

Identifying Recoverable Fire-Dependent Systems in the Cadillac-Manistee District of the Huron-Manistee National Forest: 2024-2025 Surveys



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We also acknowledge that Indigenous Peoples and their cultural practices were, and are, integral parts of Michigan's ecosystems.

Cover Photo: The Manistee River Corridor. All photos by J.M. Lincoln unless otherwise indicated.

EXECUTIVE SUMMARY

Fire-dependent natural communities are among the most imperiled ecosystems in Michigan. We define Recoverable Fire-Dependent Systems (RFDS) as altered ecosystems whose composition, structure, and ecological processes were historically shaped by recurrent fire and that retain sufficient native composition and structural features for their ecological integrity to improve through stewardship. In partnership with the United States Forest Service (Forest Service), the Michigan Natural Features Inventory (MNFI) continued a landscape-scale effort to identify and evaluate RFDS on the Cadillac-Manistee District of the Huron-Manistee National Forest and develop conservation priorities and management recommendations. The work was funded by the Michigan Department of Natural Resources (DNR) through a Good Neighbor Authority agreement with the Forest Service.

MNFI previously developed a prescribed fire needs assessment model for DNR lands that integrates vegetation, landforms, and other ecological variables to estimate the relative ecological need for prescribed fire across the landscape. In 2022, MNFI applied the model to the Cadillac-Manistee District to guide targeted field surveys for RFDS. A refined model developed for the 2024-2025 surveys identified 56.9% of the District as having high, very high, or highest need for fire stewardship.

The work presented in this report built on the initial 2022 application of the prescribed fire needs assessment model and associated field surveys by updating the model and conducting additional field investigation in 2024 and 2025. Across both phases, the project identified 27 previously undocumented natural community element occurrences (EOs) encompassing 801 acres and identified additional RFDS that did not meet criteria for EO recognition but retain conservation value and potential for recovery. These EOs and other RFDS were grouped into potential project areas to identify where prescribed fire and other stewardship could be coordinated across connected sites. Together, the model and field surveys provided a landscape-level assessment of previously undocumented natural communities and other RFDS.

Field investigation improved understanding of natural community distribution on the District. Surveys identified Michigan's largest documented occurrences of hillside prairie, wet-mesic prairie, and clay bluff; these findings also represented geographic range expansions for all three community types. Other findings included oak-pine barrens, dry-mesic northern forest, wet-mesic sand prairie, bog, and intermittent wetland. Surveys also identified extensive forests and barrens below MNFI thresholds for EO recognition that retain native vegetation, structural legacies, fire-scar evidence, habitat for fire-dependent wildlife, and strong potential for improvement through prescribed fire and ecological silviculture.

Significant conservation opportunities remain within landscapes whose ecological value may be obscured by fire suppression, past timber management, and recreational impacts. Fire-dependent recoverable systems retain native plant assemblages, characteristic structural features, and continuity with the ecological processes that shaped them; these attributes cannot be readily reconstructed once lost. Stewardship should therefore be organized around remnants that retain enough of the characteristic native composition and structure to serve as nuclei for recovery. Management of these "dynamic cores" should first reverse the effects of fire suppression through multiple prescribed fires, invasive species control, and reduction of woody encroachment, with canopy reduction used where needed to recover degraded prairie or barrens structure. Prescribed fire and carefully sequenced ecological silviculture can then extend recovery outward into the surrounding fire-dependent landscape, with fire applied across compatible ecological boundaries rather than confined to individual natural community occurrences. Prescribed fire may be needed more frequently during initial recovery before reducing this frequency as composition and structure improve. Treatment effectiveness is best evaluated using vegetation monitoring, permanent photo points, and management records rather than solely examining total acres treated.

Future work will ideally prioritize surveying under-inventoried forests and wetlands, and reassessing Research Natural Areas using current methods. Applying the RFDS approach in other fire-dependent landscapes could identify additional conservation priorities and evaluate its usefulness across a broader range of ecological settings. Continued collaboration among the Forest Service, DNR, and MNFI will be important for translating these findings into stewardship.

