted species; floods, beaver activity, and ice scour in narrow bands at the base of the slopes along the river; windthrow which causes accumulation of coarse woody debris and initiates erosion at tip-ups on steep slopes; deer herbivory which is detectable on many species but seems to have less impact on the steepest slopes compared to the flatter topography away from the slopes; sloughing on the steepest slopes where seeps tend to form, causing small concentrations of wetland obligates in an otherwise upland forest; and historically fire as there are several species characteristic of savanna systems. As a result, the forest is very diverse, especially for this natural community type.

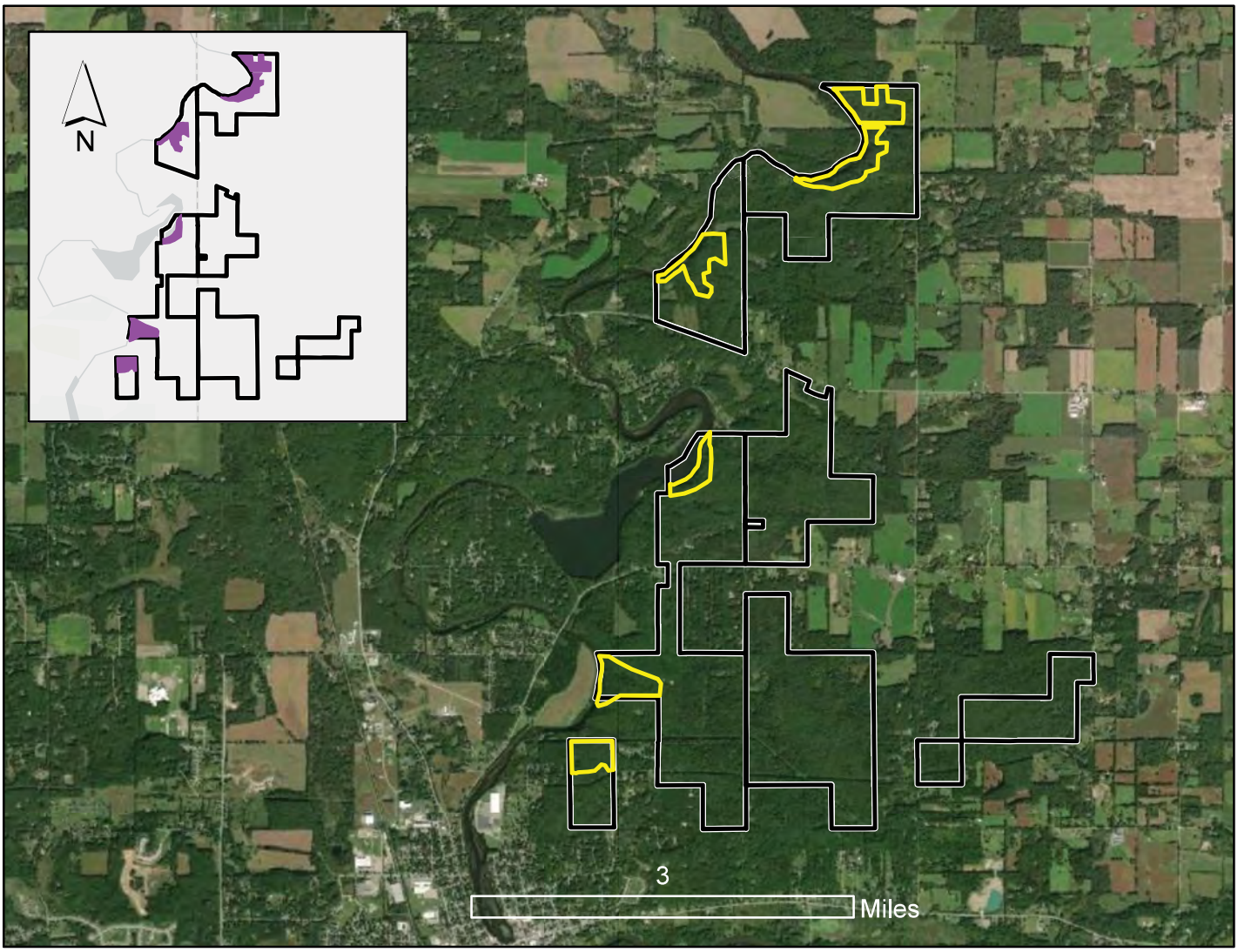
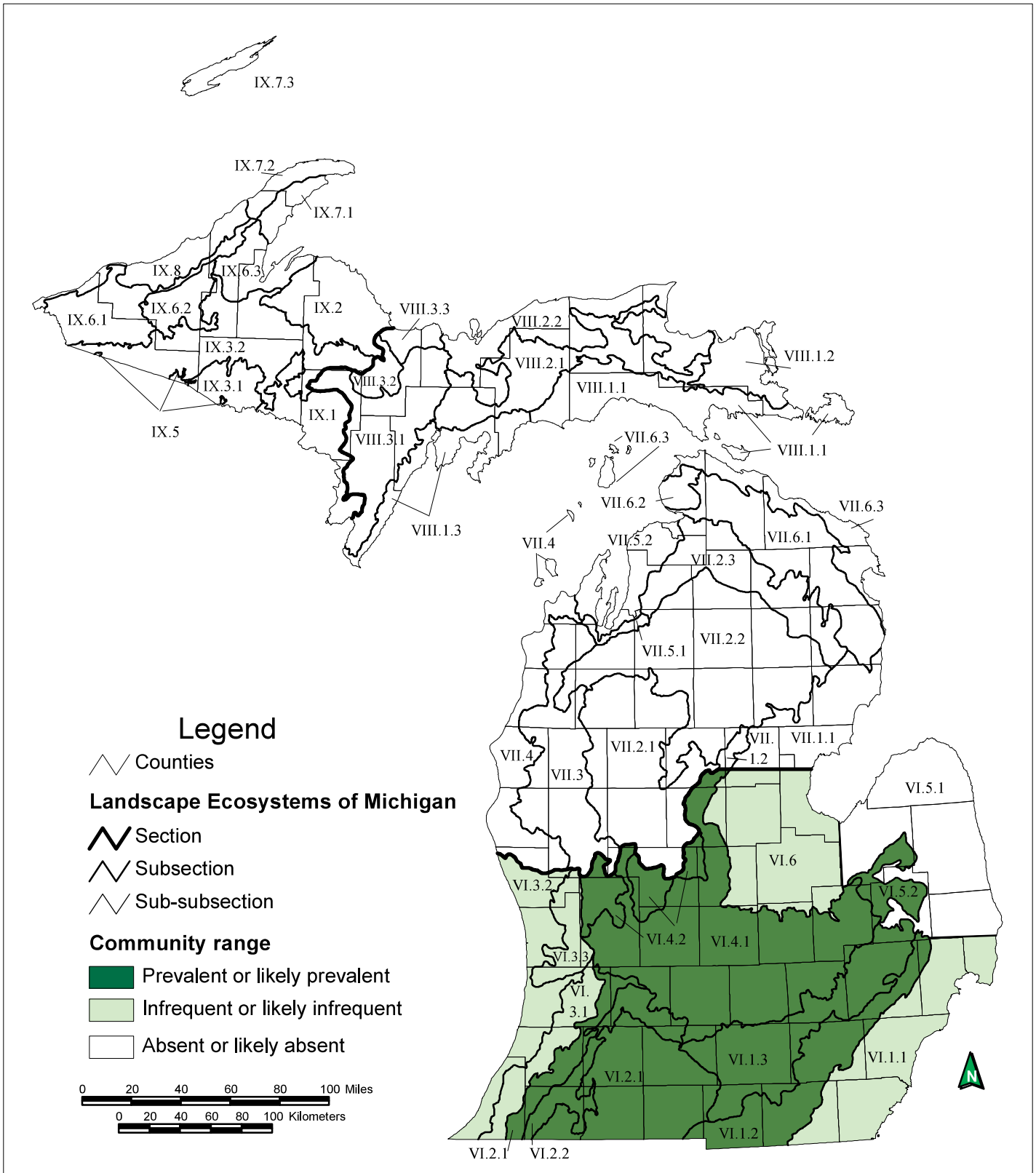


Figure 14. Location of Ziibiqua Woods dry-mesic southern forest (ESRI 2022).



MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Dry-mesic Southern Forest

Albert, D.A., J.G. Cohen, M.A. Kost, B.S. Slaughter, and H.D. Enander. 2008. Distribution Maps of Michigan's Natural Communities. Michigan Natural Features Inventory, Report No. 2008-01, Lansing, MI. 166 pp.

Figure 15. Statewide distribution of dry-mesic southern forests.

Glacial erratics occur throughout Ziibiqua Woods and sizes ranged from ½ m to nearly 1 m across. Soils were generally covered with sparse oak litter to a depth of approximately 1 cm. The top layer of soil was circumneutral (pH 7.0) medium-textured, loamy sand with dark organics to a depth of approximately 3 cm. Soil below is slightly acidic (pH 6.0-5.5) lighter and finer sand with approximately ½ to 1 cm smooth rocks to a depth of approximately 20 cm. The underlying mineral soil is acidic (pH 5.5), tan, fine, silty sand that occurs to a depth of at least 1 m.

This oak-dominated forest occurs as six-separate polygons on steep slopes along the river. The mature, primarily second-growth forest features canopy coverage of 70 to 95% with red oak (*Quercus rubra*) and white oak (*Q. alba*) as the most dominant trees. Diameters of canopy trees are typically 40 to 80 cm dbh and the largest tree is a red oak with a 110 cm dbh. Tree ages are typically between 100 to 150 years old. White oaks tended to be the oldest trees and some occurring in the steepest, most inaccessible ravines were older with a 41.9 cm dbh tree having 177 rings observed, a 67.1 cm dbh tree having 204 rings observed, and a 66.8 cm dbh white oak having 258 rings observed, making it the oldest tree documented by MNFI in Kent County.

The system is classified as a dry-mesic southern forest because red and white oak tend to be the most dominant species. However, it is an extremely variable forest and the community trends towards dry southern forest along the top of the slopes where black oak (*Quercus velutina*) dominates; mesic southern forest in zones where sugar maple (*Acer saccharum*) is more dominant; dry-mesic northern forest where white pine and hemlock are prevalent; and locally trends to floodplain at the bottom of slopes along the river.

Canopy composition varies dramatically depending on aspect, slope, position on slopes, history of logging, and sloughing along the steepest slopes. White pine forms a super canopy in a few places. South- and west-facing slopes have more black and white oak and pignut hickory (*Carya glabra*). North- facing slopes feature more red oak, basswood (*Tilia americana*), red maple (*Acer rubrum*), sugar maple, beech (*Fagus grandifolia*), and black cherry (*Prunus serotina*). One north-facing slope along the river featured eastern hemlock (*Tsuga canadensis*) in the canopy and another had some northern white-cedar (*Thuja occidentalis*) where there was abundant seepage. Towards the base of slopes where the high water levels of the river seasonally inundate trees, there is often a narrow band of floodplain species including silver maple (*Acer saccharinum*), bur oak (*Q. macrocarpa*), shagbark hickory (*Carya ovata*), black walnut (*Juglans nigra*), basswood, and quaking aspen (*Populus tremuloides*). The steep slopes often feature sloughing, which exposes small seeps and causes zones of saturated soils. These zones are sparsely canopied and dominant trees are basswood, red maple, quaking aspen, and historically American elm (*Ulmus americana*) and green ash (*Fraxinus pennsylvanica*) which are now relegated to the subcanopy.

The variable aspect, slope position, and proximity to the river drive community composition in Ziibiqua Woods. White pine forms a supercanopy in some locations. Photo by Jesse M. Lincoln.

Most of the forest in Ziibiqua Woods are mature second-growth around 150 years old. However, a few individual older trees remain (top photo). Some white oaks are over 250 years old and are the oldest trees documented in Kent County by MNFI Ecologists. Photos by Jesse M. Lincoln.

The subcanopy and understory are variable with red oak, ironwood (*Ostrya virginiana*), red maple, white oak, sassafras (*Sassafras albidum*), beech, juneberry (*Amelanchier arborea*), white ash (*Fraxinus americana*), black cherry, and witch-hazel (*Hamamelis virginiana*) being common to dominant. American elm, green ash, and musclewood (*Carpinus caroliniana*) are more prevalent in wetter areas. The low shrub layer features maple-leaved viburnum (*Viburnum acerifolium*), choke cherry (*Prunus virginiana*), and prickly gooseberry (*Ribes cynosbati*). Drier zones feature huckleberry (*Gaylussacia baccata*) and lowbush blueberry (*Vaccinium angustifolium*), and wetter zones of the low shrub layer have prickly-ash (*Zanthoxylum americanum*), elderberry (*Sambucus canadensis*), and musclewood. Seedlings of many canopy species are also present in the low shrub layer, especially white ash, pignut hickory, red maple, and red and white oak. Invasive shrubs are locally abundant and include autumn olive (*Elaeagnus umbellata*), honeysuckles (*Lonicera morrowii* and *L. maackii*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*).

The herbaceous layer is highly variable and especially diverse for the community type. Common species include Pennsylvania sedge (*Carex pensylvanica*), clustered-leaved tick-trefoil (*Hylodesmum glutinosum*), bluestem goldenrod (*Solidago caesia*), Canada mayflower (*Maianthemum canadense*), wild geranium (*Geranium maculatum*), big-leaved aster (*Eurybia macrophylla*), spreading dogbane (*Apocynum androsaemifolium*), autumn bent (*Agrostis perennans*), sedges (*Carex pedunculata, Carex gracillima,* and *Carex cephaloidea*), white lettuce (*Prenanthes alba*), nodding fescue (*Festuca subverticillata*), jumpseed (*Persicaria virginiana*), sweet-cicely (*Osmorhiza longistylis* and *O. claytonii*), lopseed (*Phryma leptostachya*), jack-in-the-pulpit (*Arisaema triphyllum*), wild sarsaparilla (*Aralia nudicaulis*), smooth pussytoes (*Antennaria parlinii*), hog peanut (*Amphicarpaea bracteata*), white snakeroot (*Ageratina altissima*), partridge-berry (*Mitchella repens*), wood-betony (*Pedicularis canadensis*), common blackberry (*Rubus allegheniensis*), wood millet (*Milium effusum*), satin brome (*Bromus nottowayanus*), and yellow violet (*Viola pubescens*).

Ephemeral streams occur at the base of steep slopes throughout Ziibiqua Woods. The unusually high species richness in this forest is partially a result of the numerous streams and areas of seepage that support small pockets of wetland species. Photo by Aaron P. Kortenhoven.

Drier areas, especially on south- and west-facing slopes and near the tops of slopes feature panic grass (*Dichanthelium dichotomum*), hairy goldenrod (*Solidago hispida*), sickle-pod (*Boechera canadensis*), pasture rose (*Rosa carolina*), yellow-pimpernel (*Taenidia integerrima*), round-leaved tick-trefoil (*Desmodium rotundifolium*), black oatgrass (*Piptochaetium avenaceum*), hairy hawkweed (*Hieracium gronovii*), bastard toadflax (*Comandra umbellata*), smooth false foxglove (*Aureolaria flava*), poverty grass (*Danthonia spicata*), and tower mustard (*Turritis glabra*).

North-facing slopes are characterized by interrupted fern (*Osmunda claytoniana*), Christmas fern (*Polystichum acrostichoides*), early meadow-rue (*Thalictrum dioicum*), blue cohosh (*Caulophyllum thalictroides*), bluegrass (*Poa alsodes*), bloodroot (*Sanguinaria canadensis*), bellwort (*Uvularia grandiflora*), spikenard (*Aralia racemosa*), and dolls-eyes (*Actaea pachypoda*). Seeps feature skunk cabbage (*Symplocarpus foetidus*), spotted touch-me-not (*Impatiens capensis*), may-apple (*Podophyllum peltatum*), *Carex stipata*, golden ragwort (*Packera aurea*), royal fern (*Osmunda regalis*), marsh-marigold (*Caltha palustris*), false nettle (*Boehmeria cylindrica*), wood nettle (*Laportea canadensis*), bishops-cap (*Mitella diphylla*), and swamp buttercup (*Ranunculus hispidus*).

Floodplain species at the base of the slopes include the rare broad-leaved puccoon (*Lithospermum latifolium*, State Special Concern), Canada wild rye (*Elymus canadensis*), Canada anemone (*Anemone canadensis*), wild ginger (*Asarum canadense*), long-beaked sedge (*Carex sprengelii*), panic grass (*Dichanthelium clandestinum*), joe-pye-weed (*Eutrochium maculatum*), cut-leaf coneflower (*Rudbeckia laciniata*), water dock (*Rumex verticillatus*), poison ivy (*Toxicodendron radicans*), Lake Ontario aster (*Symphyotrichum ontarionis*), virgins bower (*Clematis virginiana*), swamp goldenrod (*Solidago patula*), purple meadow rue (*Thalictrum dasycarpum*), Michigan lily (*Lilium michiganense*), white grass (*Leersia virginica*), great blue lobeliea (*Lobelia siphilitica*), and false rue-anemone (*Enemion biternatum*).

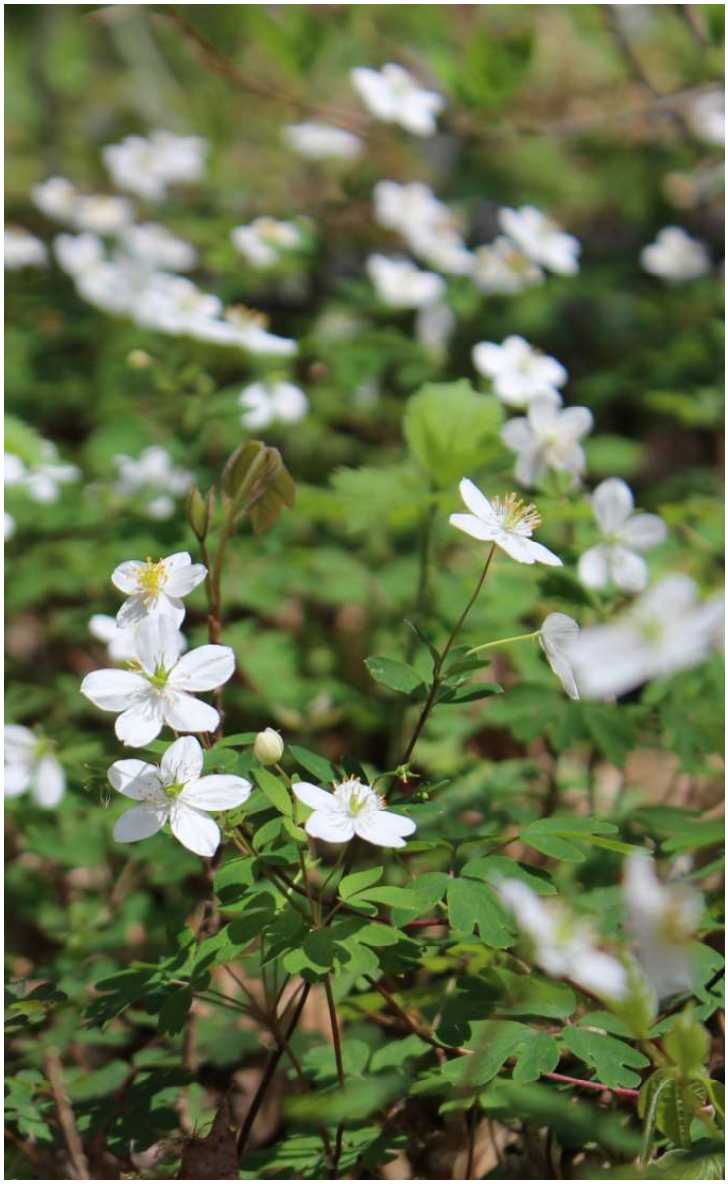
The steep slopes and sandy soils of Ziibiqua Woods contribute to frequent windthrow throughout the forest. Photo by Aaron P. Kortenhoven.

Invasive species are ubiquitous but at low densities. The most problematic species are multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), oriental bittersweet (*Celastrus orbiculatus*), reed canary grass (*Phalaris arundinacea*), and Japanese barberry (*Berberis thunbergii*). Celandine (*Chelidonium majus*) and hedge parsley (*Torilis japonica*) were noted on the margins of the forest and are increasing in abundance across the landscape.

Ziibiqua Woods was visited three times in the 2019 field season. A total of 213 plant species were observed with 197 native species and 16 non-native species recorded. Plant lists were developed for three of the six polygons and a combined list from all three is provided in the appendix. The combined Total FQI is 61.3 and the Total Mean C is 4.2. Conservation metrics for Ziibiqua Woods are available in Appendix 3 and the comprehensive species list is in Appendix 4. The number of native species and the Total FQI are especially high for the community type. It is the highest documented FQI of any dry-mesic southern forest within a state game area.

Threats and Management Recommendations

The primary threats to the Ziibiqua Woods dry southern forest are habitat fragmentation, invasive species, deer herbivory, fire suppression. Our primary management recommendations are to prevent logging within the EO and provide a 150 ft buffer around the forest where intensive silvicultural actions such as clearcutting are prevented. We recommend treating invasive species, especially multiflora rose, Japanese barberry, and oriental bittersweet. We also recommend applying prescribed fire at a rate of one to two burns per decade and reducing deer densities to mitigate impacts of herbivory.



False rue-anemone (*Enemion biternatum*) grows along the river. Photo by Jesse M. Lincoln.

Three populations of broad-leaved puccoon (*Lithospermum latifolium*, State Special Concern) were documented within Ziibiqua Woods. Photo by Nathan Martineau.

Red oak is a dominant canopy species throughout Ziibiqua Woods. Photo by Jesse M. Lincoln.

3. Fallass Wet Meadow
Natural Community Type: Southern Wet Meadow
Rank: G4 S3, apparently secure globally and vulnerable within the state
Element Occurrence Rank: C
Size: 3.5 acres
Location: Compartment 2; Stand 57
Element Occurrence Identification Number: 23908 (New)

The Fallass family settled nearby, and several members of the family had an affinity for botanical pursuits, providing several collections to the University of Michigan Herbarium in the late 1800s. These contributions by the Fallass family, under the tutelage of Emma Cole, substantially helped the understanding of the flora of Michigan (Crow 2017). This meadow was named in their honor.

This is an unusual meadow along the river. It occurs on a flat terrace above the annual flood line at the same level as the surrounding upland forest and appears to be fed by constant seepage of ground water from the nearby moraine. Sapric peats are 50 cm deep over nearly impenetrable gravel, both with a pH of 8.0. In the eastern opening, the peat was over 1 m deep. Where groundwater discharge is most substantial, the peat forms domes of perched, quaking mats of organic matter held together by a dense network of roots.

The constant seepage from surrounding uplands limits encroachments of trees and shrubs. Broad-leaved cattail (*Typha latifolia*) and *Carex stricta* are the dominant graminoids but white grass (*Leersia virginica*) and *Carex lacustris* are also locally abundant. Forbs are also abundant with Joe-Pye-weed (*Eutrochium maculatum*), boneset (*Eupatorium perfoliatum*), goldenrods (*Solidago rugosa, S. patula,* and *S. canadensis*), and New England aster (*Symphyotrichum novae-angliae*) being the most dominant.