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INTRODUCTION

Background

Historically, fire occurred at a landscape scale through Indigenous cultural burning and lightning ignitions. Fire frequency, intensity, and ecological effects varied with landform, soils, hydrology, and vegetation, maintaining a continuum of fire-dependent ecosystems that included forests, open wetlands, prairies, barrens, and savannas (Comer et al. 1995; Cleland et al. 2004; Stambaugh et al. 2024). The forced removal of Indigenous Peoples throughout the 1800s, the associated decline of cultural burning, and the later institution of wildfire suppression altered many of these ecosystems through woody encroachment, mesophication, altered regeneration, and losses of compositional and structural diversity (Nowacki and Abrams 2008; Ratajczak et al. 2012; Cohen et al. 2021; Stambaugh et al. 2024). In particular, prairie, savanna, and barrens remnants in Michigan and elsewhere in the upper midwestern United States have been lost to fire suppression and other land use changes and reduced to approximately 0.02% of their *circa*-1800 extent (Nuzzo 1986; Sampson and Knopf 1994; O'Connor et al. 2009; Cohen et al. 2021).

Although fire-dependent ecosystems have been extensively altered, portions of the landscape retain sufficient ecological legacies and potential to recover

through stewardship. This project sought to identify both high-quality natural communities and altered areas with recovery potential. Michigan Natural Features Inventory (MNFI), Michigan's natural heritage program, maintains a geospatial database of rare plants, animals, and high-quality natural communities. 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. Indigenous peoples have been integral to Michigan's landscapes, with many natural community types shaped by native land tending practices such as cultural burning, seeding, planting, and harvesting of plants, wildlife, and fish. This cultural stewardship has been responsibly implemented with sophistication and care at seasonally appropriate times (Cohen et al. 2015; Cohen et al. 2025). High-quality examples that meet established criteria are documented as natural community element occurrences (EOs). In this report, ecosystem and system are used more broadly to describe ecological settings and processes that may encompass multiple natural communities and extend beyond mapped EO boundaries.



A high-quality oak-pine barrens remnant persists above the steep slopes of the Pine River along the transition between hillside prairie and forest. Across the District, this project identified several previously undocumented natural communities and additional sites with strong potential to improve through fire stewardship.

Natural community EOs are essential conservation targets, but they represent only a portion of the remaining fire-dependent landscape. We use Recoverable Fire-Dependent Systems (RFDS) to encompass both natural community EOs and other areas that retain some combination of native composition, ecological structure, and suitable landscape context sufficient to respond favorably to stewardship. These non-EO RFDS are presented as project areas and may surround and connect existing EOs or occur independently elsewhere in the landscape. This emphasis on existing recovery potential is consistent with international restoration standards, which recognize that ecological recovery can build upon remaining native biota and natural recovery potential (Gann et al. 2026). Recovery is most promising where characteristic ground flora, structural legacies, and connections to intact natural communities persist (Pile Knapp et al. 2024). Even where altered by fire suppression and other disturbances, RFDS can continue to support important concentrations of characteristic species and represent valuable opportunities for conservation. Identifying and prioritizing these areas provides

an opportunity to stabilize, expand, and reconnect declining fire-dependent ecosystems before they are lost entirely.

In partnership with the Michigan Department of Natural Resources (DNR) and United States Forest Service (Forest Service), MNFI conducted a landscape-scale assessment of fire-dependent ecosystems on the Cadillac-Manistee District of the Huron-Manistee National Forest (Figure 1). MNFI previously developed a prescribed fire needs assessment model for DNR lands to evaluate ecological need for prescribed fire (Cohen et al. 2021). The model integrates landforms, vegetation, and other ecological variables to estimate the relative need for prescribed fire across the landscape. In 2022, MNFI adapted the model for the Cadillac–Manistee District and in collaboration with the Forest Service used it to guide targeted field surveys for RFDS (Lincoln et al. 2022). Both the 2022 and the 2024-2025 assessments reported here were funded by the Michigan DNR through a Good Neighbor Authority agreement with the Forest Service.



Little Round Barrens is an oak-pine barrens remnant prioritized for fire stewardship by the Cadillac-Manistee District. Repeated prescribed fire and mechanical canopy reduction have expanded the area supporting characteristic barrens vegetation while maintaining open sandy nesting habitat for rare turtles.

Landscape Context

Michigan has been sub-divided into ecoregions based on glacial features, climate, and characteristic ecosystems (Albert 1995). The Cadillac-Manistee District occurs within the Newaygo Outwash Subsection, where glacial landforms and surficial deposits have produced extensive sandy outwash plains, droughty soils, and cold-air drainages that favor fire-dependent natural communities (Figure 2). These underlying landscape properties help pattern vegetation assemblages across the District at multiple scales.

Another useful source for understanding vegetation patterns across the District is the General Land Office (GLO) survey record. Conducted during the first half of the nineteenth century, GLO surveys documented tree species composition, tree size, and general land conditions throughout Michigan. MNFI ecologists later interpreted these records to reconstruct *circa*-1800 vegetation patterns across the District (Comer et al. 1995). These reconstructed *circa*-1800 vegetation maps provide additional context for understanding the historical distribution of fire-dependent systems across the District.



Oak-pine barrens on sandy outwash within the Cadillac-Manistee District. *Circa*-1800 vegetation maps indicate fire-dependent systems were widespread across portions of the Newaygo Outwash Subsection, where droughty soils and recurrent fire helped maintain open structure.

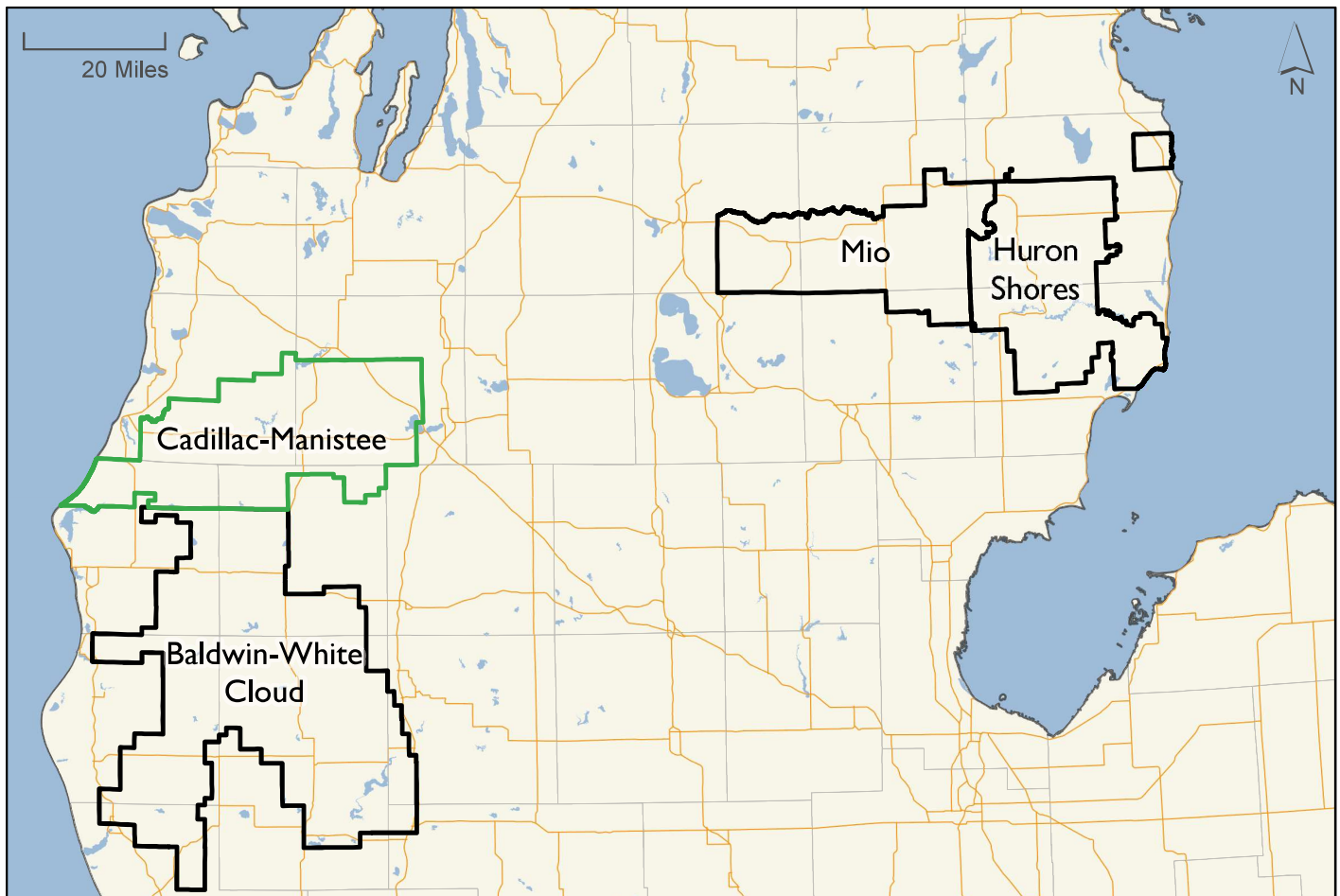


Figure 1. Location of the Cadillac-Manistee District of the Huron-Manistee National Forest. The Cadillac-Manistee is one of four ranger districts within the Huron-Manistee National Forests and encompasses approximately 251,459 acres in west-central Lower Michigan.