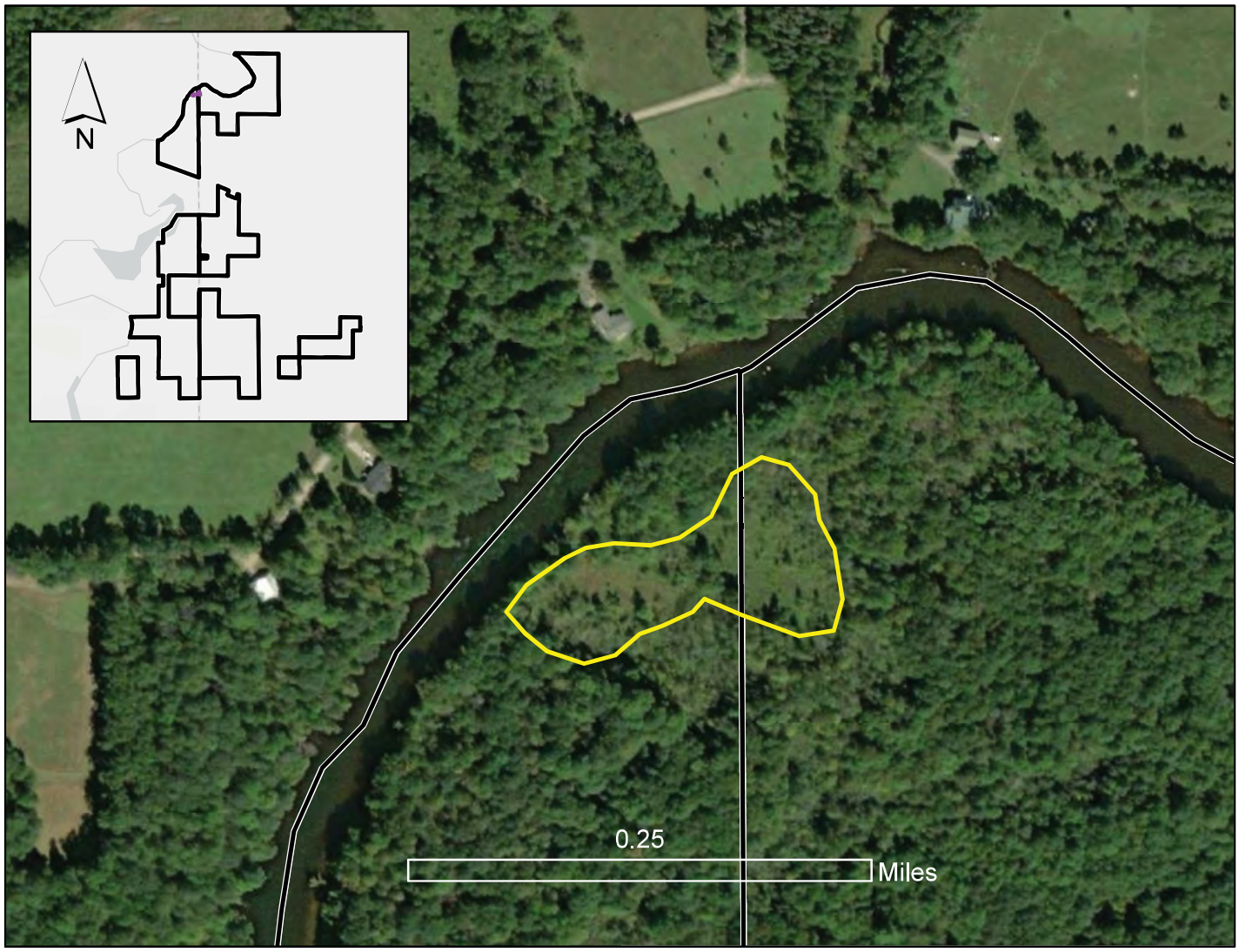
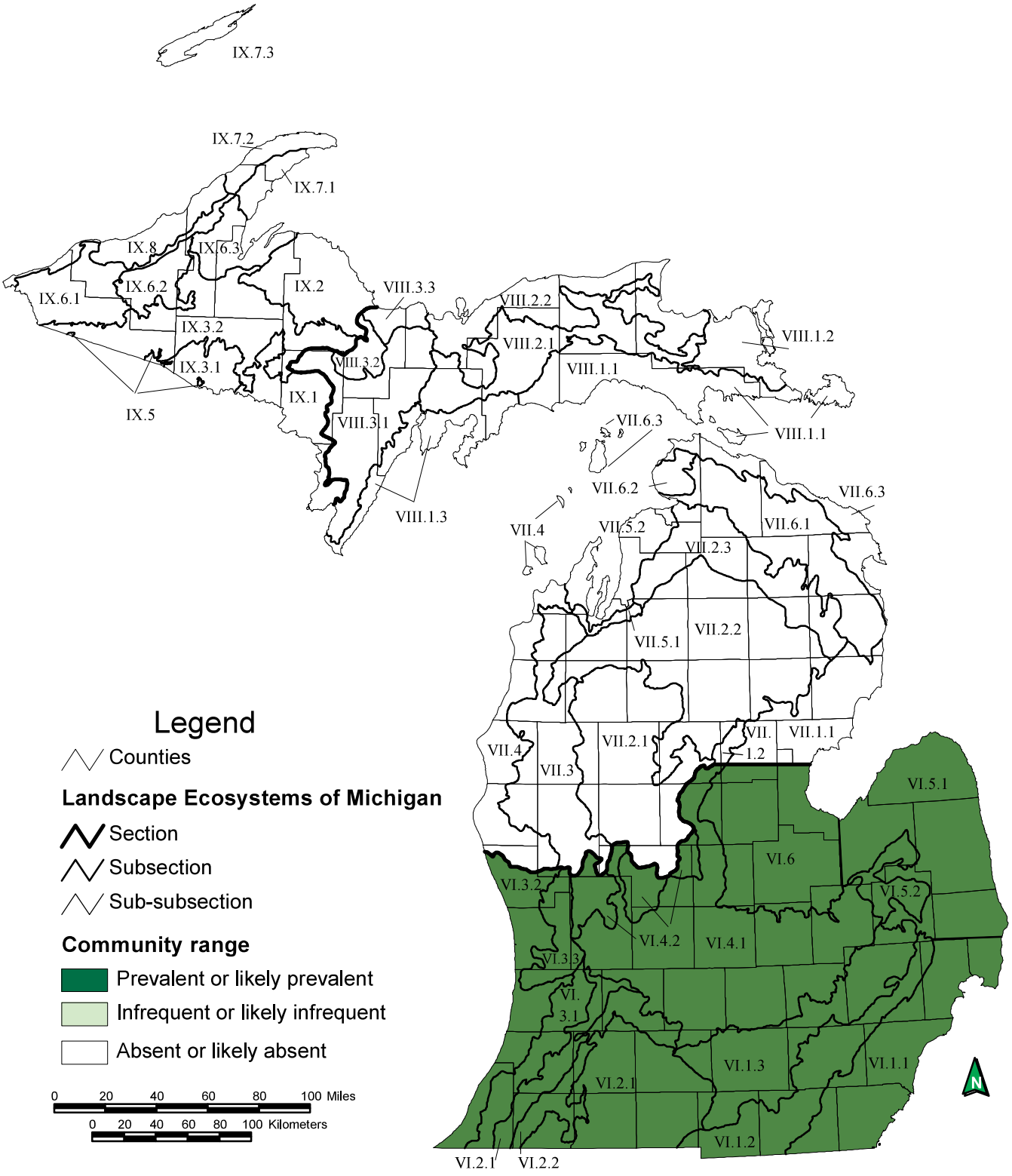


Figure 16. Location of Fallass Wet Meadow southern wet meadow (ESRI 2022).



MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Southern Wet Meadow

Albert, D.A., J.G. Cohen, M.A. Kost, B.S. Slaughter, and H.D. Enander. 2008. Distribution Maps of Michigan's Natural Communities. Michigan Natural Features Inventory, Report No. 2008-01, Lansing, MI. 166 pp.

Figure 17. Statewide distribution of southern wet meadows.

Locally, the State Threatened cut-leaved water parsnip (*Berula erecta*) is abundant where there is standing water and a constant flow of ground water. These seeps also feature duckweed (*Lemna spp.*), an unidentified liverwort, and moss forming at the base of plants. Sensitive fern (*Onoclea sensibilis*) and marsh fern (*Thelypteris palustris*) are both common ferns in the meadow.

Shrubs cover about 30% of Fallass Wet Meadow and are locally quite dense with nannyberry (*Viburnum lentago*) being abundant at the margins and autumn olive (*Elaeagnus umbellata*) being most abundant within the meadow. Silky dogwood (*Cornus amomum*), musclewood (*Carpinus caroliniana*), wild black currant (*Ribes americanum*), spicebush (*Lindera benzoin*), wild red raspberry (*Rubus strigosus*), swamp rose (*Rosa palustris*), and multiflora rose (*Rosa multiflora*) are occasional to infrequent.

Trees occur at the margins of the wet meadow and include quaking aspen (*Populus tremuloides*), bur oak (*Quercus macrocarpa*), basswood (*Tilia americana*), red oak (*Quercus rubra*), black cherry (*Prunus serotina*), red cedar (*Juniperus virginiana*), and sugar maple (*Acer saccharum*). The canopy is essentially absent within the meadow. There are some stunted American elm (*Ulmus americana*), young green ash (*Fraxinus pennsylvanica*), and some small bur oak within the meadow. A 15.7 cm dbh bur oak had 50 rings observed. A 22.6 cm dbh eastern red cedar had 110 rings observed. There is abundant dead green ash at the margins of the meadow. The most problematic invasive species are autumn olive and multiflora rose. Reed canary grass (*Phalaris arundinacea*) and narrow-leaved cat-tail (*Typha angustifolia*) are frequent on the landscape and both pose serious risk to the integrity of the site.

Fallass Wet Meadow was visited once during the 2020 field season. A total of 54 plant species were observed with 49 native species and 5 non-native species. The Total FQI is 28.7 and the Total Mean C is 3.9. Conservation metrics for Fallass Wet Meadow are available in Appendix 5 and the species list is in Appendix 6.

Threats and Management Recommendations
The primary threats to Fallass Wet Meadow are invasive species and alterations to hydrology. Our primary management recommendation is to treat invasive species, especially autumn olive and multiflora rose. We also recommend avoiding logging surrounding stands and preventing heavy equipment from entering a buffer of 150 ft of the meadow to avoid damaging sensitive, saturated soils.

Fallass Wet Meadow is dominated by broad-leaved cat-tail, tussock sedge, and joe-pye-weed. It is a small wet meadow where a constant flow of groundwater prevents encroachment by trees and shrubs. Photo by Jesse M. Lincoln.


Cut-leaved water parsnip (left) is a State Threatened species found in Fallass Wet Meadow around areas of constant groundwater seepage. Joe-pye-weed is locally dominant in the meadow (right). Photos by Jesse M. Lincoln

Some stunted trees occur in the meadow. This small bur oak had a diameter of 16 cm and was over 50 years old. Photo by Jesse M. Lincoln.

Rare Plants

Prior to the MiFI surveys there was one existing rare plant EO for broad-leaved puccoon (*Lithospermum latifolium*, State Special Concern) in Stand 20 of Compartment 2 and a historic record of cut-leaved water parsnip (*Berula erecta*, State Threatened) from the Fallasburg Park area adjacent to the game area. Additional rare species were opportunistically documented within the game area during MiFI vegetation surveys of 2015 and natural community evaluations of 2019 and 2020. These include two additional populations of broad-leaved puccoon were documented and a new occurrence of cut-leaved water-parsnip (Table 5, Figure 18). In 2006, the broad-leaved puccoon record (EOID 16257, in Compartment 1, Stand 20) had 89 clumps with 358 stems. In 2019, the same population had 39 clumps with about 150 stems. There were 5 clumps and 20 stems observed in 2015 for EO 23910 and approximately 300 stems observed in EO 23940 in 2020. There were approximately 200 cut-leaved water parsley observed in Fallass Wet Meadow in 2020. The species was first documented from this part of Kent County in 1893 with vague locational information. It had not been documented again until the MNFI surveys of the game area. Another rare plant that has historically been documented nearby is hemlock-parsley (*Conioselinum chinense*, State Threatened). It grows in areas of seepage along streams and rivers and may occur in the game area.

Table 5. Rare plant element occurrences within Saranac-Lowell State Game Area or nearby. Status abbreviations are as follows: T, state threatened; SC, species of special concern. EO rank abbreviations are as follows: B, good estimated viability; BC, good to fair estimated viability; CD, fair to poor estimated viability; and H, historic record.

Scientific Name	Common Name	EOID	State Status	Rank	Last Observed Date	Compartment	Stand
*Berula erecta**	cut-leaved water parsnip	1150	T	B	2020	2	57
Draba reptans	creeping whitlow grass	2558	T	H	1886	found just outside game area	
Lithospermum latifolium	broad-leaved puccoon	16257	SC	B	2019	1	20
*Lithospermum latifolium**	broad-leaved puccoon	23910	SC	CD	2015	2	36
*Lithospermum latifolium**	broad-leaved puccoon	23940	SC	BC	2020	2	20

** denotes populations that were found during MNFI surveys*

A population of creeping whitlow grass (*Draba reptans*; State Threatened) was documented near the game area in 1886 by pioneer botanist, Charles W. Fallass, and has not been found in the area since his collection.
Photo by Bradford Slaughter.

A population of cut-leaved water parsnip (*Berula erecta,* State Threatened) was documented near the game area in 1893 by famed Grand Rapids botanist Emma Cole. A new population within the game area was documented during the natural community surveys in 2020.
Photo by Nathan Martineau.

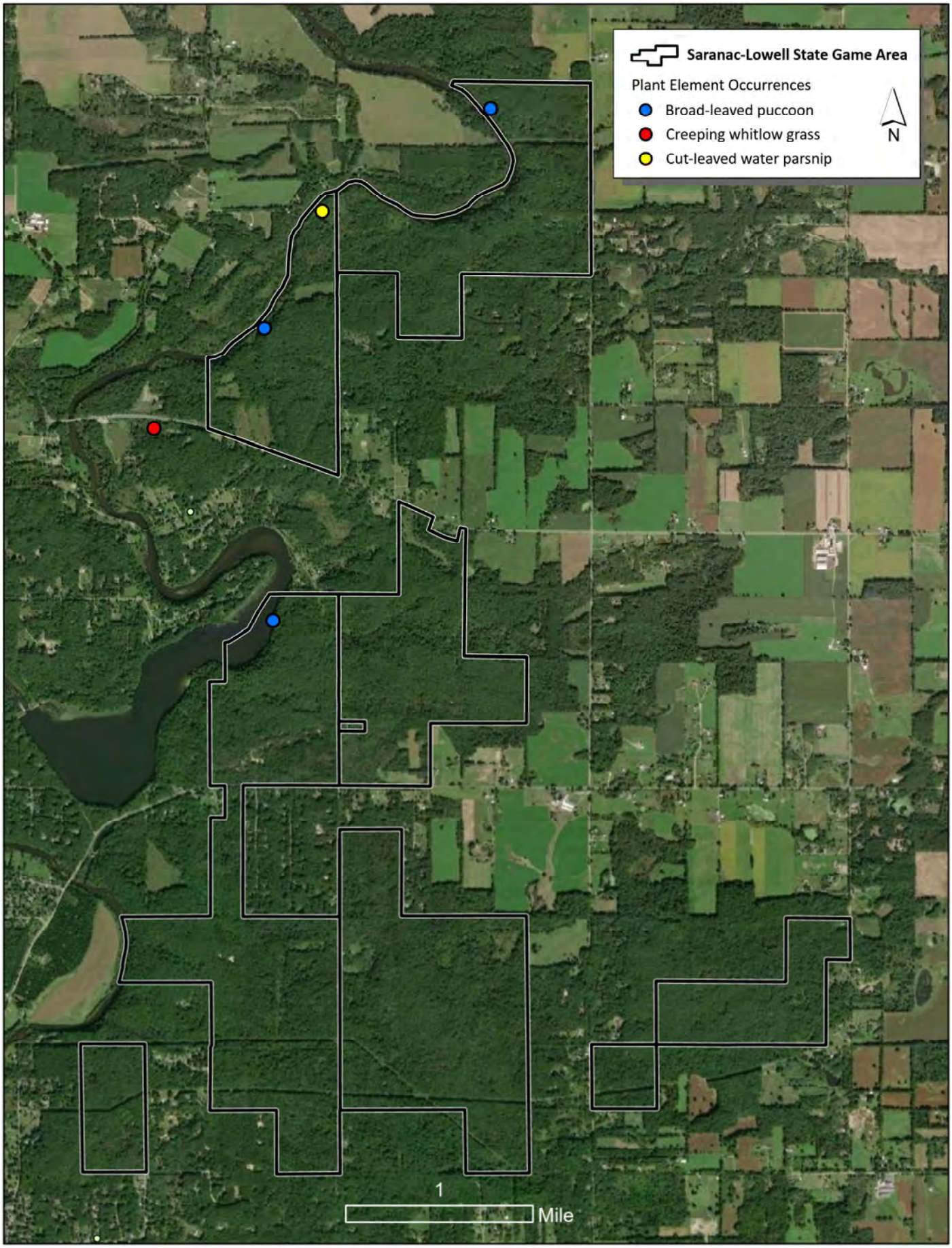


Figure 18. Location of rare plant element occurrences in Saranac-Lowell State Game Area and nearby.

Rare Birds

We completed rare raptor surveys at 34 points within the game area (Figure 7, pg 14). Red-shouldered hawks (RSHA) were not detected, and we did not record any active RSHA nests. Forest songbird surveys were conducted at 44 points (Figure 7). Four singing hooded warblers were recorded at 3 survey points. These records were included in an existing hooded warbler element occurrence (EO ID 2327) and this EO has been updated. We recorded one singing Louisiana waterthrush along the Flat River (Figure 19). This Louisiana waterthrush was a new element occurrence (EO ID 25284). Two red-headed woodpeckers were recorded. These birds were entered into our Natural Heritage database as separate element occurrences (EO 25275 and EO 25291) and represent a newly documented bird for the area (Table 6 and Figure 19). Cerulean warblers were first documented in Saranac-Lowell SGA during previous surveys in 2005 and were recorded again in 2019 during natural community surveys. Data from these surveys was used to update the cerulean warbler EO for the game area (EO ID 15885). Many of the rare songbirds were documented in the Ziibiqua Woods Dry-Mesic Southern Forest EO (Figure 14, pg 31).

In 2021 we recorded a total of 54 bird species during point counts at the Saranac-Lowell SGA (Table 7). The eight most detected species were: eastern wood-pewee (*Contopus virens*; 91% of points), red-eyed vireo (*Vireo olivaceus*; 84% of points), tufted titmouse (*Baeolophus bicolor*, 81% of points) northern cardinal (*Cardinalis cardinalis*; 69 % of the points), Acadian flycatcher (*Empidonax virescens*), ovenbird (*Seiurus aurocapilla*), red-bellied woodpecker (*Melanerpes carolinus;* 59% of points) and brown-headed cowbirds (*Molothrus ater*; 56% of points).

Two populations of red-headed woodpeckers (*Melanerpes erythrocephalus*) were documented during the 2021 bird surveys. Photo by Aaron P. Kortenhoven.

Table 6. Rare bird element occurrences and birds of special conservation status found within Saranac-Lowell State Game Area. State status abbreviation are as follows: SC, State Special Concern and T, State Threatened. Rank abbreviations are as follows: D, poor estimated viability and E, verified extant but with insufficient information to rank viability.

Common Name	Scientific Name	EO ID	EO Rank	State Status	Featured Species	SGCN	JV Focal species	Year First Observed	Year Last Observed
Listed Species									
Cerulean warbler	*Setophaga cerulea*	5474	D	T		X	X	2005	2019
Hooded warbler	*Setophaga citrina*	20721	E	SC		X		2015	2021
Hooded warbler	*Setophaga citrina*	15583	E	SC		X		2005	2005
Luoisiana watethrush	*Parkesia motacilla*	25284	E	T		X		2021	2021
Red-headed woodpecker	*Melanerpes erythrocephalus*	25275	E	SC	X	X	X	2021	2021
Red-headed woodpecker	*Melanerpes erythrocephalus*	25291	E	SC	X	X	X	2021	2021
Unlisted Species									
Black-billed cuckoo	*Coccyzus erythropthalmus*				X				2021
Pileated woodpecker	*Dryocopus pileatus*				X				2021
Wood thrush	*Hylocichla mustelina*				X		X		2021

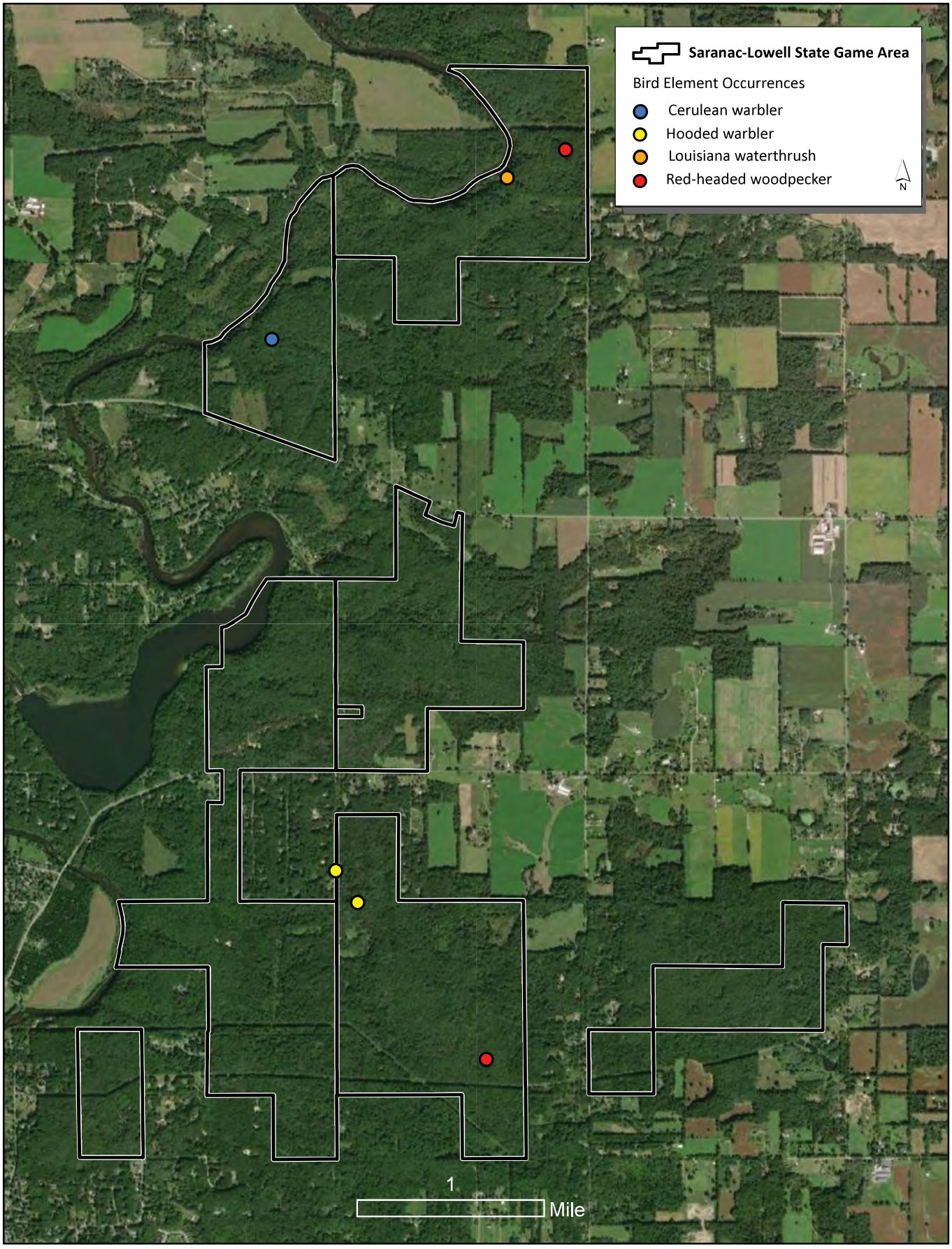


Figure 19. Location of rare bird element occurrences in Saranac-Lowell State Game Area.