Around 1800, fire-dependent forests, including white pine-red pine forest, white pine-mixed hardwood forest, jack pine-red pine forest, and white pine-white oak forest, formed an extensive mosaic with embedded patches of pine barrens and oak-pine barrens (Figure 3), especially on sandy outwash plains. Collectively, fire-dependent forests covered approximately 118,186 acres (47%) of the District, while pine and oak-pine barrens occupied roughly 9,250 acres (3.7%) (Table 1). Beech-sugar maple-hemlock forest and hemlock-white pine forest were also extensive but generally experienced less frequent fire. The GLO surveys provide a coarse-scale reconstruction of historical vegetation and likely underrepresent small or linear fire-dependent natural communities such as dry sand prairie in frost pockets, hillside prairie along river corridors, and small barrens openings.

Historically, prairies, barrens, and associated fire-dependent forests formed a shifting mosaic in which the distribution and extent of natural communities changed over time in response to landforms, climate, and patterns of disturbance (Comer et al. 1995; Cohen et al. 2021). Indigenous Peoples occupied the Great Lakes region for thousands of years, and cultural burning shaped vegetation patterns and historical fire regimes across the region (Anderton 1999; Kipfmueller et al. 2021; Stambaugh et al. 2024).

Table 1. Approximate abundance of *circa*-1800 vegetation cover types within the Cadillac-Manistee District as reconstructed by MNFI ecologists from General Land Office survey notes recorded in 1839 (Comer et al. 1995).

Circa-1800 Cover Type	% Cover
BEECH-SUGAR MAPLE-HEMLOCK FOREST	34.4
WHITE PINE-RED PINE FOREST	24.3
WHITE PINE-MIXED HARDWOOD FOREST	13.2
JACK PINE-RED PINE FOREST	7.1
HEMLOCK-WHITE PINE FOREST	4.7
PINE BARRENS	3.6
MIXED CONIFER SWAMP	3.5
CEDAR SWAMP	3.0
WHITE PINE-WHITE OAK FOREST	2.4
MIXED HARDWOOD SWAMP	2.1
LAKE/RIVER	0.6
BLACK ASH SWAMP	0.4
SHRUB SWAMP/EMERGENT MARSH	0.4
SAND DUNE	0.0
OAK/PINE BARRENS	0.1
MUSKEG/BOG	< 0.1
ASPEN-BIRCH FOREST	< 0.1
HEMLOCK-YELLOW BIRCH FOREST	< 0.1

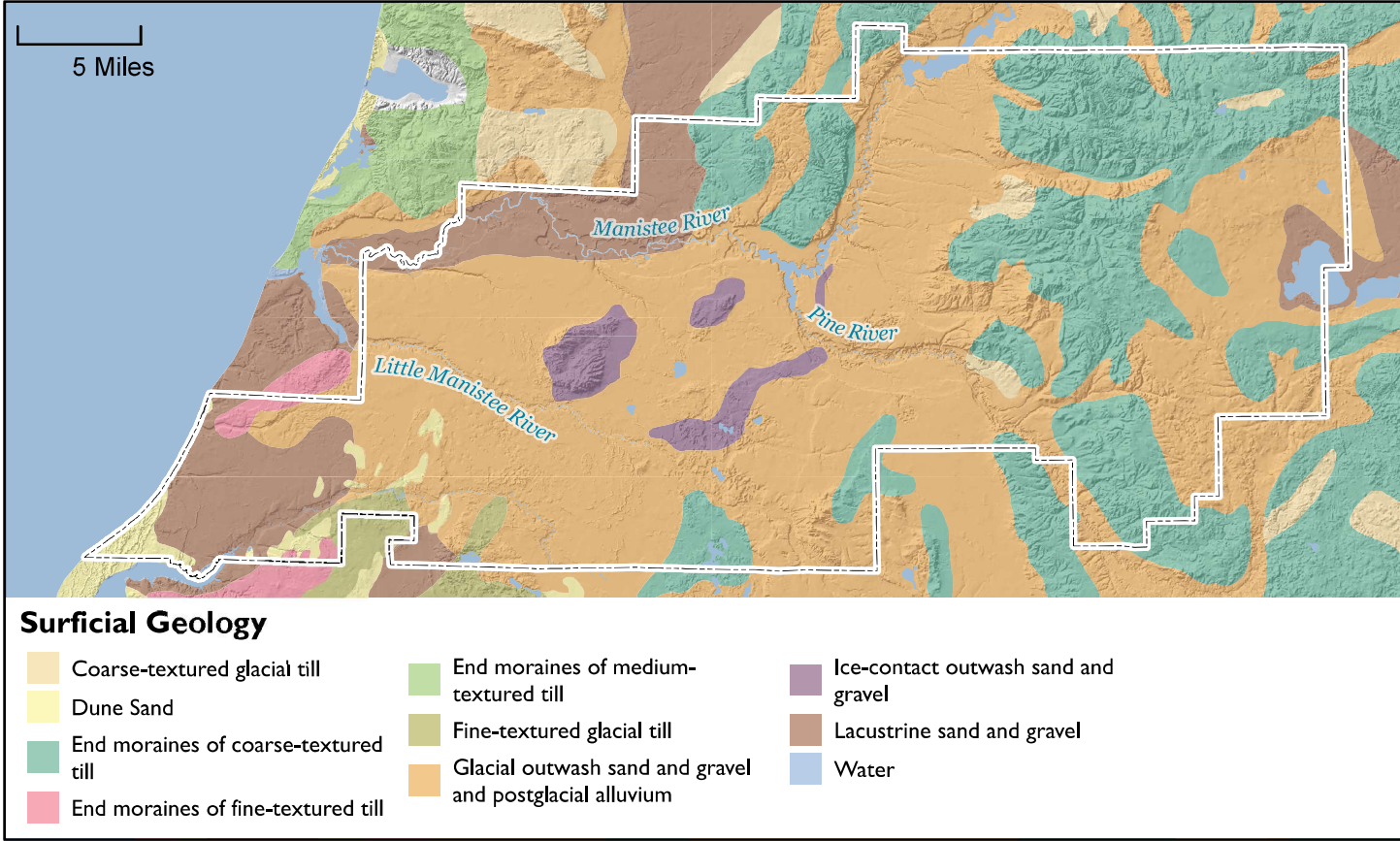


Figure 2. Surficial geology of the Cadillac-Manistee District. Glacial deposits influence landform, soil texture, drainage, and moisture conditions, helping pattern vegetation and the distribution of fire-dependent natural communities across the District.

Regional fire-history reconstructions based on red pine fire scars document frequent fire across portions of the Cadillac-Manistee District, with minimum fire intervals as short as three years before European colonization (Stambaugh et al. 2024).

European colonization disrupted Indigenous communities across the Great Lakes region before the GLO surveys of the 1830s (McDonnell 2015). The associated decline in cultural burning likely allowed some open fire-dependent systems to convert to forest before they were mapped. Subsequent timber harvest, land conversion, altered disturbance regimes, and systematic fire suppression further fragmented fire-dependent ecosystems and accelerated their conversion toward closed-canopy forest (Nowacki and Abrams 2008; Cohen et al. 2021). Today, the processes that sustained this shifting mosaic no longer function reliably, and many fire-dependent natural communities persist primarily where local environmental constraints, including drought, late-season frost, and seasonal inundation, have slowed ecological conversion following fire suppression (Lincoln et al. 2022).

Project Goals

Natural community inventory provides a coarse-filter approach to biodiversity conservation, while rare-species surveys provide complementary fine-filter information (Noss 1987; Jenkins et al. 2021). Protecting high-quality natural communities before they degrade is a fundamental conservation priority because restoration may not fully recover lost biodiversity, structure, and ecological function (Gann et al. 2026). These communities support native organisms adapted to the environmental and biotic conditions with which they evolved (Cohen et al. 2015). However, complex land-use histories, altered disturbance regimes, and ongoing impacts can make remaining examples difficult to locate and recognize (Lincoln et al. 2022). Although fire-dependent systems were historically extensive across the District, relatively few high-quality examples had been documented before this work began in 2022, reflecting both extensive degradation and limited survey effort. These occurrences provide an anchor for stewardship actions and establish reference conditions for identifying recoverable forests, barrens, prairies, and wetlands and evaluating their response to stewardship.