The following fifteen species were regularly observed (20-45% of points surveyed): wood thrush (*Hylocichla mustelina*), yellow-billed cuckoo (*Coccyzus americanus*), rose-breasted grosbeak (*Pheucticus ludovicianus*), American redstart (*Setophaga ruticilla*), black-capped chickadee (*Poecile atricapillus*), indigo bunting (*Passerina cyanea*), scarlet tanager (*Piranga olivacea*), yellow-throated vireo (*Vireo flavifrons*), American Goldfinch (*Spinus tristis*), blue jay (*Cyanocitta cristata),* great-crested flycatcher (*Myiarchus crinitus*), American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), Baltimore oriole (*Icterus galbula*) and hairy Woodpecker (*Picoides villosus*). Five (9%) of the species were detected at 10 to 19% of the survey points and 37 species (69%) were detected at less than 10% of the survey points (Table 7).

Several of the bird species detected at Saranac-Lowell SGA have special conservation status (Table 7). Three species, pileated woodpecker (*Dryocopus pileatus*), red-headed woodpecker (*Melanerpes erythrocephalus*), and wood thrush (*Hylocichla mustelina*) are listed as featured species for habitat management by the Wildlife Division of the MDNR. Red-headed woodpecker, wood thrush, hooded warbler, cerulean warbler, and Louisiana waterthrush are also listed as SGCN (Derosier et al. 2015). Four species; cerulean warbler, black-billed cuckoo (*Coccyzus erythropthalmus*), red-headed woodpecker and wood thrush are focal species for conservation efforts under the Landbird Habitat Conservation Strategy (Potter et al. 2007) of the Upper Mississippi River and Great Lakes Region Joint Venture.

Gray cat-bird. Photo by Aaron P. Kortenhoven.

Cerulean warblers have been documented from Ziibiqua Woods in Saranac-Lowell SGA. Photo by Aaron P. Kortenhoven.

Table 8. Bird species documented during surveys of Saranac-Lowell State Game Area.

Common Name	Scientific Name	State Status	Featured Species	SGCN	JV Focal Species	Prop. of Points
Acadian Flycatcher	*Empidonax virescens*					0.59
American Crow	*Corvus brachyrhynchos*					0.13
American Goldfinch	*Spinus tristis*					0.28
American Redstart	*Setophaga ruticilla*					0.38
American Robin	*Turdus migratorius*					0.25
Baltimore Oriole	*Icterus galbula*					0.22
Belted Kingfisher	*Megaceryle alcyon*					0.03
Black-billed Cuckoo	*Coccyzus erythropthalmus*				X	0.06
Black-capped Chickadee	*Poecile atricapillus*					0.38
Blue Jay	*Cyanocitta cristata*					0.28
Blue-gray Gnatcatcher	*Polioptila caerulea*					0.03
Brown Creeper	*Certhia americana*					0.06
Brown Thrasher	*Toxostoma rufum*					0.03
Brown-headed Cowbird	*Molothrus ater*					0.56
Cedar Waxwing	*Bombycilla cedrorum*					0.03
Cerulean Warbler	*Setophaga cerulea*	T		X	X	0.00
Chipping Sparrow	*Spizella passerina*					0.16
Common Yellowthroat	*Geothlypis trichas*					0.06
Downy Woodpecker	*Picoides pubescens*					0.44
Eastern Towhee	*Pipilo erythrophthalmus*					0.09
Eastern Wood-Pewee	*Contopus virens*					0.91
Field Sparrow	*Spizella pusilla*					0.03
Gray Catbird	*Dumetella carolinensis*					0.06
Great-crested Flycatcher	*Myiarchus crinitus*					0.28
Green Heron	*Butorides virescens*					0.03
Hairy Woodpecker	*Picoides villosus*					0.22
Hermit Thrush	*Catharus guttatus*					0.03
Hooded Warbler	*Setophaga citrina*	SC		X		0.06
House Wren	*Troglodytes aedon*					0.09
Indigo Bunting	*Passerina cyanea*					0.34
Louisiana Waterthrush	*Parkesia motacilla*	T		X		0.03
Magnolia Warbler	*Setophaga magnolia*					0.03
Mourning Dove	*Zenaida macroura*					0.06
Mourning Warbler	*Geothlypis philadelphia*					0.03
Northern Cardinal	*Cardinalis cardinalis*					0.69
Ovenbird	*Seiurus aurocapilla*					0.59
Pileated Woodpecker	*Dryocopus pileatus*		X			0.06
Pine Warbler	*Setophaga pinus*					0.03
Red-bellied Woodpecker	*Melanerpes carolinus*					0.59
Red-eyed Vireo	*Vireo olivaceus*					0.84
Red-headed Woodpecker	*Melanerpes erythrocephalus*	SC	X		X	0.06
Red-winged Blackbird	*Agelaius phoeniceus*					0.25
Rose-breasted Grosbeak	*Pheucticus ludovicianus*					0.41
Ruby-throated Hummingbird	*Archilochus colubris*					0.03
Sandhill Crane	*Antigone canadensis*					0.06
Scarlet Tanager	*Piranga olivacea*					0.34
Song Sparrow	*Melospiza melodia*					0.06
Tufted Titmouse	*Baeolophus bicolor*					0.81
White-breasted Nuthatch	*Sitta carolinensis*					0.19
Wood Thrush	*Hylocichla mustelina*				X	0.44
Yellow Warbler	*Setophaga petechia*					0.13
Yellow-billed Cuckoo	*Coccyzus americanus*					0.44
Yellow-throated vireo	*Vireo flavifrons*					0.31
Yellow-throated Vireo	*Vireo flavifrons*					0.13

Rare Mussels

We documented five new mussel species EOs within Saranac-Lowell SGA, including elktoe (*Alasmidonta marginata*, State Special Concern), rainbow (*Cambarunio (Villosa) iris*, State Special Concern) creek helsplitter (*Lasmigona compressa*, State Special Concern), flutedshell (*Lasmigona costata*, State Special Concern), and ellipse (*Venustaconcha ellipsiformis*, State Special Concern) (Table 8). Aquatic surveys were performed at three sites in the Flat River within Saranac-Lowell SGA (Figure 20).

Conditions for performing aquatic surveys were favorable with high water clarity and wadable habitat. A total of eight unionid mussel species were found including the five species of special concern (Table 9). These five species are also species of greatest conservation need (SGCN). Of the eight species recorded only ellipse (*Venustaconcha ellipsiformis*) and Wabash pigtoe (*Fusconaia flava*) were represented by live individuals. The rest were represented by shell only.

A shell midden was found at Site 2 in shallow water near the edge of the riverbank. The one live Wabash pigtoe found there had scratch marks on the outside of the shell that appeared to be from a predator, likely a muskrat. Nearly all the shells found in the midden were in good condition indicating predation had occurred recently (i.e., within several weeks).

Live zebra mussels (*Dreissena polymorpha*) and Asian clams (*Corbicula fluminea*) are present in the Flat River within Saranac-Lowell SGA. Live zebra mussels were found attached to empty shells of native mussels including ellipse. Aquatic snail species (Gastropoda) were noted at all three sites and Fingernail clams (Sphaeriidae) were observed at one of the sites. Johnny darter (*Etheostoma nigrum*), one of the fish species known to act as a host for ellipse and northern hogsucker (*Hypentelium nigricans*) a species known to be a host for elktoe and flutedshell were observed during mussel surveys at Site 1.

Ellipse (*Venustaconcha ellipsiformis*, left), a species of special concern and SGCN found at aquatic survey Site 3 and Johnny darter (*Etheostoma nigrum*, right), a species known to be a suitable host for ellipse and rainbow (*Cambarunio iris*) observed at aquatic survey Site 1. Photos by Peter J. Badra.

Table 8. Rare mussel element occurrences documented within Saranac-Lowell State Game Area during 2021 surveys. Status abbreviations are as follows: SC, State Special Concern. Element occurrence rank abbreviation E = verified extant.

Common Name	Scientific Name	State Status	EO ID	EO Rank	Year First Observed	Year Last Observed	Survey Site #
Elktoe	*Alasmidonta marginata*	SC	25482 (new)	E	2021	2021	Site 1
Elktoe	*Alasmidonta marginata*	SC	25505 (new)	E	2021	2021	Site 2
Rainbow	*Cambarunio iris*	SC	25506 (new)	E	2021	2021	Site 2
Creek heelsplitter	*Lasmigona compressa*	SC	25507 (new)	E	2021	2021	Site 2
Flutedshell	*Lasmigona costata*	SC	25500 (new)	E	2021	2021	Site 1
Ellipse	*Venustaconcha ellipsiformis*	SC	25504 (new)	E	2021	2021	Site 1
Ellipse	*Venustaconcha ellipsiformis*	SC	25508 (new)	E	2021	2021	Site 2
Ellipse	*Venustaconcha ellipsiformis*	SC	25509 (new)	E	2021	2021	Site 3

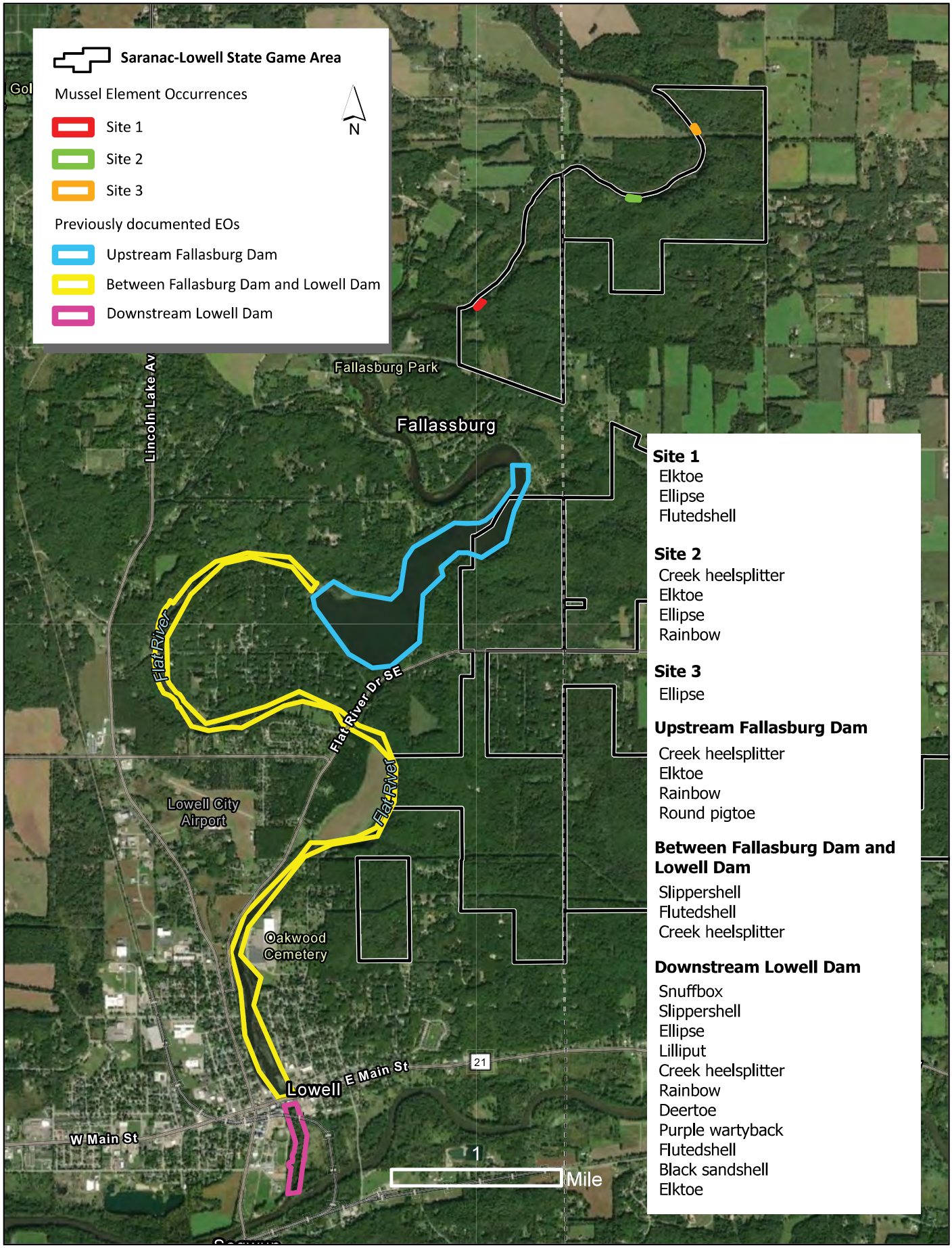


Figure 20. Location of rare mussel element occurrences in Saranac-Lowell State Game Area.

Table 9. Unionid mussel species found at each aquatic survey site. Numbers of live unionid mussels (#) given and number shells of rare species are given in parentheses (S(#)) if only shells were found at a site. Presence/absence of non-native bivalves is noted. (SC= State Special Concern).

		1	2	3
Common name	Species	#	#	#
Elktoe (SC)	*Alasmidonta marginata*	S(1)	S(5)	
Rainbow (SC)	*Cambarunio iris*		S(4)	
Spike	*Eurynia dilatata*	S	S	S
Wabash pigtoe	*Fusconaia flava*	S	1	S
Plain pocketbook	*Lampsilis cardium*	S	S	
Creek heelsplitter (SC)	*Lasmigona compressa*		S(2)	
Flutedshell (SC)	*Lasmigona costata*	S(8)		
Ellipse (SC)	*Venustaconcha ellipsiformis*	S(11)	S(66)	1
	# species live	0	1	1
	# species live or shell	6	7	3
	Area searched (m^2)	56	60	100
Asian clams	*Corbicula fluminea*		L	
Zebra mussels	*Dreissena polymorpha*	L		L*

* Live zebra mussels were attached to an empty ellipse shell

Table 10. Incidental finds at aquatic survey sites, including aquatic snails and limpets (Gastropoda), fingernail clams (Sphaeriidae), and fish.

Common Name	Species/Taxa	1	2	3
Snails	Gastropoda			
Pointed campeloma	*Campeloma decisum*	X		X
Liver elimia	*Elimia livescens*	X	X	X
Two-ridge rams-horn	*Helisoma anceps*		X	
Blunt ambersnail	*Oxyloma retusum*		X	
Tadpole physa	*Physella gyrina*			X
Striped whitelip snail	*Webbhelix multilineata*	X	X	
Freshwater limpet	Gastropoda			
Creeping ancylid	*Ferrissia rivularis*		X	
Fingernail clams	Sphaeriidae			X
Fish	Osteichthyes			
Johnny darter	*Etheostoma nigrum*	X		
Northern hogsucker	*Hypentelium nigricans*	X		

A live zebra mussel (*Dreissena polymorpha*) attached to the shell of an ellipse (*Venustaconcha ellipsiformis*) at aquatic survey Site 3. Photo by Peter J. Badra.

A live ellipse (*Venustaconcha ellipsiformis*) at aquatic survey Site 3. A relatively silt-free substrate of sand, gravel, pebble, and other large size particles provides high-quality habitat for this State Special Concern species and species of greatest conservation need. Photo by Peter J. Badra.

Rare Reptiles and Amphibians

Seven eastern box turtles were found in the northwest portion of the game area during the 2021 surveys, of which six were found on one day in two small, open upland stands comprised of old agricultural fields. The six adult box turtles were found in Stand 29 of Compartment 2 on July 16. These turtles consisted of three males, two females, and one turtle whose sex was undetermined. An adult male box turtle was found in one of the same stands on September 24. These turtles were found in abandoned agricultural fields and ranged in age from 14 to over 20 years old based on visible annuli (rings) on the turtles' carapace or plastron. At least 25 observations of eastern box turtles have been documented throughout the game area and on adjacent or nearby private lands since 2002 (Michigan Herp Atlas 2019, MNFI 2022). These observations updated and filled in a distribution gap for an existing eastern box turtle element occurrence in the Natural Heritage Database for the Saranac-Lowell SGA (EO ID 4675).

Additionally, we found two turtle nests with eggshells in one of the old agricultural fields which may be box turtle nests but this was not confirmed. This population of box turtles has been estimated to have excellent to good viability given the number and distribution of observations and extended history of occurrence within and around the Saranac-Lowell SGA (Michigan Herp Atlas 2019; MNFI 2022); long-lived nature of eastern box turtles (i.e., typically at least 40-50 years; Harding and Mifsud 2017); extensive available habitat for this species in the game area; and protected nature of the game area (MNFI 2022). This was the only rare species documented during MNFI amphibian and reptile surveys in the Saranac-Lowell SGA in 2021. One SGCN reptile species, and seven common amphibian and reptile species were also documented (Table 12, Figure 21, Appendix 7).

A blue racer (*Coluber constrictor foxii*, SGCN) was found in one of the old agricultural fields in which the box turtles were observed. Additional amphibian and reptile species detected during herptile surveys in 2021 included the northern spring peeper (*Pseudacris crucifer crucifer*), gray treefrog (*Hyla versicolor*), eastern American toad (*Anaxyrus americanus americanus*), wood frog (*Lithobates sylvaticus*), eastern red-backed salamander (*Plethodon cinereus*), eastern gartersnake (*Thamnophis sirtalis sirtalis*), and eastern hog-nosed snake (*Heterodon platirhinos*) (Appendix 7).

Box turtles found during reptile surveys of Saranac-Lowell State Game Area. Photos by Yu Man Lee.

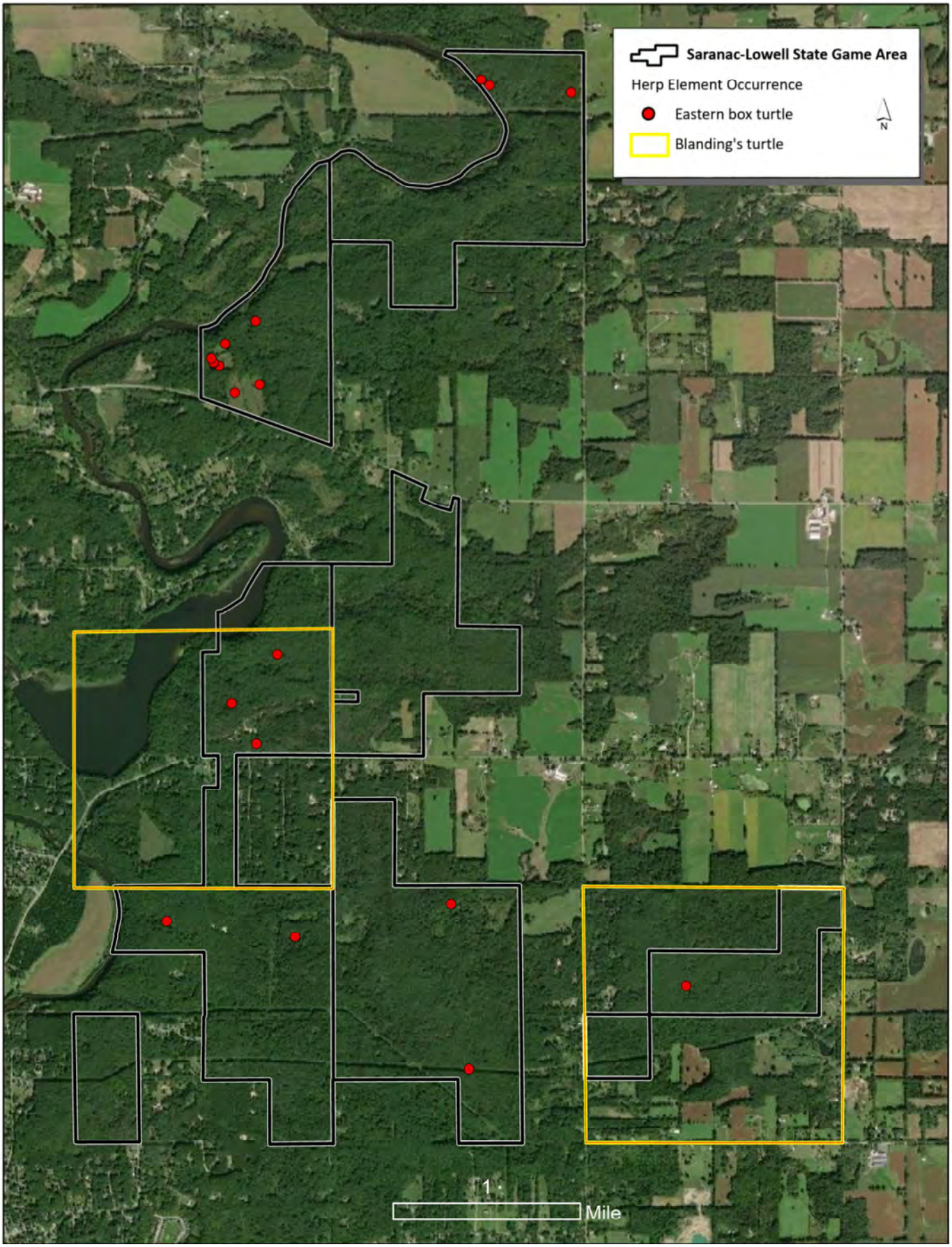


Figure 21. Location of rare reptile element occurrences in Saranac-Lowell State Game Area and nearby.

Although MNFI herptile surveys did not detect Blanding's turtles in the game area, there are vague reports of the species from the area recorded in the Michigan Herp Atlas (2019; MNFI 2022). It is not clear where the Blanding's turtles were observed, but potential habitat exists especially along the river (Harding and Mifsud 2017). Blanding's turtle is a semi-aquatic species, spending most of the year in wetland or aquatic habitats but also occurring in upland or terrestrial habitats (Harding and Mifsud 2017). The Blanding's turtle observations updated and expanded an existing element occurrence (EO 24655) in the area.

Additional Michigan Herp Atlas observations of rare herptiles have been documented within or near the Saranac-Lowell State Game Area (Michigan Herp Atlas 2019). These include 15 observations of eastern box turtles from 2005-2018 from four sections and 2 observations of Blanding's turtles from 2007 and 2015 from two sections that include or are adjacent to the game area. Given the small number of observations of this species in this area to date; long-lived nature of this species (50+ years); limited wetland and aquatic habitats except for Flat River; protected nature of this site; surrounding landscape comprised of agricultural and residential development and roads; and potential threats, this population of Blanding's turtle was estimated to have good to fair viability (Table 12; MNFI 2022).

Three observations of Blanchard's cricket frogs were documented southwest of the game area, adjacent to the site of an existing element occurrence (EO ID 19911). A Fowler's toad was documented west of the game area in 1996 which represented a new element occurrence for this species (EO 25485). Potential exists for these two species to occur in the Saranac-Lowell SGA given the proximity of these observations, but the potential may be low given limited availability of suitable habitat for these species within the game area.

Table 11. Rare reptile element occurrences within Saranac-Lowell State Game Area and nearby. State and federal status abbreviations are as follows: SC – State Special Concern. EO rank abbreviations are as follows: AB – excellent to good estimated viability; BC – good to fair estimated viability. The Blanding's turtle EO includes observations from Michigan Herp Atlas in two sections which contain portions of the game area. It is unclear from available data if the Blanding's turtles were actually found within the game area but potential exists for the species to occur within these areas.

Common Name	Scientific Name	State Status	EO ID	EO Rank	Year First Observed	Year Last Observed
Eastern box turtle	*Terrapene carolina carolina*	SC	4675	AB	2002	2021
Blanding's turtle	*Emydoidea blandingii*	SC	25485	BC	2007	2021

Two box turtles observed during surveys. Left photo by Jesse M. Lincoln, Right Photo by Ashley Cole-Wick.

Rare Insects

Four types of rare insect surveys were conducted targeting butterflies and spittlebugs; odonates; regal fern borer; and bumble bees (Table 3, Page 22). During surveys we recorded 27 butterfly species (Table 12) but did not encounter any rare butterfly species. We documented monarch butterflies, a SGCN, at four out of nine sites. We did not encounter any monarchs in oak savanna where the canopy was closed in, such as Compartment 1; Stands 30 and 32.

None of the five stands we surveyed for lupine feeders (Karner blue, frosted elfin, dusted skipper, Persius duskywing) currently support an abundance of wild lupine that would justify future surveys for the suite of rare lepidopterans. Due to the late season timing of our surveys, we did not encounter all potential butterfly species that inhabit these natural areas and follow up surveys could focus on mottled duskywings in Compartment 1, Stand 32 and Compartment 2, Stand 4.

Two of the three sites surveyed for Great Plains spittlebug had ample populations of host plants: little bluestem (*Schizachyrium scoparium*) and big bluestem (*Andropogon gerardii*) but we did not encounter any rare species. We documented one common spittlebug (*Lepyronia quadrangularis*) in Compartment 2; Stand 11.

Table 12. Locations of unlisted, non-target species of insects encountered during insect surveys.

		Compartment 1		Compartment 2						
	Stand	30	32	2	4	11	26	41	42	51
SWALLOWTAILS	**PAPILIONIDAE**									
Giant Swallowtail	*Papilio cresphontes*					X		X	X	X
Eastern Tiger Swallowtail	*Papilio glaucus*							X	X	
Black Swallowtail	*Papilio polyxenes*							X	X	
Spicebush Swallowtail	*Papilio troilus*					X				
WHITES & SULPHURS	**PIERIDAE**									
Clouded Sulphur	*Colias philodice*			X		X	X			
Cabbage White	*Pieris rapae*						X	X	X	
COPPERS, BLUES, HAIRSTREAKS	**LYCANIDAE**									
Summer Azure	*Celastrina neglecta*					X		X	X	
Eastern Tailed Blue	*Cupido comyntas*					X				
American Copper	*Lycaena phlaeas*						X			
Edwards' Hairstreak	*Satyrium edwardsii*					X				
Gray Hairstreak	*Strymon melinus humuli*					X				
BRUSHFOOTS	**NYMPHALIDAE**									
Monarch	*Danaus plexippus*					X	X	X	X	
Buckeye	*Junonia coenia*							X	X	
Red Spotted Purple	*Limenitis arthemis astyanax*						X	X		
Mourning cloak	*Nymphalis antiopa*				X					
Pearl Crescent	*Phyciodes tharos*					X		X	X	
Eastern Comma	*Polygonia comma*								X	
Great Spangled Fritillary	*Speyeria cybele*						X	X	X	
Painted lady	*Vanessa cardui*			X						
American Painted Lady	*Vanessa virginiensis*			X						
Red Admiral	*Vanessa atalanta*			X			X			
SATYRS & BROWNS	**SATYRINAE**									
Northern Pearly Eye	*Enodia anthedon*	X	X							
Appalachian Brown	*Satyrodes appalachia*							X	X	
Little Wood Satyr	*Megisto cymela*								X	
SKIPPERS	**HESPERIIDAE**									
Roadside Skipper	*Amblyscirtes vialis*		X							
Least Skipper	*Ancyloxpha numitor*			X						
Silver Spotted Skipper	*Epargyreus clarus*				X	X		X	X	

No rare odonates were captured or observed during surveys, nor did we document any species closely related to the rare species for which we were surveying (e.g., species in the genus *Ophiogomphus* or *Stylurus*). The most frequently encountered species were bluets (*Enallagma* spp.) (seven locations) and the American rubyspot (*Hetaerina americana*) (six locations).

Saranac-Lowell SGA contains suitable habitat for the rare odonate species we surveyed for and we recommend continuing surveys along the Flat River and its headwater streams. Surveys for the three *Stylurus* snaketails were well-timed, however a failure to find these species in three survey days does not confirm their absence. Our surveys missed the ideal time frame for adult flight of pygmy snaketail (*Ophiogomphus howei*).

We did not capture any regal fern borer or other species of *Papaipema* during this survey. The survey location had minimal availability of royal fern host plant, and likely did not contain enough host plants to sustain insect populations.

We documented a total of 141 occurrences of 7 bumble bee species during the two-hour survey, including new records of black and gold bumble bee (*Bombus auricomus*, State Special Concern, EO 24526) and Sanderson's bumble bee (*B. sandersoni*, State Special Concern, EO24527) at Saranac-Lowell SGA (Figure 22). At the site selected for bumble bee surveys, we encountered a total of 14 blooming wildflower species during the survey including yarrow (*Achillea millefolium*), butterfly-weed (*Asclepias tuberosa*), shepherd's-purse (*Capsella bursa-pastoris*), spotted knapweed (*Centaurea stoebe*), daisy fleabane (*Erigeron annuus*), flowering spurge (*Euphorbia corollata*), common St. John's-wort (*Hypericum perforatum*), wild-bergamot (*Monarda fistulosa*), horse mint (*Monarda punctata*), black-eyed Susan (*Rudbeckia hirta*), horse-nettle (*Solanum carolinense*), early goldenrod (*Solidago juncea*), mullein (*Verbascum thapsus*), and hairy vetch (*Vicia vilosa*). Bumble bees at the survey site were primarily utilizing spotted knapweed and wild-bergamot (Table 13).

New records for black and gold bumble bee (above) and Sanderson's bumble bee were recorded during standardized meander surveys. Photo by Logan Rowe.

Table 13. Bumble bee species and associated plant species observed during meander surveys at Saranac-Lowell State Game Area in 2021. During this survey, we documented 2 occurrences of black and gold bumble bee (*B. auricomus**, State Special Concern) on hairy vetch (*Vicia villosa*) and a single occurrence of Sanderson's bumble bee (*B. sandersoni**, State Special Concern) on spotted knapweed (*Centaurea stoebe*).

Species	*Achillea millefolium*	*Centaurea stoebe*	*Hypericum perforatum*	*Monarda fistulosa*	*Vicia villosa*	Total
*Bombus auricomus**	0	0	0	0	2	***2***
Bombus bimaculatus	1	7	1	65	0	***74***
Bombus citrinus	0	0	0	1	0	***1***
Bombus griseocollis	0	2	0	7	0	***9***
Bombus impatiens	0	14	0	18	0	***32***
*Bombus sandersoni**	0	1	0	0	0	***1***
Bombus vagans	0	5	1	11	5	***22***
Total	***1***	***29***	***2***	***102***	***7***	**141**

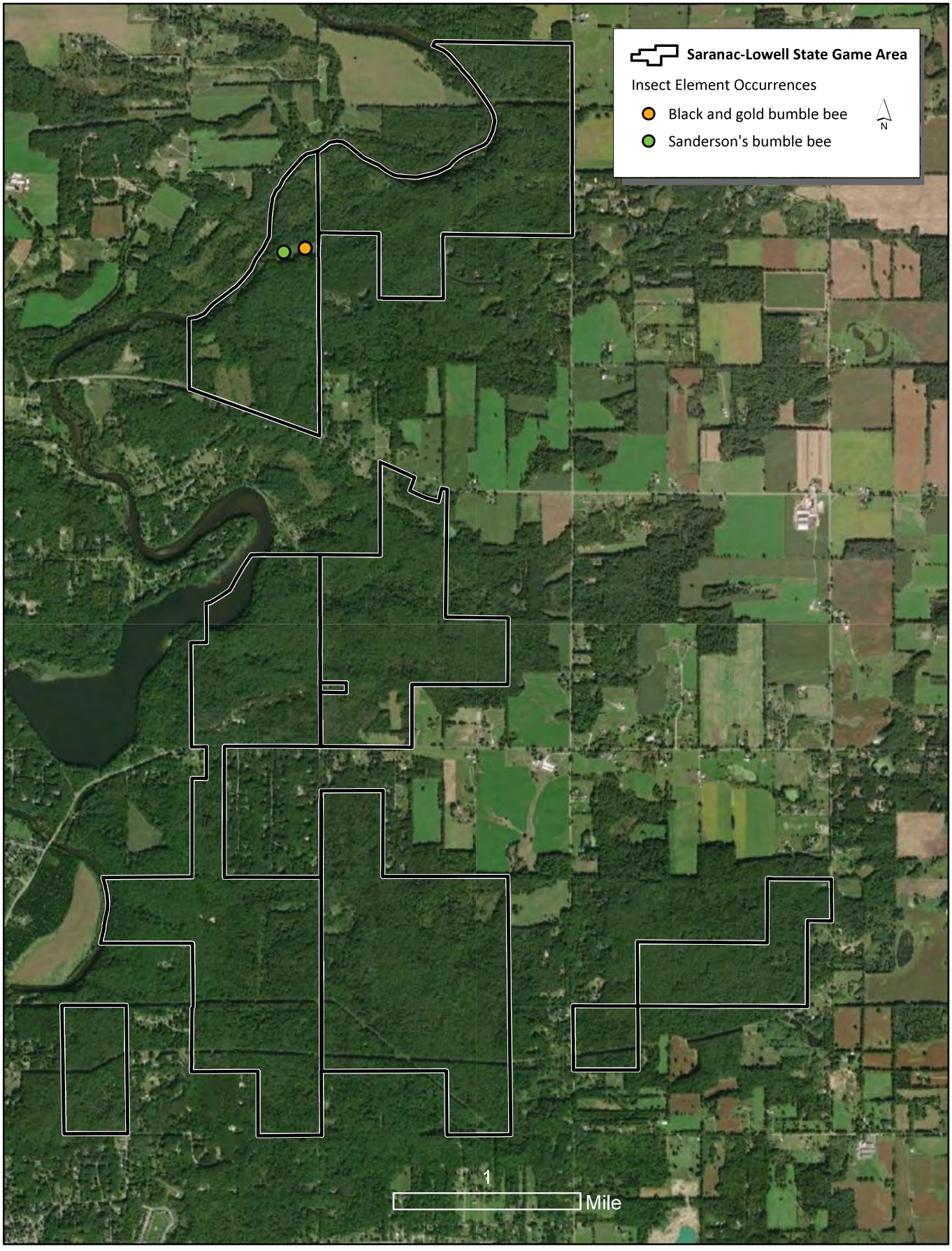


Figure 22. Location of rare insect element occurrences in Saranac-Lowell State Game Area.

Discussion

As stated within the DNR's Master Plan for Saranac-Lowell State Game Area, this public land was acquired by the State of Michigan to preserve and improve natural habitat for wildlife as urbanization, industrialization, and intensive farming are contributing to the destruction of such habitats. The game area occurs in one of the most rapidly developing economic regions in the country and offers a large variety of recreational opportunities including hunting, fishing, and non-consumptive uses. "The scenic landscape and various historic sites are highly attractive to picnickers, hikers, and photographers. Habitat management programs and other resource management practices will insure the continuation of these recreational values" (Lowell State Game Area Master Plan 1977). Our report and management recommendations for the Saranac-Lowell SGA are intended to inform decisions around meeting those stated objectives, particularly the stewardship of natural habitat for rare wildlife.

According to the most recent plan for the game area, "The primary management goal of the Saranac-Lowell Strategic Plan is to provide quality wildlife habitat for a variety of forest dwelling species through the development and maintenance of a healthy, productive, and diverse forest. This will be accomplished by managing for the long-term sustainability of the following systems where appropriate: oak-hickory forest, oak savanna, early-successional aspen forest, and lowland hardwoods".

This summary of the natural features of the game area can support the goals of the DNR's strategic plan by identifying areas to favor stewardship of high-quality diverse forests by applying prescribed fire or preventing additional forest fragmentation. We also provide justification for targeting specific areas for oak savanna restoration.

Ziibiqua Woods is one of the most species-rich examples of a dry-mesic southern forest and supports populations of rare plants and animals. Photo by Jesse M. Lincoln.

Protecting and managing representative natural communities is critical to biodiversity conservation because native organisms are best adapted to environmental and biotic forces with which they have survived and evolved over millennia. Biodiversity is most easily and effectively protected by preventing high-quality sites from degrading, and invasive plants are much easier to eradicate when their populations are small and not yet well-established. Stewardship actions within the game area should focus on the highest quality examples of the rarest natural community types and the largest sites. Generally, we recommend that management efforts to maintain ecological integrity and native biodiversity be focused in natural communities that provide potential habitat for numerous rare plant and animal species. To that end, we provide the following management recommendations for your consideration.

We believe the main management needs in order of importance are to: 1) minimize forest fragmentation along the river and around priority high-quality natural communities identified in this report; 2) implement prescribed fire in oak-dominated forests and areas identified as having potential to recover oak savanna habitat; 3) implement restoration efforts in areas identified as historic and recoverable oak savanna; 4) control invasive species within high-quality natural communities and opportunistically when resources allow; 5) actively protect populations of herptiles; 6) investigate improving aquatic connectivity along the Flat River; and 7) monitor these activities to facilitate adaptive management.

Fundamentally, our primary recommendations are to minimize fragmentation of the highest quality forests, return fire to the landscape, attempt to address the most pernicious invasive species, and protect populations of box turtles. The following discussion section has been organized around these management recommendations. In addition, based on our experience researching and surveying this game area, we provide recommendations for future survey needs.

Many of the oak-dominated forests that characterize Saranac-Lowell are fire-suppressed with red maple dominating the subcanopy and a diminished herbaceous layer. Photo by Aaron P. Kortenhoven.

Habitat Fragmentation

Many of the forests within the game area were logged and then cleared for agriculture. When the farms failed, the land was transferred to state ownership. The highest quality forests remaining in the game area correspond to areas that were partially cleared but not converted into agriculture. Based on the age of trees and the pattern of European colonization in the area, the forests at Saranac-Lowell SGA were logged in the late 1800s but the forests identified in this report as natural communities escaped intensive land clearing. Because they were spared intensive clearing, the forests tend to reflect historic conditions to a remarkable degree: they have the lowest proportion of invasive species; the oldest trees; and the greatest concentration of rare taxa. The Ziibiqua Woods dry-mesic southern EO is an especially diverse example of the community type with 199 native species observed during the natural community surveys, more than any other documented dry-mesic southern forest within a state game area. The plant diversity of the Ziibiqua Woods can be partially attributed to the forests land use history. In contrast, forests that were logged, cleared, farmed, and then reverted to forest are floristically depauperate in comparison.

These high-quality forests tend to persist on the steepest slopes along the Flat River where agriculture would have been unfeasible. The structure and processes of riparian ecosystems are influenced by their interface with adjacent terrestrial ecosystems (Tepley et al. 2004). Consequently, water quality of the Flat River is locally dependent, in part, on maintaining the forests along its slopes. Further, the biodiversity refugia potential of riparian corridors within fragmented landscapes can be predicted based on width and contiguity of the natural cover (Goforth et al. 2002). Wider, more contiguous riparian corridors provide the greatest benefits to long-term biodiversity conservation in fragmented landscapes (Goforth et al. 2002). Therefore, minimizing forest fragmentation by maintaining high-quality, closed-canopy forested conditions and providing a 150 ft conservation buffer around them is our top priority management recommendation.

Although the Saranac-Lowell SGA is relatively unfragmented compared to the surrounding landscape, anthropogenic disturbance has fragmented forests within the game area. The effects of forest fragmentation on native plants and animals and ecosystem processes are drastic (Heilman et al. 2002). Local population extinctions within fragments are accelerated by reduced habitat and population size. Native plant diversity within forested fragments is threatened by low seedling survivorship, infrequent seed dispersal, high levels of herbivory, and growing prevalence of invasive species, which thrive in response to forest clearing (Brosofske et al. 2001, Heilman et al. 2002, Hewitt and Kellman 2004).

The landscape surrounding the game area features a high degree of fragmentation. Photo by Jesse M. Lincoln.

Hooded warblers and many other bird species found in Saranac-Lowell rely on the mature forests along the Flat River. Photo by Aaron P. Kortenhoven.

Activities that reduce the cover of mature forest or increase fragmentation will also reduce the value of Saranac-Lowell SGA to forest-interior nesting songbirds. These forests currently support populations of hooded warblers, cerulean warblers, and Louisiana waterthrush but these species require extensive, mature, closed-canopy forests. However, these and other Neotropical migrants are particularly susceptible to nest parasitism from brown-headed cowbirds (*Molothrus ater*). Cowbirds thrive in fragmented landscapes and reduce the reproductive success of forest-breeding songbirds through nest parasitism (Robinson et al. 1995). Cowbirds were observed at 56% of the point-count stations surveyed. Efforts to reduce forest fragmentation (i.e. edge habitat) could decrease nest parasitism by brown-headed cowbirds on rare and declining forest songbirds. Because the rare songbirds recorded use mature deciduous forest, we recommend protecting existing stands of upland forest that are over 100 years old, especially along the Flat River corridor.

Considering the contiguous, mature forests along the river, we found it surprising to not record red-shouldered hawk breeding within Saranac-Lowell SGA. However, the game area is a narrow block of natural cover with even the largest forests having relatively close proximity to agricultural land and edge habitat. The maintenance and expansion of mature forest blocks within the game area would benefit rare songbirds, other forest-interior species, and red-shouldered hawks. While we did not document any active red-shouldered hawk nests within the game area in 2021, there is a reproducing population 10 miles to the northeast in Flat River State Game Area, and ongoing protection of high-quality forests from additional fragmentation may increase the probability of future occupancy. Further, the lack of detection does not equate to its absence. Hawk activity varies across years and future surveys will better determine hawk usage of the game area and if reduced fragmentation can encourage establishment of nesting territories.

Fragmentation, particularly logging of forests can have deleterious impacts on aquatic systems. The potential for timber harvest to affect stream habitat and aquatic animal communities is well documented. Increases in sedimentation or sediment load in rivers because of timber harvest can lead to changes in abundance of fish (Broadmeadow and Nisbet 2004; Nislow and Lowe 2006) and invertebrates (Noel et al. 1986; Brown et al. 1997). Changes in the amount of instream coarse woody debris caused by timber harvest can affect stream habitat (Smokorowski and Pratt 2007) and aquatic animal communities (Bilby and Ward 1991). Maintaining forested buffers on slopes along streams is a commonly used and important practice to mitigate impacts to aquatic species and ecosystems (Olson et al. 2007). Saranac-Lowell SGA currently provides natural riparian buffers along approximately 6 river miles. These buffers of natural cover contribute to the viability of the 5 listed mussel populations within the SGA and federally endangered snuffbox populations downstream of the SGA. Excessive sedimentation can impact native mussel populations directly (Brim-Box and Mossa 1999) and also indirectly if habitat for fish hosts is degraded by runoff generated by timber harvest.

Large, mature woodlands host much more native biodiversity than small, young forests and are particularly important for conservation. Forest patches that have been forested for a long time will likely be more-species rich than recently established forests, due to slow immigration of forest specialists (Valdes et al. 2020). Dampening the effects of forest fragmentation can be realized by preventing timber harvest in large blocks of mature, contiguous forest and adjacent stands. The delivery of some ecosystem services may decline with low habitat connectivity within an intensively managed landscape matrix. Additionally, more ancient forest patches have higher topsoil carbon storage potential. Loss of area, increased isolation, and greater exposure to human disturbances along forest edges are leading causes of biodiversity loss and reduced ecosystem functioning (Haddad et al. 2015, Valdes et al 2020).

Because high-quality forests occupy only 8.9% of the game area, we recommend the following specific actions to minimize fragmentation and degradation of these important forests that host the most native biodiversity: prevent logging in the high-quality forest EOs; establish no-cut buffers of 150 ft from steep slopes, along wetlands, and natural community EOs; prevent impacts to small order streams and vernal pools by establishing 150 ft buffers adjacent to them; avoid dramatically altering canopy of forests over 100 years old, particularly if they are near documented high-quality natural communities; and treat invasive species within areas of the highest quality, mature forest and areas where timber harvest is planned.

To facilitate protection of the riparian system and the most diverse areas of forest, we have developed a map depicting a conservation areas (Figure 23). This conservation area includes the most sensitive areas where we recommend avoiding intensive silvicultural actions, such as clearcutting. Within the conservation area, we suggest focusing management actions on promoting ecological integrity such as application of prescribed fire and treatment of invasive species. The conservation area covers habitat within 400 ft of the river, based on recommendations for rivers designated as Natural Rivers. It includes high-quality natural communities with an added 150 ft buffer to minimize fragmentation. Within the conservation area we have also included the oldest forested stands that have mature trees and limited invasive species but without restoration actions, do not meet MNFI standards for inclusion as natural communities. Overall, the proposed conservation area is 35% of the game area.

Within the conservation area, we suggest that eliminating intensive timber harvest will have the greatest positive impact on protecting aquatic systems and limiting the deleterious impacts of forest fragmentation on the highest quality forests and thereby most effectively protect native biodiversity. Treating invasive species and applying prescribed burns are management tools that are recommended for enhancing ecosystem services and promoting native biodiversity within the conservation area.

Many areas of saturated soils along the slopes of the Flat River create especially high plant diversity and should be protected from fragmentation. Photo by Jesse M. Lincoln.

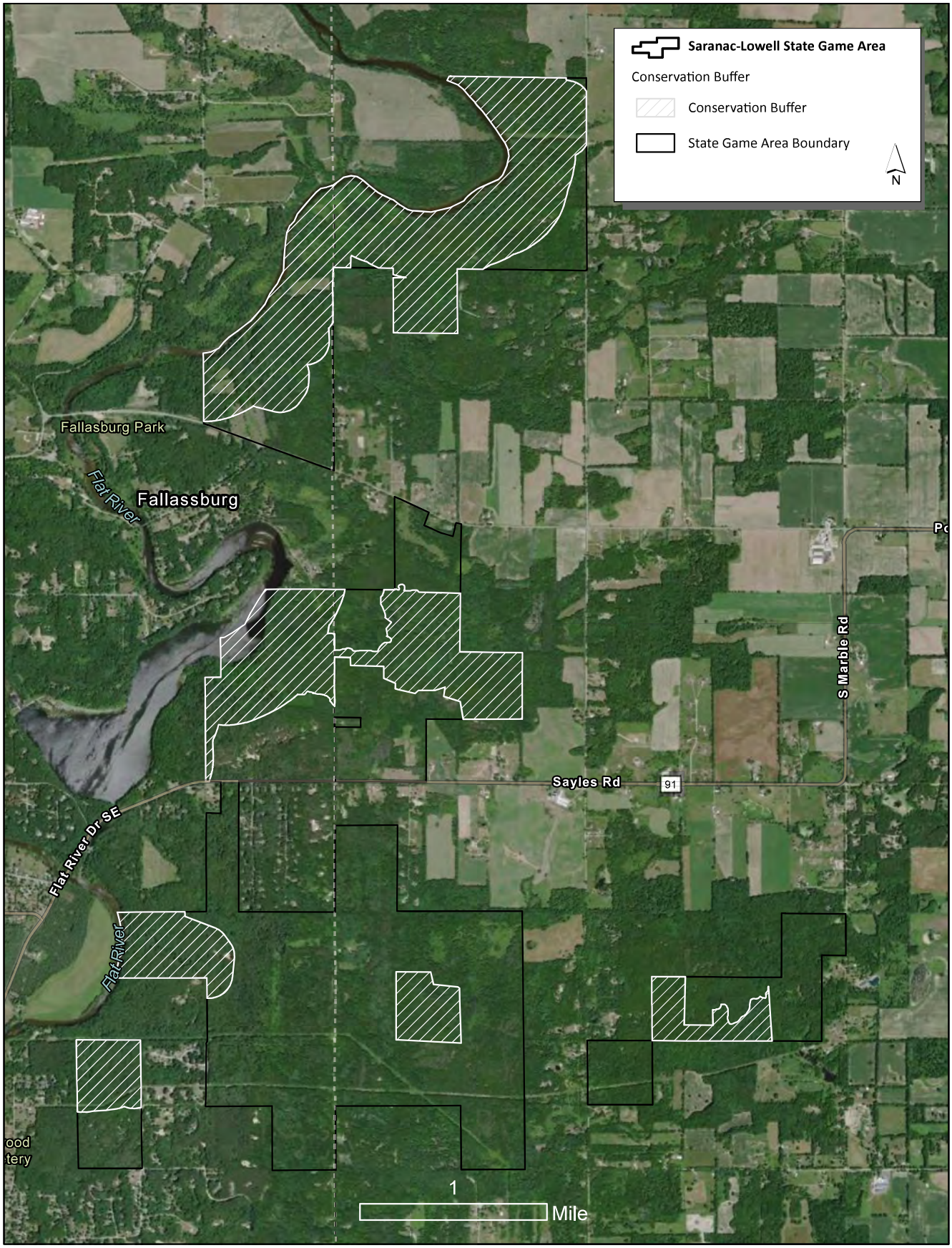


Figure 23. Proposed conservation area for Saranac-Lowell State Game Area. To prevent habitat fragmentation, protect ecological integrity of the highest quality forests, limit erosion along the river, and protect populations of rare plants and animals, we suggest that land managers avoid intensive forest management, such as clearcuts, in the conservation area. The conservation area includes uplands 400 ft from the edge of the Flat River; natural community element occurrences buffered by 150 ft; and other areas of forest that were not cleared for agriculture and have the highest restoration potential.

Fire as an Ecological Process

Based on historic descriptions of the natural communities on the local landscape, known occupancy of Indigenous Peoples along the Flat River, and current plant communities supporting species characteristic of fire-adapted communities, we presume that fire was likely a frequent disturbance across the entirety of the game area and surrounding region. Currently, much of the landscape is fire suppressed with minimal fires prescribed. Application of prescribed fire across the game area will reduce mesophytic species in forested ecosystems and promote herbaceous diversity. This approach will be beneficial to the documented natural communities, oak savanna restoration, and numerous game species.

MNFI has developed a model for assessing prescribed fire needs on state game areas (Cohen et al. 2021). This model suggests that most of the uplands within Saranac-Lowell SGA support fire-dependent ecosystems (Figure 24). Resources for burning are limited and should be prioritized for high-quality, fire-dependent oak forests – Ziibiqua Woods and Sparks Woods – and areas immediately adjacent to these systems. Additional oak savanna restoration areas have also been identified (Figure 26, pg. 70). Land managers could consider developing permanent project areas and applying prescribed fire with the goals of reducing dominance of mesophytes like red maple in the subcanopy but also to increase herbaceous vegetation and promote recruitment of oaks.

As part of the effort to reintroduce fire to the landscape, we suggest the development of permanent project boundaries using existing features such as roads, trails, and the river that can act as burn breaks to facilitate burning across ecotones and avoid creating new burn breaks near sensitive areas. Developing large, permanent burn units that include younger forests adjacent to the highest quality natural communities can also provide forests with various age classes, a common goal of wildlife managers that is often achieved through timber harvest alone. Fire-suppressed forests sites should be burned using a fire-return interval of one to three burns per decade and priority oak savanna restoration areas burned at least three times per decade.

Some areas of Ziibiqua Woods with a canopy characterized by white and black oak tend to have the subcanopy overwhelmingly dominated by red maple. These areas could be prioritized for prescribed burns. Compartment 2, Stand 1. Photo by Jesse M. Lincoln.

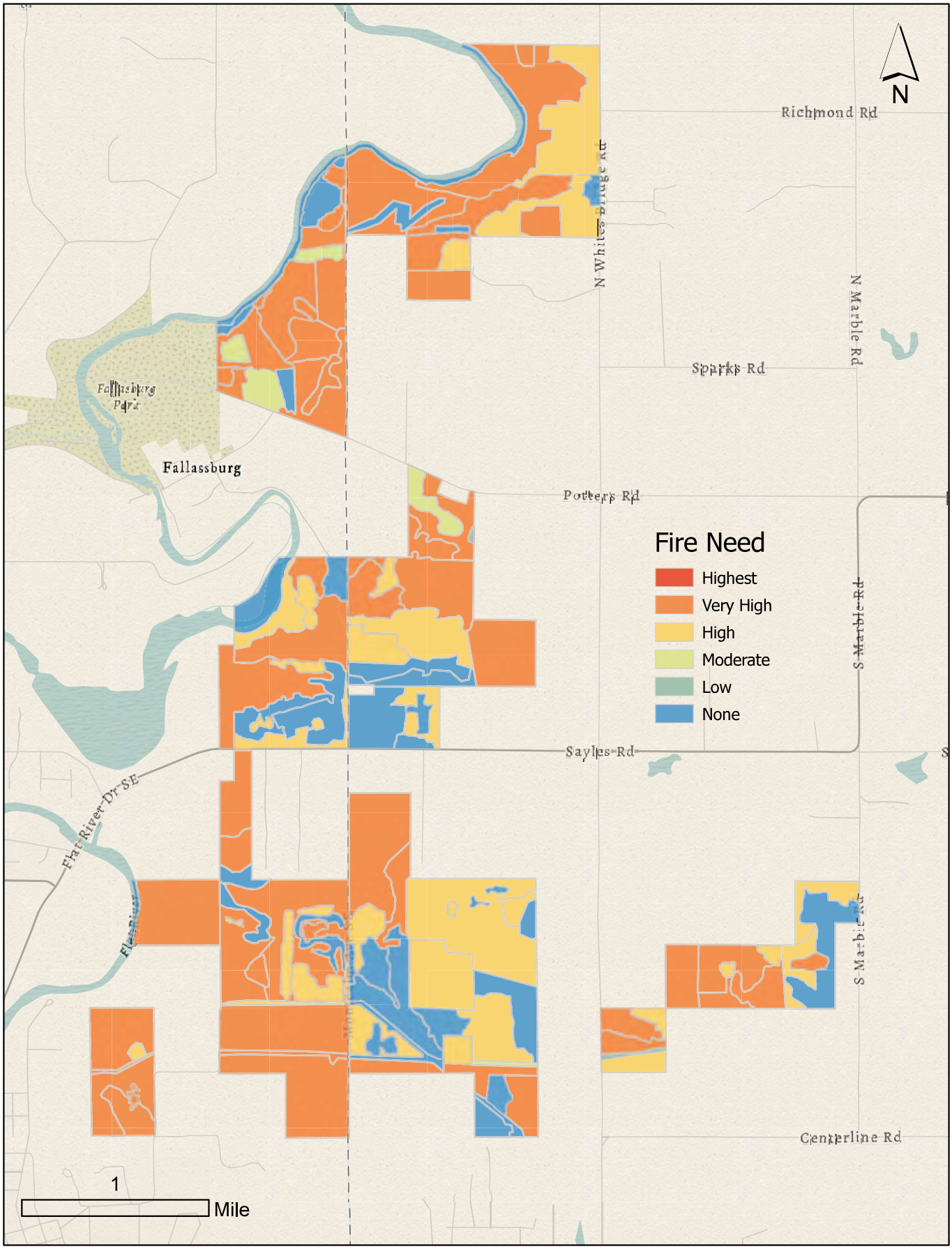


Figure 24. Prescribed fire needs assessment of Saranac-Lowell State Game Area. Most of the game area has a "very high" or "high" need. Many areas that have no fire need are areas of planted pine and are generally degraded.

Although prescribed fire typically improves the overall quality of habitat for many animal species, its impact on rare animals should be considered when planning a burn. To protect box turtles, we recommended that managers avoid applying prescribed fires during the early spring emergence period (April to mid-May) when turtles and other herptiles may be lethargic or less active after emerging from their winter hibernacula. Instead, fires should be conducted later in the growing season when turtles and other herptiles are fully active and may be able to evade slow-moving flames or find suitable refugia during prescribed fires (Melvin 2017).

For turtles, if prescribed burning needs to occur during the active season and particularly in open upland habitats, conducting these activities in early July through mid-August would minimize the potential for harming turtles (Laarman et al. 2018). This time period avoids turtle emergence, nesting season (mid-May to late June), and hatchling emergence (mid-August through October) (Melvin 2017, Laarman et al. 2018). If these seasons cannot be avoided, conducting slow-moving fires such as backburns is recommended so individuals have time to avoid fire. In addition, we recommend dividing occupied habitat into multiple burn units and leaving at least one burn unit unburned at a time to serve as refugia for turtles during fires.

Refugia, or unburned areas, are critical if prescribed burning needs to occur during spring and early summer. We suggest burning relatively large areas and striving for patchy burns by burning either when fuels are somewhat patchy or when weather conditions will not support hot, unbroken fire lines (such as can occur under atypically warm, dry weather and steady winds). Areas adjacent to where fire is applied can be burned in alternate years or seasons to protect populations of fire-sensitive species. This allows unburned units to serve as refugia for immobile invertebrates and slow-moving herptile species.

Figure 25. Location of priority forests to include in prescribed burns.

Kitten tails (top left; photo by Nathan Martineau), creeping whitlow grass (top right; photo by Nate Martineau), and slender yellow flax (right; photo by Julie P. Tuttle, accessed from iNaturalist) are rare species that have been documented from eastern Kent County. Despite an abundance of natural cover and potential habitat on the game area, these populations have not been seen for over 100 years. Development, habitat fragmentation, fire suppression, invasive species, and intense pressure from deer herbivory are dramatically reducing the native plant biodiversity on the landscape. Through the prevention of habitat fragmentation, implementation of prescribed fire, restoration of oak savanna, and treatment of invasive species, the game area could provide habitat for numerous rare species and stem the continual loss of biodiversity on the landscape.

Oak Savanna Restoration

In addition to maintaining ecological integrity within forested ecosystems, prescribed fire can also be used to restore oak savanna. Application of prescribed fire can be used to promote the open structure and floristic composition of oak savannas that includes widely spaced trees and an abundant ground layer of herbaceous species. Within Michigan, more than 99.9% of oak savannas have been destroyed. Oak savanna ecosystems once covered over 1 million acres in the southern portion of the state (O'Connor et al. 2009). Historically, Oak Openings covered 36% of the Saranac-Lowell SGA, mostly concentrated in the southern portion of the game area. Through the process of European colonization, all areas within the game area boundaries that were historically savanna now exist as abandoned agricultural land or have converted to closed-canopy forest. Because oak savannas have become so rare and because maintenance of oak savannas in Saranac-Lowell SGA is a management objective of the DNR, we recommend management of target areas for savanna restoration, especially through the application of prescribed fire at a high-frequency return interval of around 3 burns per decade.

The best areas to target for restoration have not been tilled and are adjacent to areas that may have been disturbed but still support savanna vegetation (Figure 26). The persistence of characteristic vegetation is an important signal that the site was historically savanna and additional characteristic vegetation may be expressed through restoration and the site can potentially be recovered to a savanna state. Fire is a critical management tool for maintaining an open canopy, promoting high levels of grass and forb diversity, deterring the encroachment of woody vegetation and some invasive species. Fire intervals of one to three years bolster graminoid dominance, increase overall grass and forb diversity, and remove woody cover of saplings and shrubs.

Restoration may be accelerated with removal of target species, particularly invasive species and red maple which generally dominates the subcanopy of many historic savannas that have converted to closed-canopy forest in the absence of fire. Savannas are characterized by a sparse canopy coverage of 5 to 60%. This is best achieved through gradual canopy reduction and applying consistent prescribed fire. Combining the removal of subcanopy red maple and the application of prescribed fire can accelerate the restoration process and dramatically increase the herbaceous vegetation and populations of native insects at a site (Lettow et al. 2014).

Michigan savannas have become exceedingly rare through the ongoing process of habitat fragmentation and fire suppression. A small remnant persists south of Lowell on township property. This site may serve as a reference area to understand ideal species composition of savanna restoration priorities in the game area. Photo by Jesse M. Lincoln.

After clearing in the 1800s and over a century of subsequent fire suppression, areas with savanna restoration potential have only the faintest of hints to indicate either their historic state or their future potential. They will require prolonged dedication to recover. Stand 2, Compartment 1. Photo by Jesse M. Lincoln.

Figure 26. Four priority areas for savanna restoration in Saranac-Lowell State Game Area.

Figure 27. Priority savanna restoration area 1. Aerial imagery from 1938 shows Stands 2 and 3 in Compartment 1 was not cleared for agriculture. This is an area we recommend prioritizing oak savanna restoration. This area was described as an "oak opening" in the GLO notes from 1837 and fire-dependent plant species persists locally. The stand has mature trees but fire suppression has caused red maple to dominate the subcanopy and understory and suppress the characteristic herbaceous vegetation within the stand. We recommend targeting this area for oak savanna restoration and applying prescribed fire at a relatively high frequency of 3 burns per decade to reduce red maple and encourage emergence of characteristic vegetation in the seed bank. These efforts could be accelerated by reducing red maple from the system with herbicide or mechanical removal.

Numerous oak savanna indicator species occur along the powerline corridor near Stand 2 in Compartment 1. These include hairy puccoon (*Lithospermum caroliniense*, top) and prairie phlox (*Phlox pilosa*, white form, bottom). The presence of such species confirms the historic cover as oak savanna and suggests that focused restoration efforts may be especially effective in this area.
Photos by Jesse M. Lincoln.

Numerous rare species that have been documented in the game area would benefit from savanna restoration and broad-scale application of prescribed fire. The populations of box turtle and red-headed woodpeckers would especially benefit from the resoration of savanna structure. The rare bumblebees are foraging generalists and need access to abundant and diverse floral resources. Managing landscapes to maximize season-long availability of floral resources is necessary for colony health and can be achieved with broadscale oak savanna restoration. Because consistent application of prescribed fire is known to increase the abundance of flowering plants, the documented rare bumblebees would also likely benefit from broadscale prescribed fire and savanna restoration. Many of the rare plants historically found in the surrounding landscape are characteristic of fire-adapted communities. Species like Kitten-tails (*Besseya bullii*, State Endangered), Virginia flax (*Linum virginianum*, State Threatened), prairie smoke (*Geum triflorum*, State Threatened), creeping whitlow grass (*Draba reptans*, State Threatened) have been found in this general area of Kent County but have not been documented for decades due to extensive habitat loss and a culture of fire-suppression in a fire-adapted landscape. It is not known if these plants occurred on the game area historically, but potential habitat persists and the regular application of landscape-scale prescribed fire might recover their habitat and express dormant material from the seedbank.

With respect to oak savanna restoration, we recommend 1) focusing efforts on specific areas and creating permanent project boundaries that function as burn breaks, 2) establishing a consistent application of fire of approximately three burns per decade within target areas, 3) removing mesophytic species – such as red maple and black cherry – to accelerate the process of recreating savanna structure, 4) treating invasive species before and after burns, and 5) allowing seedback expression by not supplementing restoration sites with additional plant species until reevaluating sites after several burns.

Stand 2 in Compartment 1 is characterized by mature oaks and is in an area that was historically described as oak savanna. This is a priority target for savanna restoration efforts. Photo by Jesse M. Lincoln.

Lupine and other savanna indicator species were found locally in the area around Stands 69 and 30 in Compartment 1. The lupine was too sparse to support populations of rare butterflies but with expansion of lupine populations following application of prescribed fire, butterfly populations may expand. Photo by Jesse M. Lincoln.

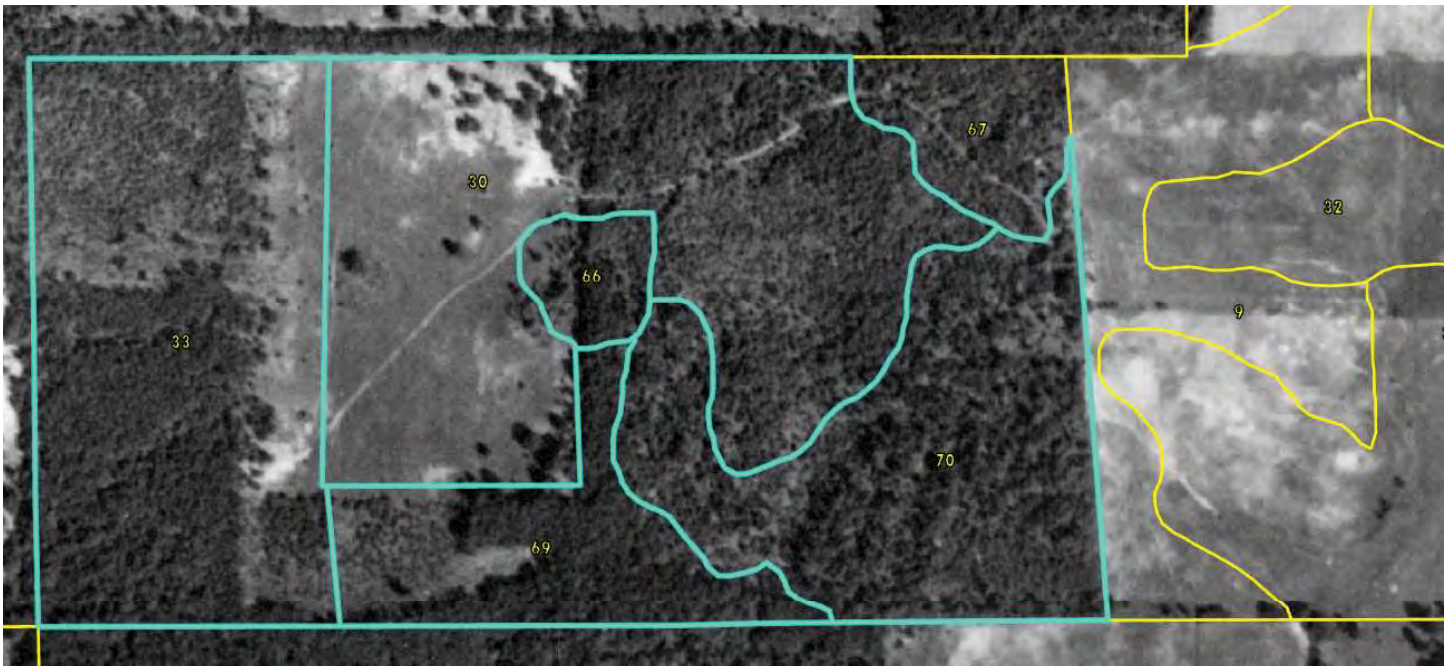


Figure 28. Priority savanna restoration area 2. Aerial imagery from 1938 shows most of Stands 30, 33, 69, and 70 in Compartment 1 were not cleared for agriculture. This is our second priority area for savanna restoration. This area was described as "oak openings" in the GLO notes from 1837 and characteristic vegetation persists in the area. The stands have mature trees but fire suppression has caused red maple to dominate the subcanopy and suppress characteristic herbaceous vegetation. We recommend targeting this area for oak savanna restoration and applying prescribed fire at a relatively high frequency of 3 burns per decade to reduce red maple and encourage emergence of characteristic vegetation in the seed bank. These efforts could be accelerated by reducing red maple within the system with herbicide or mechanical removal.

Stand 52 in Compartment 1 has several indicator species throughout the stand, including goat's rue (inset), lupine, shrubby St. John's-wort, and little bluestem. Photos by Jesse M. Lincoln.

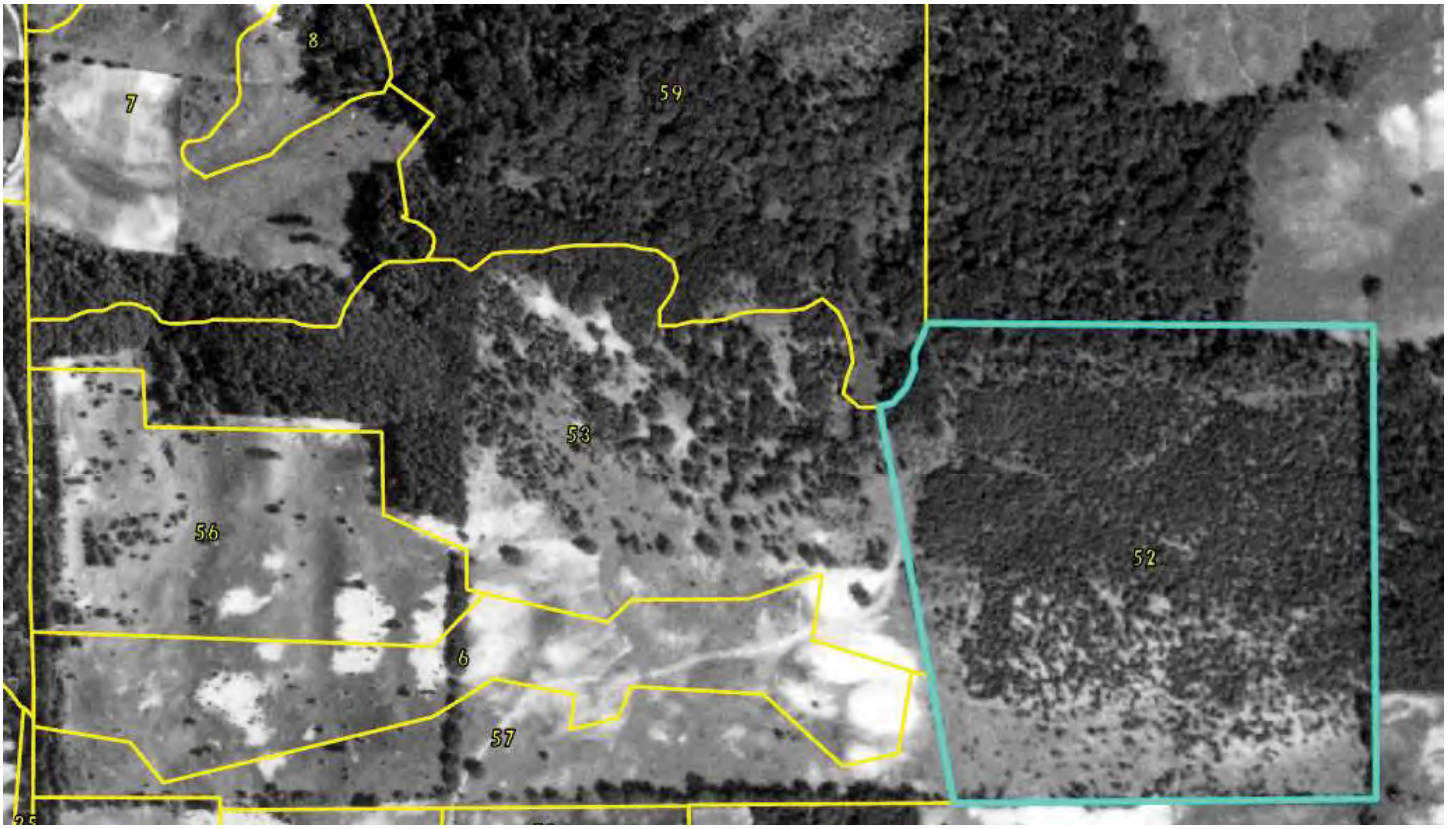


Figure 29. Priority savanna restoration area 3. Stand 52 in Compartment 1 is the third priority area that should be investigated for oak savanna restoration. Imagery from 1938 indicates it was not cleared for agriculture and that it recently had areas of widely-spaced trees, similar to savanna structure and indicator species persist throughout the stand. These factors indicate that savanna restoration may be successful and the area is worthy of applying prescribed fire. Other nearby stands that were forested in the imagery had been selectively logged, feature saturated soils, or did not have any savanna indicator species. While we suggest managers do not exclude surrounding areas from prescribed burns, the focus of the savanna restoration efforts in this specific area should be Stand 52.

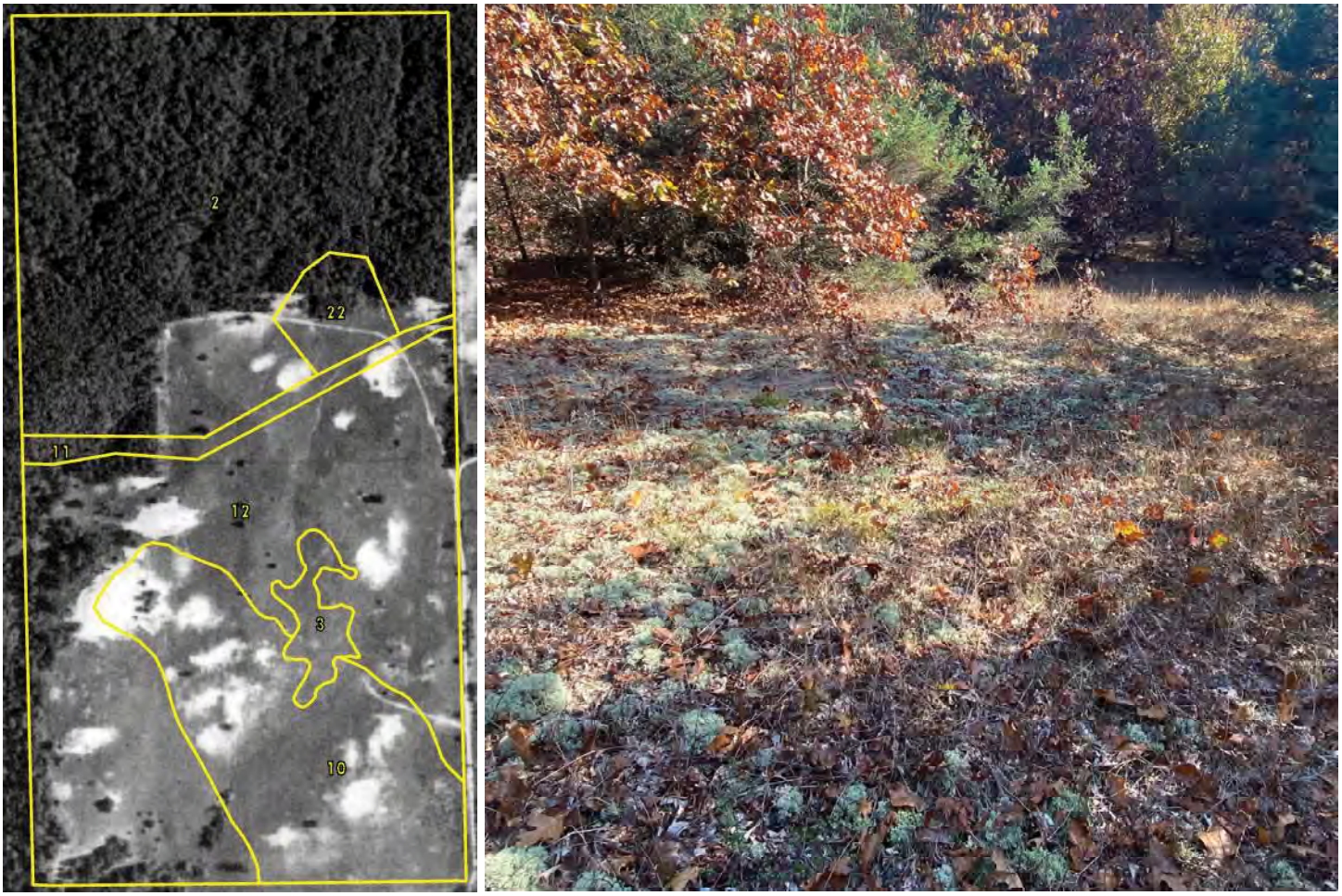


Figure 30. Priority savanna restoration area 4. Savanna indicator species persist in Stand 3 (above right) and along the powerline corridor in Stand 11. The hillsides in northwest Stand 12 also have savanna restoration potential. As part of Ziibiqua Woods EO, Stand 4 is a priority forest to include in prescribed burns. Photo by Jesse M. Lincoln.

Oak savanna indicator species such as big bluestem, lupine, and goat's-rue persist along the powerline corridor in Stand 11 of Compartment 2. While only a limited signal, they point to the historic community assemblage and indicate a possibility for successful oak savanna restoration in adjacent forests. Photo by Jesse M. Lincoln.

Addressing Invasive Species

Biological invasions are a critical driver of ecosystem degradation and the global decline of biodiversity (Vitousek et al. 1996, Kennedy et al. 2002). Invasive plants affect ecosystem processes through their patterns of resource acquisition and degrade native biodiversity by altering the fundamental structure and function of ecosystems and even triggering trophic cascades (Ehrenfield 2010). Non-native invasive species often have no natural predators and can therefore spread aggressively. By out-competing and replacing native species, invasive species can change floristic composition of natural communities, alter vegetative structure, and reduce native species diversity; often causing local or even complete extinction of some native species (Harty 1986).

Invasive species can also upset delicately balanced ecological processes such as trophic relationships, interspecific competition, nutrient cycling, soil erosion, hydrologic balance, and disturbance regimes (Bratton 1982). In addition, invasive species compromise pollinator services, change microclimates, despoil recreational resources, and degrade the economy of the Great Lakes states (Zavaleta 2000, Pimentel et al. 2005, Huang and Asner 2009, Ehrenfeld 2010). Environmental damages and losses caused by invasive species within the United States were estimated to be over $120 billion per year (Pimentel et al. 2005). Invasive infestations are projected to increase as the landscape continues to be fragmented (Vila and Ibanez 2011) and the climate changes.

According to the original DNR's Lowell State Game Area Master Plan from 1977, the state purchased and planted 3,060 stems of multiflora rose, autumn olive, and Morrow's honeysuckle. To reduce the risk of introducing problematic species, we recommend the DNR instate a policy to plant only species known to be native to the region, particularly focusing on Michigan genotypes when available.

We also encourage a multi-faceted approach to invasive species control and emphasize that improving the landscape context surrounding the high-quality natural areas is important. Treatment should be focused in the highest quality forests, areas targeted for savanna restoration, and easily accessible populations of the most severe invasive species.

Oriental bittersweet is especially invasive in portions of Saranac-Lowell SGA. This infestation occurs along the margins of Stand 5 in Compartment 2. A similar infestation occurs along the margins of Stand 29 in Compartment 2. Photos by Jesse M. Lincoln.

Reducing background levels of the most pernicious invasive species across the game area will reduce the propagule pressure for these invaders. This is best facilitated by preventing additional habitat fragmentation around high-quality natural communities and implementing prescribed fire across the landscape. Invasive species management at Saranac-Lowell SGA should focus on prevention and then the control of infestations of invasive species within high-quality natural communities and the immediately surrounding areas. Evaluating forests for risk of invasive species should occur before logging operations proceed. Timber harvest in fragmented landscapes can significantly increase populations of invasive species, especially oriental bittersweet, autumn olive, multiflora rose, and Japanese barberry. Forest management in the absence of addressing invasive species can detrimentally affect attributes of regenerating forest ecosystems. The rapid expansion of invasive species following logging operations can decrease biological diversity, forest productivity, water and soil quality, and contributions to the carbon cycle (Pimentel et al. 2000).

Within Saranac-Lowell SGA, the most pronounced impact from invasive species occurs within forests where oriental bittersweet and Japanese barberry threaten the long-term health of the forested systems. MNFI has developed a prioritization list of invasive species that pose a serious risk to native biodiversity and we also recommend prioritizing the treatment of these species when feasible (Table 14). Newly establishing invasive species should be removed as rapidly as possible, before they infest additional areas. Treating invasive species is difficult and expensive, and severe infestations can take several years to control. Partnerships with organizations such as West Michigan Conservation Network will be important for reducing existing populations and addressing new populations. Invasive species abstracts, which include detailed management guidelines, can be obtained at the following website: http://mnfi.anr.msu.edu/invasive-species/best-control-practice-guides.cfm.

A severe barberry infestation was observed in Compartment 2, Stand 47 during the MiFI surveys of 2015.

Table 14. Invasive species that pose a significant risk to natural communities in Michigan. This list was generated considering the following factors: likelihood to invade high-quality habitat, ability to form monospecific areas, allelopathic proclivities, likelihood to be documented in existing EO records, and a capacity to treat the species. Species in bold are those of greatest concern.

Scientific Name	Common Name
Ailanthus altissima	Tree of heaven
Berberis thunbergii*	Japanese barberry
Celastrus orbiculatus*	Oriental bittersweet
Centaurea stoebe*	Spotted knapweed
Elaeagnus umbellata*	Autumn olive
Frangula alnus	Glossy buckthorn
Phragmites australis var. australis	Phragmites, common reed
Rhamnus cathartica	Common buckthorn
Rosa multiflora*	Multiflora rose
Typha angustifolia	Narrow leaved cat-tail
Vincetoxicum nigrum*	Black swallow-wort
Gypsophila spp. *	Baby's breath
Alnus glutinosa	Black alder
Torilis japonica *	Hedge-parsley
Phalaris arundinacea *	Reed canary grass
Fallopia japonica *	Japanese knotweed
Fallopia sachalinensis	Giant knotweed
Mycelis muralis	Wall lettuce

** species has been found in Saranac-Lowell SGA*

Black swallow-wort (above) has been found in Stand 25 of Compartment 2. While this population has been treated by West Michigan CISMA, the area should be monitored for this species because of its capacity to dominate native vegetation and create extensive monocultures. Japanese knotweed (right) has also been observed in the game area in Stand 33 of Compartment 2, along the road. Infestations of these and other priority invasive species should be addressed as soon as possible to reduce harm to native ecosystems. Photos by Jesse M. Lincoln.

Considerations for Rare Herptiles

One Blanding's turtle and at least 25 observations of eastern box turtles have been documented throughout the game area and on adjacent or nearby private lands since 2002. The eastern box turtle population within the Saranac-Lowell SGA and surrounding area is a substantial, regionally-important population of box turtles. While many adults have been found in the game area, only one juvenile has been documented and the population may be facing serious threats from predation, loss of nesting habitat, and mortality from roads.

The eastern box turtle is primarily a terrestrial species and is typically associated with deciduous or mixed forests, especially those with sandy soils that occur near water or wetlands (Tinkle et al. 1979; Harding and Mifsud 2017). Box turtles utilize open habitats adjacent to forested habitats including old fields, savannas, and edges of wetlands (Harding and Mifsud 2017). The eastern box turtle and Blanding's turtle populations within the game area face a number of threats, including: 1) limited population recruitment due to nest predation; 2) loss and degradation of suitable nesting habitats that are safe from predators; and 3) mortality due to roads (Harding and Mifsud 2017, Melvin 2017, Laarman et al. 2018). Reducing predation from mesopredators such as raccoons, improving nesting conditions through the application of prescribed fire, limiting fragmentation in highest quality forests, and controlling invasive species are management actions that will best protect populations of box turtles and other herptiles within the game area.

All but one of the eastern box turtle observations that have been documented within the Saranac-Lowell SGA have been adult turtles. This may be due to limited recruitment because of nest and hatchling predation or limited availability of suitable nesting habitat. Young turtles also may be harder to detect and may use different habitats than the adult turtles. Eastern box turtle and Blanding's turtle are long-lived species that are characterized by delayed sexual maturity, low annual recruitment rates, and high adult survival rates. Because of these characteristics, populations of these species are extremely vulnerable to increases in adult mortality rates (Congdon et al. 1993 and 1994, Erb 2011). Studies on box turtle and Blanding's turtle population dynamics suggest that high levels of reproduction, high adult population densities, and low annual mortality are needed to maintain stable populations and ensure long-term viability (Congdon et al. 1993, Doroff and Keith 1990, Hall et al. 1999).

Maintaining suitable habitats that meet the needs of all the life history stages of the diverse amphibian and reptile species that occur at Saranac-Lowell SGA is critical for conserving these species. Controlling woody encroachment and maintaining early-successional conditions or canopy gaps within open and forested uplands and wetlands in the game area would sustain suitable habitat for these and other herp species. Restoring oak savanna through the application of prescribed fire, treating invasive species, and creating canopy gaps in target savanna restoration areas would provide substantial increase in potential nesting

Raccoons are having devastating impacts on reptile populations, primarily through depredation of nests. Despite the frequency with which box turtles were encountered, only one juvenile was detected, suggesting the population is not being replaced by younger cohorts. Photo by Howard Patterson, accessed through flckr.com, April 2022.

habitat for the box and Blanding's turtle populations in the game area. Eastern box turtles, Blanding's turtles, and other turtle species generally nest in open, sunny, unvegetated or sparsely vegetated areas with moist but well-drained sandy or loamy soil (Harding and Mifsud 2017, NatureServe 2022).

Applying fire to maintaining open, early-successional conditions, controlling woody encroachment, and ensuring open, sandy areas in these stands would provide suitable nesting habitat for turtles. Expanding nesting habitat, particularly adjacent to wetland habitats, through the application of prescribed fire in Ziibiqua Woods would provide critical habitats for foraging, mating, thermoregulating, nesting, gestating, giving birth to young, aestivating and/or overwintering (Harding and Mifsud 2017, NatureServe 2022). The old agricultural fields in which the eastern box turtles were found in 2021 (Stand 29 of Compartment 2) and other similar stands in the game area are likely being used for nesting, thermoregulating, and foraging. These fields could be included in prescribed burns as well. We suggest that agricultural operations be avoided in these nesting areas to prevent destruction of the nesting locations. Converting the abandoned agricultural fields to permanent, diverse plantings of native species would benefit both the rare herptiles but also documented rare bumble bees. These plantings could also be included in burns, especially if they occur adjacent to high-quality natural communities or savanna restoration sites. We recommend focusing application of prescribed burns in areas that have documented high-quality natural communities or targeted savanna restoration efforts and include plantings as a secondary goal.

Minimizing mortality or loss of adult and juvenile turtles, snakes, and other herptiles is important for maintaining viable populations of these species, particularly long-lived species such as the eastern box turtle and Blanding's turtles. Control of meso-predators (e.g., raccoons) in nesting areas, particularly during the turtle nesting season, would help reduce predation of turtle nests and enhance reproductive success and population recruitment. Other methods for reducing turtle nest predation such as turtle nest enclosures, should be investigated. Maintaining or providing downed woody debris (e.g., hollow logs, rotting stumps, rootwads), brush piles, or wood chip piles post timber harvest would provide critical microhabitats for amphibians and reptiles (e.g., cover for frogs and salamanders, places for snakes to deposit their eggs or give birth to their young) (Ernst and Ernst 2003, Harding and Mifsud 2017, NatureServe 2022). Road mortality can pose a substantial threat to turtle species, particularly females moving to nesting areas. One box turtle road mortality was documented along N Whites Bridge Road adjacent to the game area, and box turtles may cross McPherson Street NE just east of Fallasburg Park to access the old agricultural fields just north of the road in the game area.

Activities such as timber harvest and mechanical vegetation control or removal are important tools for land managers but adjusting the timing or manner in which these practices are conducted can reduce the potential for adversely impacting herptiles. Conducting intensive management in late winter or early spring before amphibian and reptile species emerge or in the fall after species have entered their hibernacula (e.g., late October/early November), would minimize the potential for adversely impacting these species. Similarly, limiting mowing, hydro-axing, and cultivation practices that involve the use of motorized vehicles or heavy equipment in occupied habitats during the active season (April-October) or following the same recommendations for prescribed burns would minimize potential for adversely impacting herp species. Raising mower decks to 15 – 20 cm (6-8 in) can help minimize potential for adversely impacting snakes. Kingsbury and Gibson (2012) and Mifsud (2014b) provide additional general habitat management guidelines and recommendations for amphibians and reptiles.

Box turtles were frequently encountered during vegetation surveys. Photo by Jesse M. Lincoln.

Aquatic System Considerations

The Flat River flows into the Grand River just south of Lowell. The Grand River is the second largest river in Michigan and supports diverse fish and unionid mussel communities. Historical industries that took place on the Flat River included a fur trading post in the early 1800s, a sawmill circa 1870-1890, and a button factory near Lowell that was in operation until the use of plastics became widespread in the 1930s and 1940s. Live mussels were harvested and made into buttons until the overharvest of native mussels led to the decline of the shell button industry and the Michigan Department of Conservation (now Michigan DNR) ceased legal harvest of native mussels in 1944 (Van der Schalie 1948). The lower Grand River once supported 31 native mussel species, making it the second most species-rich river in Michigan. However, recent surveys have only documented 23 species in the Grand, including the State and Federally Endangered snuffbox mussel (MNFI 2022).

In 1979 the Natural Resources Commission designated the Flat River as a country-scenic river and adopted the Flat River Natural River Plan under Act 231 of the Public Acts of 1970. Guidelines for management of the Flat River system in the plan include minimum setbacks for new construction (25 ft from the 50-year floodplain or 100 ft from the ordinary high-water mark, whichever is greater); vegetated buffers along the river's edge (25-50 ft); and no commercial, industrial, or mining operations within 300 ft of the river (Michigan DNR 1979).

The Flat River was designated a natural river under the Michigan Natural River Act in 1994. The Flat River Watershed Council was formed with the purpose "to protect, enhance, and maintain land and water quality and other natural resources in the Flat River Watershed". The council was awarded a grant from the Michigan Department of Environmental Quality (now the Department of Environment, Great Lakes, and Energy) to write a Watershed Management Plan (WMP) which is required for certain funding of restoration activities in the watershed.

These protective designations can help the Flat River continue to provide habitat for the five State Special Concern mussel species of greatest conservation need documented within the game area. The Flat River within Saranac-Lowell SGA is a relatively high-quality river system, and the game area helps to maintain the quality of mussel habitat and the broader Flat River ecosystem through its relatively wide and intact riparian buffers, extensive natural cover, low levels of impervious surface (large amount of natural land cover), and low levels of other non-point and point source impacts. This benefit extends downstream of the game area, contributing to the habitat quality of the lower Flat River and to the Grand River.

However, there are 33 known dams in the Flat River watershed (Beard et al. 2016), including Burroughs (Fallasburg) and Lowell/King Mill dams (Hanshue and Harrington 2017). The King Mill Dam in Lowell is the lowermost dam on the Flat River and prevents upstream movement of fish from the Grand River. It also alters flow patterns, water temperatures, and sediment transport. The Grand River could function as a source for fish and mussel species to colonize habitats and exchange genes among populations in the Flat River watershed. Because the dams along the Flat River restrict fish passage, they also restrict the passage of mussels that rely on fish hosts for transportation to new locations (Watters 1996). A population of the snuffbox near the confluence of the Flat and Grand Rivers below the dam in Lowell, but there are no documented snuffbox populations upstream. Snuffbox mussels are unlikely to occur in Saranac-Lowell SGA Due to the dams in the lower Flat River. However, two known host fish species for snuffbox occur in the Flat River and improved connectivity through dam removal could expand the population of the snuffbox upstream.

Rainbow (*Cambarunio iris,* State Special Concern), top and ellipse (*Venustaconcha ellipsiformis,* State Special Concern) shells, bottom, from muskrat midden at aquatic survey Site 2. Photo by Peter J. Badra.

Populations of the invasive zebra mussel were found attached to shells of native mussel species during aquatic surveys but they occur in relatively low numbers and do not appear to be having a large negative impact on the native mussels. There is currently no efficient method of controlling zebra mussels once established in a river system. However, there is opportunity to return some of the hydrologic characteristics of the Flat River to a more natural state by removing dam structures or releasing water in ways that more closely mimic natural flow patterns. Removing barriers to improve fish passage is a potential management action that could improve the population viability of elktoe, rainbow, creek heelsplitter, flutedshell, ellipse and other mussels within Saranac-Lowell SGA. This expanded habitat and improved gene flow would potentially make the populations of rare mussels more resilient to the existing populations of zebra mussels present in the river.

Dams and impoundments are barriers to the movement of fish and have implications for the conservation and management of native mussels due to mussel's reliance on fish hosts for reproduction and movement within river systems. The creation of the Burroughs (Fallasburg) Dam impoundment drastically changed the current speed and nature of sediments deposited in the section of Flat River within the central portion of Saranac-Lowell SGA. Very slow flow and an increase in fine sediments causes this habitat to be less suitable for most native mussel species, including the five mussel species of special concern found in the northern section of the game area. More silt tolerant and habitat generalist species tend to thrive in impoundments.

Removing dams will allow for mussel migration to new habitats, the transportation of mussels between populations, and improved gene flow among populations, which prevents inbreeding and genetic isolation of populations. Restoring connectivity in the Flat River could improve the viability of mussel populations within the Flat River by improving the connectivity of mussel populations within the watershed.

The Lowell Dam prevents fish passage. Photo by Jesse M. Lincoln.

Monitoring

We strongly encourage the implementation of monitoring within the high-quality natural communities and throughout actively managed areas to gauge the success of restoration activities at reducing invasive species populations. In addition, periodic early-detection surveys should be implemented to allow for the identification of invasive species that have yet to establish a stronghold within Saranac-Lowell SGA. Considering the importance of this game area for neotropical migrants birds and the potential impacts of forest fragmentation, monitoring for rare birds should also be continued. We recommend conducting songbird point counts periodically to monitor use of the game area by rare species and track overall forest bird assemblages. Periodic surveys would allow us to determine if the stands where rare birds were observed continue to be occupied.

Effects of fire will need to be carefully monitored and plans should be adjusted based on the response of vegetation and rare species. Because fire affects the plant species that are growing at the time of application, varying the timing of the fires will need to be carefully considered. The exact seasonality, frequency, and conditions under which burns take place should be continually evaluated by local experts familiar with the site and the rare species that occupy it. Periodic surveys would also provide an opportunity to monitor the effects of management actions on these and other species of management interest.

Additional research is needed to determine if road mortality is a significant issue in the game area and if so, where could actions be locally implemented to reduce its impact. Installing fencing along roads or ecopassages (e.g., tunnels or culverts) to facilitate safe crossings under roads where turtle and/or other herp road mortality is an issue could be considered and implemented. Monitoring prior to and after installation of fencing or ecopassages is critical for ensuring their effectiveness.

Known box turtle nesting areas should be closely monitored. Photo by Jesse M. Lincoln.

Future Survey Needs

In addition to the above identified monitoring needs, we suggest additional surveys to build off of our natural features inventory of the game area. Many of the rare species that we targeted are cryptic by nature and difficult to document in a single field season. Additionally, many rare species may increase in abundance following active stewardship of priority natural areas. Reducing populations of invasive species, applying prescribed fires, and restoring savanna structure in priority areas are all steps that have real potential to increase populations of rare species.

Numerous rare plants characteristic of open, savanna conditions have been historically documented in the surrounding landscape. These include Kitten-tails (*Besseya bullii*, State Endangered), Virginia flax (*Linum virginianum*, State Threatened), prairie smoke (*Geum triflorum*, State Threatened), creeping whitlow grass (*Draba reptans*, State Threatened). Many of these are old records and the species have disappeared from the landscape due to land clearing, fire suppression, and deer herbivory. Application of prescribed fire, especially in high-quality forests and targeted savanna restoration areas may express rare plant species from the seedbank.

Suitable nesting habitat for numerous bird species was observed and there is potential for them to occur within the game area, especially with ecosystem stewardship. Because rare species are often not detected even when present, additional surveys will help determine if rare songbirds occur at sites where the habitat appeared suitable, but they were not observed.

Because of the significance of the Saranac-Lowell SGA to the population of box turtles, and because they appear to have limited recruitment, follow-up surveys are recommended to identify potential nesting sites where predator control may be implemented. Furthermore, many herp species are cryptic and difficult to detect in the field, particularly if they are rare. Additional surveys and monitoring are needed to determine the status and distribution of rare herptile species and other SGCN that have been documented or have potential to occur in the Saranac-Lowell SGA. Longitudinal surveys, monitoring, and research would provide information on the size, distribution, and demographics of the eastern box turtle and Blanding's turtle populations within the game area and the threats facing these populations. Surveys also are needed to determine if additional rare herp species and SGCN such as wood turtles, gray ratsnakes, Fowler's toads, and Blanchard's cricket frogs occur within the Saranac-Lowell SGA. This information would help identify and prioritize strategies, actions, and locations for management and conservation of rare and common amphibian and reptile species within the game area.

Many of the targeted rare insects were not detected during these surveys. However, due to the quality of the forest along the river and the potential for restoration to improve areas of historic oak savanna, additional surveys should be conducted. It is also possible that the regal fern borer moth may occupy parts of Saranac-Lowell SGA.

Future surveys should focus on locating nesting locations of rare turtles. Photo by Nathan Martineau.

Conclusions

Game areas are important for supporting biodiversity, promoting ecological resilience, maintaining ecological integrity, and providing ecosystem services. In this report, scientists from Michigan Natural Features Inventory provided detailed information about several important high-quality natural communities and populations of rare species documented during surveys in Saranac-Lowell SGA. To maintain the game area's critical contribution to biodiversity protection, resilience, ecological integrity, and ecosystems services, we recommend that managers prioritize actions around sustaining the unique natural communities and populations of rare species by preventing and reducing forest fragmentation around the high-quality natural communities; applying prescribed fire to fire-adapted natural communities; restoring oak savannas; treating invasive species; improving connectivity of aquatic systems; protecting populations of box turtles; and monitoring these stewardship actions to inform future management actions.

Concluding Remarks

The Greater Grand Rapids Metropolitan Area is one of the most rapidly developing economic regions of the country. The Saranac-Lowell State Game Area substantially contributes to the native biodiversity of the region. Extensive networks of green infrastructure like the Saranac-Lowell SGA, protect native biodiversity and provide substantial return of ecosystem service, including maintenance of water quality, recharging groundwater aquifers that are the source of residential drinking water, management of storm water, flood mitigation, and the protection of the economically-significant fisheries that rely on the health of the river.

The Land Conservancy of West Michigan has developed strategic conservation plans to address the increasing pressures of urban development, habitat fragmentation, and the degradation of natural areas in Southwestern Michigan. These plans focus conservation efforts around three distinct regions, including the Eastern Glacial Corridor (Figure 31), within which the Saranac-Lowell SGA and Flat River feature prominently as important corridors. By virtue of its size, the extent of high-quality natural communities within its boundaries, and its position along the Flat River, the game area is a central part of regional efforts to maintain critical ecosystem services to a rapidly developing landscape.

The landscape surrounding the game area features a patchwork of rural residences and agriculture with perforated, fragmented patches of natural cover. Photo by Jesse M. Lincoln.

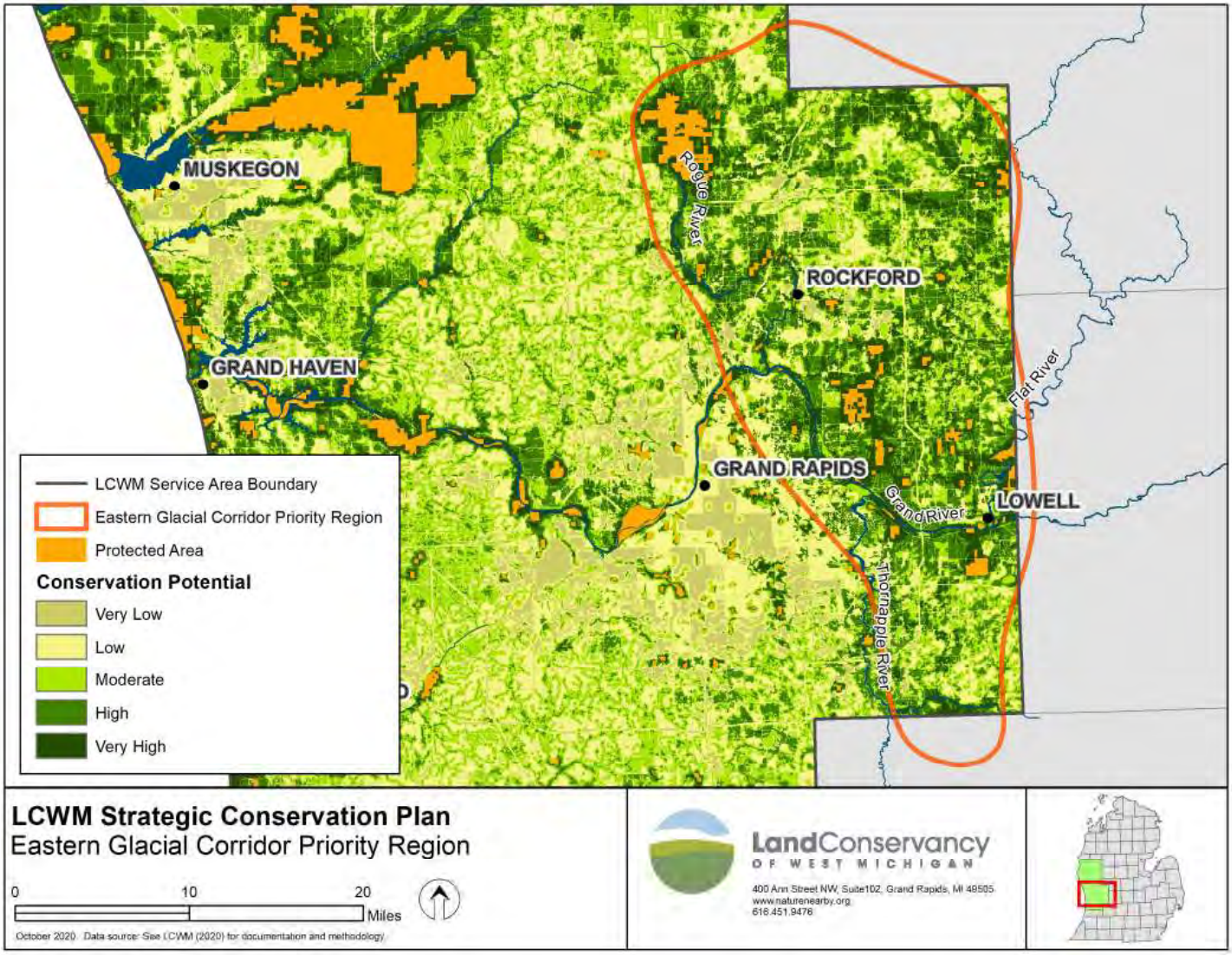


Figure 31. A strategic conservation priority region developed by the Land Conservancy of West Michigan (LCWM). Saranac-Lowell, Cannonsburg, and Rogue River State Game Areas provide extensive natural cover and feature prominently into the conservation planning efforts of the LCWM . This area forms their Eastern Glacial Corridor Priority Region where they will expand conservation corridors and concentrations of natural cover that can protect the greatest native biodiversity as the region continues to develop. Partnering with such organizations may be a potential opportunity for game area managers to treat invasive species, apply prescribed fire, and restore oak savannas in a collaborative approach to biodiversity conservation.

This game area was acquired by the State of Michigan to preserve and improve natural habitat for wildlife as urbanization, industrialization, and intensive farming are contributing to the destruction of such habitats. The game area is intended to offer a large variety of recreational opportunities including hunting, fishing, and non-consumptive uses. The Flat River supports one of the best smallmouth bass fisheries in the state and has been designated as a Natural River – an important regional destination for fishing and recreation – in part because of the natural beauty exemplified by the forests along its edges. The North Country Trail national headquarters is in Lowell and the game area features 3.5 miles of trail that is used by hundreds of hikers every year. The game area is part of a series of parcels of public land central to helping the North Country Trail Association maintain the trail as the premier hiking path across the northern portion of the United States. With limited public land in Southern Michigan game areas such as Saranac-Lowell SGA provide critical outdoor spaces that are adjacent to population centers.

As the extent of natural cover continues to decrease, public lands such as Saranac-Lowell State Game Area will have an ever-expanding role in the protection of Michigan's natural heritage and quality of life for its residents. Its unique position in a developing landscape, the existence of the North Country Trail, and its accessible beauty offers an opportunity to introduce significant segments of the population to the phenomenon of public land. It is big enough to protect native biodiversity, offer myriad recreational opportunities, and maintain the critical access to hunting, fishing, and trapping for which it was purchased. The importance of Saranac-Lowell State Game Area as both a reservoir of biodiversity and an entry point for citizens to experience that nature will only grow with the passage of time.

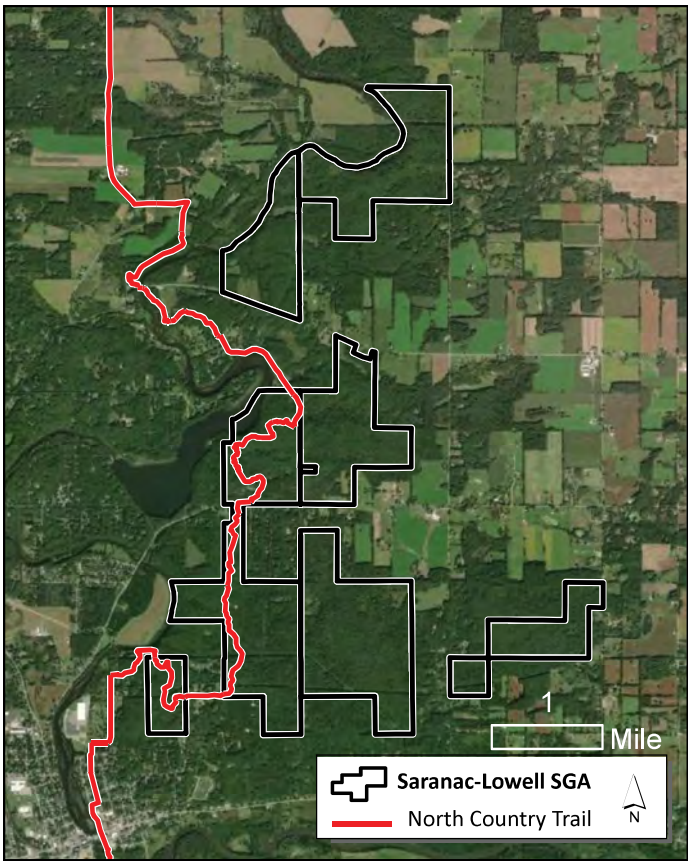


Figure 33. Location of North Country Trail in Saranac-Lowell State Game Area.

Protecting the high-quality forests within the game area offers real potential to expand populations of rare species, such as red-shouldered hawk. Photo by Aaron P. Kortenhoven.

The game area provides numerous recreational opportunities, including hunting, fishing, kayaking, and hiking. Photo by Jesse M. Lincoln.

The Saranac-Lowell State Game Area is a vital natural resource and a critical component of the efforts to conserve and protect rare and declining native biodiversity in southwest Michigan. Photo by Jesse M. Lincoln.

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Appendix 1. Conservation metrics for Sparks Woods dry southern forest (EO ID 24247 pg 27).

Conservatism-Based Metrics:

Total Mean C:	3.8
Native Mean C:	4.1
Total FQI:	30.2
Native FQI:	31.5
Adjusted FQI:	39.7
% C value 0:	7.9
% C value 1-3:	27
% C value 4-6:	60.3
% C value 7-10:	4.8
Native Tree Mean C:	4.6
Native Shrub Mean C:	3.2
Native Herbaceous Mean C:	4.1

Species Richness:

Total Species:	63	
Native Species:	59	93.70%
Non-native Species:	4	6.30%

Species Wetness:

Mean Wetness:	2.8
Native Mean Wetness:	2.7

Physiognomy Metrics:

Tree:	11	17.50%
Shrub:	12	19%
Vine:	5	7.90%
Forb:	24	38.10%
Grass:	5	7.90%
Sedge:	6	9.50%
Rush:	0	0%
Fern:	0	0%
Bryophyte:	0	0%

Duration Metrics:

Annual:	2	3.20%
Perennial:	60	95.20%
Biennial:	1	1.60%
Native Annual:	2	3.20%
Native Perennial:	57	90.50%
Native Biennial:	0	0%

Appendix 2. Plant species observed in Sparks Woods dry southern forest (EO ID 24247 pg 27) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
red maple	*Acer rubrum*	ACERUB	native	1	0
garlic mustard	***Alliaria petiolata***	**ALLPET**	**non-native**	**0**	**3**
juneberry	*Amelanchier arborea*	AMEARB	native	4	3
hog-peanut	*Amphicarpaea bracteata*	AMPBRA	native	5	0
poke milkweed	*Asclepias exaltata*	ASCEXA	native	6	5
long-awned wood grass	*Brachyelytrum erectum*	BRAERE	native	7	5
sedge	*Carex cephalophora*	CXCEPP	native	3	3
sedge	*Carex grayi*	CXGRAY	native	6	-3
sedge	*Carex grisea; c. amphibola*	CXGRIS	native	3	0
sedge	*Carex pensylvanica*	CXPENS	native	4	5
curly-styled wood sedge	*Carex rosea; c. convoluta*	CXROSE	native	2	5
sedge	*Carex sprengelii*	CXSPRE	native	5	0
pignut hickory	*Carya glabra*	CARGLA	native	5	3
alternate-leaved dogwood	*Cornus alternifolia*	CORALT	native	5	3
flowering dogwood	*Cornus florida*	CORFLO	native	8	3
cockspur thorn	*Crataegus crus-galli*	CRACRU	native	5	0
autumn-olive	***Elaeagnus umbellata***	**ELAUMB**	**non-native**	**0**	**3**
silky wild-rye	*Elymus villosus*	ELYVIL	native	5	3
big-leaved aster	*Eurybia macrophylla*	EURMAC	native	4	5
green-stemmed joe-pye-weed	*Eutrochium purpureum*	EUTPUR	native	5	0
nodding fescue	*Festuca subverticillata*	FESSUB	native	5	3
wild strawberry	*Fragaria virginiana*	FRAVIR	native	2	3
white ash	*Fraxinus americana*	FRAAME	native	5	3
annual bedstraw	*Galium aparine*	GALAPA	native	0	3
white wild licorice	*Galium circaezans*	GALCIR	native	4	3
yellow wild licorice	*Galium lanceolatum*	GALLAN	native	4	5
wild geranium	*Geranium maculatum*	GERMAC	native	4	3
white avens	*Geum canadense*	GEUCAN	native	1	0
witch-hazel	*Hamamelis virginiana*	HAMVIR	native	5	3
naked tick-trefoil	*Hylodesmum nudiflorum*	HYLNUD	native	7	5
shrubby st. johns-wort	*Hypericum prolificum*	HYPPRO	native	5	3
hairy sweet-cicely	*Osmorhiza claytonii*	OSMCLI	native	4	3
smooth sweet-cicely	*Osmorhiza longistylis*	OSMLON	native	3	3
virginia creeper	*Parthenocissus quinquefolia*	PARQUI	native	5	3
jumpseed	*Persicaria virginiana*	PERVIR	native	4	0
wild blue phlox	*Phlox divaricata*	PHLDIV	native	5	3
canada bluegrass	***Poa compressa***	**POACOM**	**non-native**	**0**	**3**
may-apple	*Podophyllum peltatum*	PODPEL	native	3	3
downy solomon seal	*Polygonatum pubescens*	POLPUB	native	5	5
old-field cinquefoil	*Potentilla simplex*	POTSIM	native	2	3
wild black cherry	*Prunus serotina*	PRUSER	native	2	3
choke cherry	*Prunus virginiana*	PRUVIR	native	2	3
white oak	*Quercus alba*	QUEALB	native	5	3
black oak	*Quercus velutina*	QUEVEL	native	6	5
prickly or wild gooseberry	*Ribes cynosbati*	RIBCYN	native	4	3
pasture rose	*Rosa carolina*	ROSCAR	native	4	3
multiflora rose	***Rosa multiflora***	**ROSMUL**	**non-native**	**0**	**3**
common blackberry	*Rubus allegheniensis*	RUBALL	native	1	3
northern dewberry	*Rubus flagellaris*	RUBFLA	native	1	3
black raspberry	*Rubus occidentalis*	RUBOCC	native	1	5
bloodroot	*Sanguinaria canadensis*	SANCAA	native	5	3
black snakeroot	*Sanicula odorata*	SANODO	native	2	0
sassafras	*Sassafras albidum*	SASALB	native	5	3
false melic	*Schizachne purpurascens*	SCHPUP	native	5	3

Appendix 2 (continued). Plant species observed in Sparks Woods dry southern forest (EO ID 24247 pg 27) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
early figwort	*Scrophularia lanceolata*	SCRLAN	native	5	3
bristly greenbrier	*Smilax hispida; s. tamnoides*	SMIHIS	native	5	0
bluestem goldenrod	*Solidago caesia*	SOLCAE	native	6	3
heart-leaved aster	*Symphyotrichum cordifolium*	SYMCOR	native	4	5
poison-ivy	*Toxicodendron radicans*	TOXRAD	native	2	0
maple-leaved viburnum	*Viburnum acerifolium*	VIBACE	native	6	5
american vetch	*Vicia americana*	VICAME	native	5	3
yellow violet	*Viola pubescens*	VIOPUB	native	4	3
prickly-ash	*Zanthoxylum americanum*	ZANAME	native	3	3

Appendix 3. Combined conservation metrics for three polygons of Ziibiqua Woods dry-mesic southern forest (EO ID 23909 pg 31).

Conservatism-Based Metrics:

Total Mean C:	4.2
Native Mean C:	4.6
Total FQI:	61.3
Native FQI:	64.7
Adjusted FQI:	44.4
% C value 0:	10.3
% C value 1-3:	20.7
% C value 4-6:	54
% C value 7-10:	15
Native Tree Mean C:	4.4
Native Shrub Mean C:	3.7
Native Herbaceous Mean C:	4.7

Species Richness:

Total Species:	213	
Native Species:	198	93%
Non-native Species:	15	7%

Species Wetness:

Mean Wetness:	1.7
Native Mean Wetness:	1.6

Physiognomy Metrics:

Tree:	32	15%
Shrub:	20	9.40%
Vine:	8	3.80%
Forb:	108	50.70%
Grass:	21	9.90%
Sedge:	8	3.80%
Rush:	2	0.90%
Fern:	14	6.60%
Bryophyte:	0	0%

Duration Metrics:

Annual:	6	2.80%
Perennial:	200	93.90%
Biennial:	7	3.30%
Native Annual:	5	2.30%
Native Perennial:	189	88.70%
Native Biennial:	4	1.90%

Appendix 4. Plant species observed in Ziibiqua Woods dry-mesic southern forest (EO ID 23909 pg 31) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
red maple	*Acer rubrum*	ACERUB	native	1	0
silver maple	*Acer saccharinum*	ACESAI	native	2	-3
sugar maple	*Acer saccharum*	ACESAU	native	5	3
dolls-eyes	*Actaea pachypoda*	ACTPAC	native	7	5
maidenhair fern	*Adiantum pedatum*	ADIPED	native	6	3
white snakeroot	*Ageratina altissima*	AGEALT	native	4	3
tall agrimony	*Agrimonia gryposepala*	AGRGRY	native	2	3
autumn bent	*Agrostis perennans*	AGRPER	native	5	3
garlic mustard	***Alliaria petiolata***	**ALLPET**	**non-native**	**0**	**3**
wild leek	*Allium tricoccum*	ALLTRI	native	5	3
juneberry	*Amelanchier arborea*	AMEARB	native	4	3
hog-peanut	*Amphicarpaea bracteata*	AMPBRA	native	5	0
canada anemone	*Anemone canadensis*	ANECAN	native	4	-3
wood anemone	*Anemone quinquefolia*	ANEQUI	native	5	3
smooth pussytoes	*Antennaria parlinii*	ANTPAL	native	2	5
spreading dogbane	*Apocynum androsaemifolium*	APOAND	native	3	5
wild columbine	*Aquilegia canadensis*	AQUCAN	native	5	3
wild sarsaparilla	*Aralia nudicaulis*	ARANUD	native	5	3
spikenard	*Aralia racemosa*	ARARAC	native	8	3
common burdock	***Arctium minus***	**ARCMIN**	**non-native**	**0**	**3**
jack-in-the-pulpit	*Arisaema triphyllum*	ARITRI	native	5	0
wild-ginger	*Asarum canadense*	ASACAN	native	5	5
pawpaw	*Asimina triloba*	ASITRI	native	9	0
ebony spleenwort	*Asplenium platyneuron*	ASPPLA	native	2	3
lady fern	*Athyrium filix-femina*	ATHFIL	native	4	0
smooth false foxglove	*Aureolaria flava*	AURFLA	native	8	5
japanese barberry	***Berberis thunbergii***	**BERTHU**	**non-native**	**0**	**3**
common beggar-ticks	*Bidens frondosa*	BIDFRO	native	1	-3
sickle-pod	*Boechera canadensis*	BOECAN	native	7	5
smooth bank cress	*Boechera laevigata*	BOELAE	native	5	5
false nettle	*Boehmeria cylindrica*	BOECYL	native	5	-5
rattlesnake fern	*Botrypus virginianus*	BOTVIR	native	5	3
long-awned wood grass	*Brachyelytrum erectum*	BRAERE	native	7	5
satin brome	*Bromus nottowayanus*	BRONOT	native	7	0
marsh-marigold	*Caltha palustris*	CALPAR	native	6	-5
harebell	*Campanula rotundifolia*	CAMROT	native	6	3
pennsylvania bitter cress	*Cardamine pensylvanica*	CARPEN	native	1	-3
sedge	*Carex cephaloidea*	CXCEPD	native	5	3
sedge	*Carex gracillima*	CXGRAA	native	4	3
sedge	*Carex pedunculata*	CXPEDU	native	5	3
sedge	*Carex pensylvanica*	CXPENS	native	4	5
curly-styled wood sedge	*Carex rosea; c. convoluta*	CXROSE	native	2	5
sedge	*Carex sprengelii*	CXSPRE	native	5	0
sedge	*Carex stipata*	CXSTIP	native	1	-5
sedge	*Carex stricta*	CXSTRI	native	4	-5
blue-beech	*Carpinus caroliniana*	CARCAO	native	6	0
bitternut hickory	*Carya cordiformis*	CARCOR	native	5	0
pignut hickory	*Carya glabra*	CARGLA	native	5	3
shagbark hickory	*Carya ovata*	CAROVA	native	5	3
blue cohosh	*Caulophyllum thalictroides*	CAUTHA	native	5	5
oriental bittersweet	***Celastrus orbiculatus***	**CELORB**	**non-native**	**0**	**5**
hackberry	*Celtis occidentalis*	CELOCC	native	5	0
celandine	***Chelidonium majus***	**CHEMAJ**	**non-native**	**0**	**5**
turtlehead	*Chelone glabra*	CHEGLB	native	7	-5

Appendix 4 (continued). Plant species observed in Ziibiqua Woods dry-mesic southern forest (EO ID 23909 pg 31) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
wood reedgrass	*Cinna arundinacea*	CINARU	native	7	-3
enchanters-nightshade	*Circaea canadensis*	CIRCAN	native	2	3
carolina spring-beauty	*Claytonia caroliniana*	CLACAR	native	6	3
virgins bower	*Clematis virginiana*	CLEVIR	native	4	0
bastard-toadflax	*Comandra umbellata*	COMUMB	native	5	3
squaw-root	*Conopholis americana*	CONAME	native	10	5
alternate-leaved dogwood	*Cornus alternifolia*	CORALT	native	5	3
flowering dogwood	*Cornus florida*	CORFLO	native	8	3
gray dogwood	*Cornus foemina*	CORFOE	native	1	0
dotted hawthorn	*Crataegus punctata*	CRAPUN	native	1	3
common dodder	*Cuscuta gronovii*	CUSGRO	native	3	-3
fragile fern	*Cystopteris tenuis*	CYSTEN	native	5	5
poverty grass; oatgrass	*Danthonia spicata*	DANSPI	native	4	5
small-leaved tick-trefoil	*Desmodium marilandicum*	DESMAR	native	7	5
round-leaved tick-trefoil	*Desmodium rotundifolium*	DESROT	native	8	5
beak grass	*Diarrhena obovata*	DIAOBO	native	9	-3
panic grass	*Dichanthelium clandestinum*	DICCLA	native	3	-3
panic grass	*Dichanthelium dichotomum*	DICDIC	native	7	0
broad-leaved panic grass	*Dichanthelium latifolium*	DICLAT	native	5	3
wild yam	*Dioscorea villosa*	DIOVIL	native	4	0
evergreen woodfern	*Dryopteris intermedia*	DRYINT	native	5	0
autumn-olive	***Elaeagnus umbellata***	**ELAUMB**	**non-native**	**0**	**3**
canada wild rye	*Elymus canadensis*	ELYCAN	native	5	3
bottlebrush grass	*Elymus hystrix*	ELYHYS	native	5	3
virginia wild-rye	*Elymus virginicus*	ELYVIR	native	4	-3
false rue-anemone	*Enemion biternatum*	ENEBIT	native	8	0
helleborine	***Epipactis helleborine***	**EPIHEL**	**non-native**	**0**	**0**
common horsetail	*Equisetum arvense*	EQUARV	native	0	0
robins-plantain	*Erigeron pulchellus*	ERIPUL	native	5	3
big-leaved aster	*Eurybia macrophylla*	EURMAC	native	4	5
joe-pye-weed	*Eutrochium maculatum*	EUTMAC	native	4	-5
green-stemmed joe-pye-weed	*Eutrochium purpureum*	EUTPUR	native	5	0
american beech	*Fagus grandifolia*	FAGGRA	native	6	3
nodding fescue	*Festuca subverticillata*	FESSUB	native	5	3
white ash	*Fraxinus americana*	FRAAME	native	5	3
annual bedstraw	*Galium aparine*	GALAPA	native	0	3
white wild licorice	*Galium circaezans*	GALCIR	native	4	3
shining bedstraw	*Galium concinnum*	GALCON	native	5	3
yellow wild licorice	*Galium lanceolatum*	GALLAN	native	4	5
huckleberry	*Gaylussacia baccata*	GAYBAC	native	7	3
wild geranium	*Geranium maculatum*	GERMAC	native	4	3
yellow avens	*Geum aleppicum*	GEUALE	native	3	0
white avens	*Geum canadense*	GEUCAN	native	1	0
witch-hazel	*Hamamelis virginiana*	HAMVIR	native	5	3
round-lobed hepatica	*Hepatica americana*	HEPAME	native	6	5
dames rocket	***Hesperis matronalis***	**HESMAT**	**non-native**	**0**	**3**
prairie alum root	*Heuchera richardsonii*	HEURIC	native	8	3
hairy hawkweed	*Hieracium gronovii*	HIEGRO	native	5	5
clustered-leaved tick-trefoil	*Hylodesmum glutinosum*	HYLGLU	native	5	5
naked tick-trefoil	*Hylodesmum nudiflorum*	HYLNUD	native	7	5
spotted touch-me-not	*Impatiens capensis*	IMPCAP	native	2	-3
black walnut	*Juglans nigra*	JUGNIG	native	5	3
path rush	*Juncus tenuis*	JUNTEN	native	1	0
red-cedar	*Juniperus virginiana*	JUNVIR	native	3	3

Appendix 4 (continued). Plant species observed in Ziibiqua Woods dry-mesic southern forest (EO ID 23909 pg 31) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
wood nettle	*Laportea canadensis*	LAPCAN	native	4	-3
white grass	*Leersia virginica*	LEEVIR	native	5	-3
michigan lily	*Lilium michiganense*	LILMIC	native	5	-3
broad-leaved puccoon	*Lithospermum latifolium*	LITLAT	native	10	5
great blue lobelia	*Lobelia siphilitica*	LOBSIP	native	4	-3
amur honeysuckle	***Lonicera maackii***	**LONMAA**	**non-native**	**0**	**5**
morrow honeysuckle	***Lonicera morrowii***	**LONMOR**	**non-native**	**0**	**3**
hairy wood rush	*Luzula acuminata*	LUZACU	native	5	3
canada mayflower	*Maianthemum canadense*	MAICAN	native	4	3
false spikenard	*Maianthemum racemosum*	MAIRAC	native	5	3
starry false solomon-seal	*Maianthemum stellatum*	MAISTE	native	5	0
indian cucumber-root	*Medeola virginiana*	MEDVIR	native	10	3
wood millet	*Milium effusum*	MILEFF	native	8	3
partridge-berry	*Mitchella repens*	MITREP	native	5	3
bishops-cap	*Mitella diphylla*	MITDIP	native	8	3
indian-pipe	*Monotropa uniflora*	MONOUN	native	5	3
slender satin grass	*Muhlenbergia tenuiflora*	MUHTEN	native	8	5
sensitive fern	*Onoclea sensibilis*	ONOSEN	native	2	-3
rough-leaved rice-grass	*Oryzopsis asperifolia*	ORYASP	native	6	5
hairy sweet-cicely	*Osmorhiza claytonii*	OSMCLI	native	4	3
smooth sweet-cicely	*Osmorhiza longistylis*	OSMLON	native	3	3
cinnamon fern	*Osmunda cinnamomea*	OSMCIN	native	5	-3
interrupted fern	*Osmunda claytoniana*	OSMCLN	native	6	0
royal fern	*Osmunda regalis*	OSMREG	native	5	-5
ironwood; hop-hornbeam	*Ostrya virginiana*	OSTVIR	native	5	3
yellow wood-sorrel	*Oxalis stricta*	OXASTR	native	0	3
golden ragwort	*Packera aurea*	PACAUR	native	5	-3
virginia creeper	*Parthenocissus quinquefolia*	PARQUI	native	5	3
wood-betony	*Pedicularis canadensis*	PEDCAN	native	10	3
jumpseed	*Persicaria virginiana*	PERVIR	native	4	0
reed canary grass	***Phalaris arundinacea***	**PHAARU**	**non-native**	**0**	**-3**
lopseed	*Phryma leptostachya*	PHRLEP	native	4	3
white pine	*Pinus strobus*	PINSTR	native	3	3
black oatgrass	*Piptochaetium avenaceum*	PIPAVE	native	10	3
bluegrass	*Poa alsodes*	POAALS	native	9	0
bluegrass	*Poa saltuensis*	POASAL	native	5	5
may-apple	*Podophyllum peltatum*	PODPEL	native	3	3
solomon-seal	*Polygonatum biflorum*	POLBIF	native	4	3
downy solomon seal	*Polygonatum pubescens*	POLPUB	native	5	5
christmas fern	*Polystichum acrostichoides*	POLACR	native	6	3
big-tooth aspen	*Populus grandidentata*	POPGRA	native	4	3
quaking aspen	*Populus tremuloides*	POPTRE	native	1	0
old-field cinquefoil	*Potentilla simplex*	POTSIM	native	2	3
white lettuce	*Prenanthes alba*	PREALB	native	5	3
tall white lettuce	*Prenanthes altissima*	PREALT	native	5	3
self-heal	*Prunella vulgaris*	PRUVUL	native	0	0
sweet cherry	***Prunus avium***	**PRUAVI**	**non-native**	**0**	**5**
wild black cherry	*Prunus serotina*	PRUSER	native	2	3
choke cherry	*Prunus virginiana*	PRUVIR	native	2	3
bracken fern	*Pteridium aquilinum*	PTEAQU	native	0	3
round-leaved pyrola	*Pyrola americana*	PYRAME	native	7	0
white oak	*Quercus alba*	QUEALB	native	5	3
bur oak	*Quercus macrocarpa*	QUEMAC	native	5	3
red oak	*Quercus rubra*	QUERUB	native	5	3

Appendix 4 (continued). Plant species observed in Ziibiqua Woods dry-mesic southern forest (EO ID 23909 pg 31) during 2019 natural community surveys.

Common Name	Scientific Name	Acronym	Native?	C	W
black oak	*Quercus velutina*	QUEVEL	native	6	5
small-flowered buttercup	*Ranunculus abortivus*	RANABO	native	0	0
swamp buttercup	*Ranunculus hispidus*	RANHIS	native	5	0
prickly or wild gooseberry	*Ribes cynosbati*	RIBCYN	native	4	3
pasture rose	*Rosa carolina*	ROSCAR	native	4	3
multiflora rose	***Rosa multiflora***	**ROSMUL**	**non-native**	**0**	**3**
common blackberry	*Rubus allegheniensis*	RUBALL	native	1	3
northern dewberry	*Rubus flagellaris*	RUBFLA	native	1	3
swamp dewberry	*Rubus hispidus*	RUBHIS	native	4	-3
black raspberry	*Rubus occidentalis*	RUBOCC	native	1	5
black-eyed susan	*Rudbeckia hirta*	RUDHIR	native	1	3
cut-leaf coneflower	*Rudbeckia laciniata*	RUDLAC	native	6	-3
curly dock	***Rumex crispus***	**RUMCRI**	**non-native**	**0**	**0**
water dock	*Rumex verticillatus*	RUMVER	native	7	-5
elderberry	*Sambucus canadensis*	SAMCAN	native	3	-3
bloodroot	*Sanguinaria canadensis*	SANCAA	native	5	3
black snakeroot	*Sanicula odorata*	SANODO	native	2	0
sassafras	*Sassafras albidum*	SASALB	native	5	3
bristly greenbrier	*Smilax hispida*	SMIHIS	native	5	0
carrion-flower	*Smilax illinoensis*	SMIILL	native	4	5
tall goldenrod	*Solidago altissima*	SOLALT	native	1	3
bluestem goldenrod	*Solidago caesia*	SOLCAE	native	6	3
hairy goldenrod	*Solidago hispida*	SOLHIS	native	3	5
swamp goldenrod	*Solidago patula*	SOLPAT	native	6	-5
bladdernut	*Staphylea trifolia*	STATRI	native	9	0
heart-leaved aster	*Symphyotrichum cordifolium*	SYMCOR	native	4	5
panicled aster	*Symphyotrichum lanceolatum*	SYMLAN	native	2	-3
lake ontario aster	*Symphyotrichum ontarionis*	SYMONT	native	6	0
arrow-leaved aster	*Symphyotrichum urophyllum*	SYMURO	native	2	5
skunk-cabbage	*Symplocarpus foetidus*	SYMFOE	native	6	-5
yellow-pimpernel	*Taenidia integerrima*	TAEINT	native	8	5
purple meadow-rue	*Thalictrum dasycarpum*	THADAS	native	3	-3
early meadow-rue	*Thalictrum dioicum*	THADIO	native	6	3
new york fern	*Thelypteris noveboracensis*	THENOV	native	5	0
arbor vitae	*Thuja occidentalis*	THUOCC	native	4	-3
basswood	*Tilia americana*	TILAME	native	5	3
hedge-parsley	***Torilis japonica***	**TORJAP**	**non-native**	**0**	**3**
poison-ivy	*Toxicodendron radicans*	TOXRAD	native	2	0
common trillium	*Trillium grandiflorum*	TRIGRA	native	5	3
hemlock	*Tsuga canadensis*	TSUCAN	native	5	3
tower mustard	*Turritis glabra*	TURGLA	native	3	5
american elm	*Ulmus americana*	ULMAME	native	1	-3
stinging nettle	*Urtica dioica*	URTDIO	native	1	0
bellwort	*Uvularia grandiflora*	UVUGRA	native	5	5
low sweet blueberry	*Vaccinium angustifolium*	VACANG	native	4	3
white vervain	*Verbena urticifolia*	VERURT	native	4	0
common speedwell	***Veronica officinalis***	**VEROOF**	**non-native**	**0**	**3**
culvers-root	*Veronicastrum virginicum*	VERVIR	native	8	0
maple-leaved viburnum	*Viburnum acerifolium*	VIBACE	native	6	5
yellow violet	*Viola pubescens*	VIOPUB	native	4	3
prickly-ash	*Zanthoxylum americanum*	ZANAME	native	3	3

Appendix 5. Conservation metrics for Fallass Wet Meadow southern wet meadow (EO ID 23908 pg 39).

Conservatism-Based Metrics:

Total Mean C:	3.9
Native Mean C:	4.3
Total FQI:	28.7
Native FQI:	30.1
Adjusted FQI:	41
% C value 0:	9.3
% C value 1-3:	31.5
% C value 4-6:	50
% C value 7-10:	9.3
Native Tree Mean C:	3.7
Native Shrub Mean C:	4
Native Herbaceous Mean C:	4.6

Physiognomy Metrics:

Tree:	9	16.70%
Shrub:	10	18.50%
Vine:	3	5.60%
Forb:	23	42.60%
Grass:	3	5.60%
Sedge:	4	7.40%
Rush:	0	0%
Fern:	2	3.70%
Bryophyte:	0	0%

Species Richness:

Total Species:	54	
Native Species:	49	90.70%
Non-native Species:	5	9.30%

Duration Metrics:

Annual:	1	1.90%
Perennial:	51	94.40%
Biennial:	2	3.70%
Native Annual:	1	1.90%
Native Perennial:	46	85.20%
Native Biennial:	2	3.70%

Species Wetness:

Mean Wetness:	-1.9
Native Mean Wetness:	-2.3

Appendix 6. Plant species observed in Fallass Wet Meadow southern wet meadow (EO ID 23908 pg 39) during 2019 natural community surveys.

Scientific Name	Common Name	Acronym	Native?	C	W
Asclepias incarnata	swamp milkweed	ASCINC	native	6	-5
Asclepias syriaca	common milkweed	ASCSYR	native	1	5
Berula erecta	water-parsnip	BERERE	native	10	-5
Bromus ciliatus	fringed brome	BROCIL	native	6	-3
Carex bromoides	sedge	CXBROM	native	6	-3
Carex lacustris	sedge	CXLACU	native	6	-5
Carex stricta	sedge	CXSTRI	native	4	-5
Carpinus caroliniana	blue-beech	CARCAO	native	6	0
Cicuta maculata	water hemlock	CICMAC	native	4	-5
Cirsium muticum	swamp thistle	CIRMUT	native	6	-5
Clematis virginiana	virgins bower	CLEVIR	native	4	0
Cornus amomum	silky dogwood	CORAMO	native	2	-3
Cornus sericea	red-osier	CORSER	native	2	-3
Elaeagnus umbellata	**autumn-olive**	**ELAUMB**	**non-native**	**0**	**3**
Epilobium coloratum	cinnamon willow-herb	EPICOL	native	3	-5
Eupatorium perfoliatum	boneset	EUPPER	native	4	-3
Eutrochium maculatum	joe-pye-weed	EUTMAC	native	4	-5
Fraxinus pennsylvanica	red ash	FRAPEN	native	2	-3
Galium asprellum	rough bedstraw	GALASP	native	5	-5
Gentiana andrewsii	bottle gentian	GENAND	native	5	-3
Helianthus giganteus	tall sunflower	HELGIG	native	5	-3
Impatiens capensis	spotted touch-me-not	IMPCAP	native	2	-3
Juniperus virginiana	red-cedar	JUNVIR	native	3	3
Leersia virginica	white grass	LEEVIR	native	5	-3
Lindera benzoin	spicebush	LINBEN	native	7	-3
Lonicera morrowii	**morrow honeysuckle**	**LONMOR**	**non-native**	**0**	**3**
Mentha canadensis	wild mint	MENCAS	native	3	-3
Micranthes pensylvanica	swamp saxifrage	MICPEN	native	10	-5
Onoclea sensibilis	sensitive fern	ONOSEN	native	2	-3
Ostrya virginiana	ironwood; hop-hornbeam	OSTVIR	native	5	3
Packera aurea; senecio a.	golden ragwort	PACAUR	native	5	-3
Pedicularis lanceolata	swamp-betony	PEDLAN	native	8	-3
Poa compressa	**canada bluegrass**	**POACOM**	**non-native**	**0**	**3**
Populus tremuloides	quaking aspen	POPTRE	native	1	0
Quercus macrocarpa	bur oak	QUEMAC	native	5	3
Quercus rubra	red oak	QUERUB	native	5	3
Ranunculus hispidus	swamp buttercup	RANHIS	native	5	0
Ribes americanum	wild black currant	RIBAME	native	6	-3
Rosa multiflora	**multiflora rose**	**ROSMUL**	**non-native**	**0**	**3**
Rosa palustris	swamp rose	ROSPAL	native	5	-5
Rubus strigosus	wild red raspberry	RUBSTR	native	2	0
Rumex verticillatus	water dock	RUMVER	native	7	-5
Scirpus atrocinctus	wool-grass	SCIATC	native	5	-5
Solanum dulcamara	**bittersweet nightshade**	**SOLDUL**	**non-native**	**0**	**0**
Solidago canadensis	canada goldenrod	SOLCAN	native	1	3
Solidago patula	swamp goldenrod	SOLPAT	native	6	-5
Solidago rugosa	rough-leaved goldenrod	SOLRUG	native	3	0
Symphyotrichum novae-angliae	new england aster	SYMNOV	native	3	-3
Thelypteris palustris	marsh fern	THEPAL	native	2	-3
Tilia americana	basswood	TILAME	native	5	3
Typha latifolia	broad-leaved cat-tail	TYPLAT	native	1	-5
Ulmus americana	american elm	ULMAME	native	1	-3
Viburnum lentago	nannyberry	VIBLEN	native	4	0
Viola cucullata	marsh violet	VIOCUC	native	5	-5

Appendix 7. All reptile and amphibian species observed during surveys in Saranac-Lowell State Game Area.

Amphibian/ Reptile	Common Name[1,3]	Scientific Name[1]	US Status	State Status	WAP SGCN[2]	Rare Species Targeted for 2021 Surveys	Species Observed in 2021 by MNFI and/or Other Sources	Species Observed Prior to 2021	General Habitat Description[3,4]
Amphibian	Marbled Salamander	*Ambystoma opacum*		E	X	X			Moist lowland forests most common but also drier wooded ridges and rocky hillside; spend most of time hidden beneath logs, rocks, and leaf litter; tolerant of dry conditions but will move into deeper burrows to avoid summer heat.
Amphibian	Eastern Red-backed Salamander	*Plethodon cinereus*					X		Deciduous, coniferous, and mixed forests; avoid areas prone to frequent flooding or with dry sandy soils but otherwise tolerate a wide range of forest conditions; most often under logs, fallenbark, leaf litter, and rocks.
Amphibian	Eastern American Toad	*Anaxyrus [Bufo] americanus americanus*					X		Open forests, forest edges, prairies, marshes, and meadows, suburban yards ad agricultural areas; usually buried in moist soil or leaf litter or beneath logs or rocks.
Amphibian	Fowler's Toad	*Anaxyrus [Bufo] fowleri*		SC	X	X		Species observed nearby	Open woodlands, sand prairies, meadows, dunes, and beaches, also agricultural areas and suburban backyards; closely associated with sandy soils, particularly along lake shorelines and river valleys
Amphibian	Blanchard's Cricket Frog	*Acris blanchardi*		T	X			Species observed nearby	Open, muddy edges of permanent ponds, lakes, bogs, and slow-moving streams or rivers with abundant aquatic vegetation, including fens and wet or sedge meadows
Amphibian	Northern Spring Peeper	*Pseudacris crucifer crucifer*					X		Temporary and permanent ponds, marshes, floodings, and ditches, as well as forests, old fields, shrubby areas
Amphibian	Gray Treefrog (Eastern & Cope's)	*Hyla versicolor / Hyla chrysoscelis*					X		Temporary ponds, swamps, floodings, shallow edges of permanent lakes, and sloughs, surrounded by forested or open habitats; deciduous or mixed forests, farm woodlots, swamps, old fields, suburban yards - anywhere with suitable breeding ponds adjacent to trees or shrubs.
Amphibian	Wood Frog	*Lithobates [Rana] sylvaticus*					X		Moist, forested habitats (deciduous, coniferous, and mixed); breeding - vernal ponds, floodings, forested swamps, and quiet stream backwaters
Reptile	Wood Turtle	*Glyptemys insculpta*		SC	X	X			Sand-bottomed streams or rivers, also streams with rocky or silty beds; mostly terrestrial during summer months - forests, alder thickets, swamps, wet meadows, and fields within or near the floodplain, generally within 150 m (500 ft) of moving water; nest in open sandy habitats along or near rivers and streams
Reptile	Eastern Box Turtle	*Terrapene carolina carolina*		SC	X	X	X		Deciduous or mixed forests, esp. with sandy soils, also adjacent old fields, pastures, dunes, marshes, and bog edges
Reptile	Blanding's Turtle	*Emydoidea blandingii*		SC	X	X			Shallow, weedy waters - ponds, marshes, forested and shrub swamps, wet meadows, lake inlets/coves, rivers backwaters, embayments, sloughs, vernal pools
Reptile	Queen Snake	*Regina septemvittata*		SC	X	X			Warm, shallow, rocky-bottomed streams with abundance of crayfish; edges of ponds, lakes, marshes, ditches and canals, open to mostly forested but totally shaded sites are avoided; often bask at water's edge or in overhanging shrubbery or
Reptile	Eastern Gartersnake	*Thamnophis sirtalis sirtalis*					X		Almost any natural habitats - open and forested habitats and moist grassy places - edges of ponds, lakes, streams, and ditches
Reptile	Eastern Hog-nosed Snake *	*Heterodon platirhinos*					X		All types of terrestrial habitats - from open pine or deciduous forests to old fields, meadows, and pastures. Prefer sandy, well-drained soils.
Reptile	Blue Racer	*Coluber constrictor foxii*			X		X		Dry sunny, open habitats with access to cover - old fields, hedgerows, shrub thickets, open forests, forest edges, also grassy lake borders and marshes
Reptile	Gray Ratsnake	*Pantherophis spiloides*		SC	X	X			In or near forests, and adjacent open habitats - shrubby fields, pastures, marsh and bog edges

Key:

U.S. Status: LE = Federally Endangered; LT = Federally Threatened; C = Federal Candidate

State Status: E = State Endangered; T = State Threatened; SC = State Special Concern

WAP SGCN - Wildlife Action Plan Species of Greatest Conservation Need

* - Species was a SGCN prior to 2015 but was removed from the list of SGCN by the Michigan DNR in 2015.

Appendix 8. Global and State Element Ranking Criteria.

GLOBAL RANKS

G1 = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.

G2 = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.

G3 = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.

G4 = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = secure: common; widespread.

GU = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GX = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

G? = incomplete data.

STATE RANKS

S1 = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 = uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 = common and widespread in the state.

SX = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S? = incomplete data.