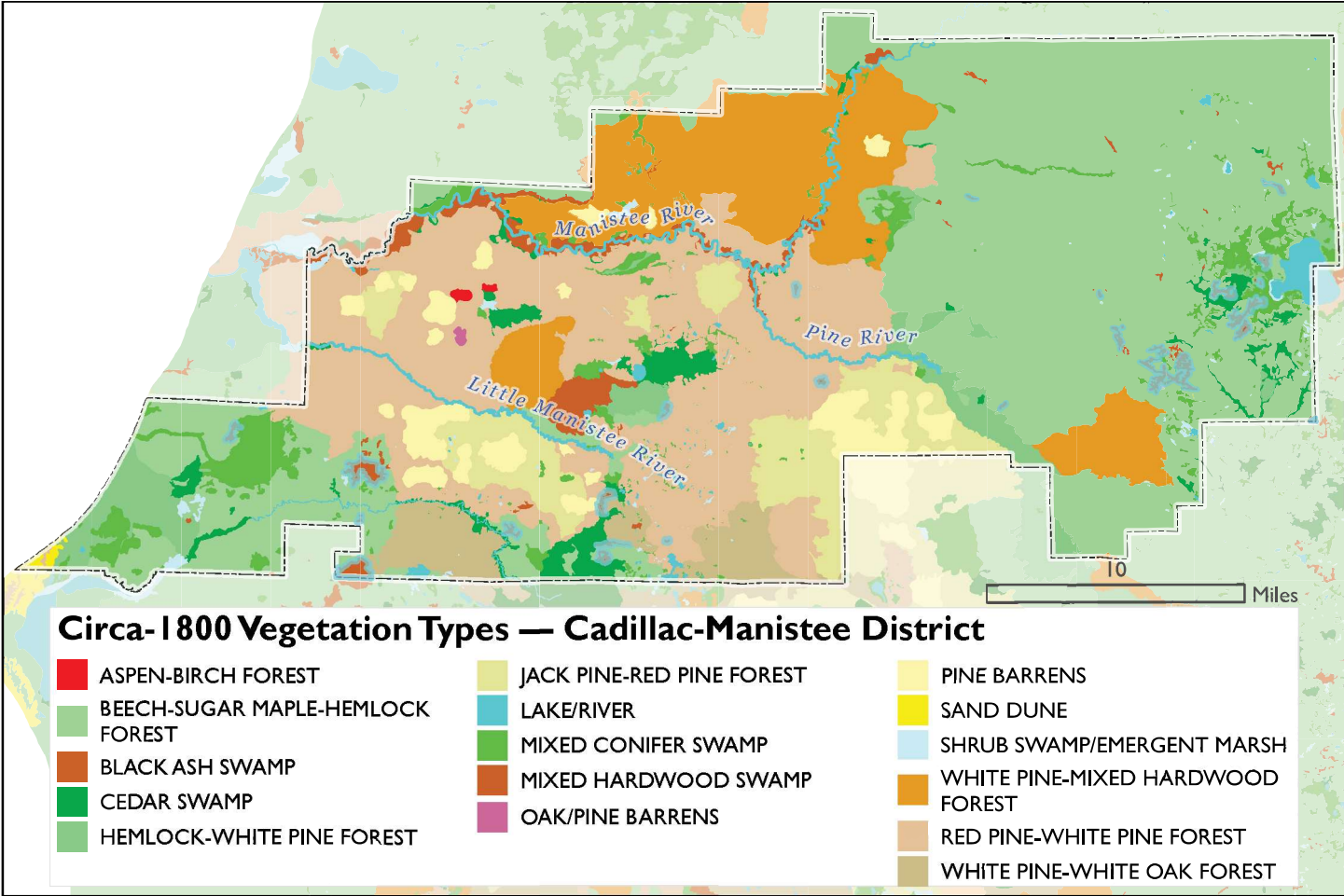


Figure 3. Vegetation of the Cadillac-Manistee District *circa* 1800 (Comer et al. 1995). MNFI ecologists interpreted nineteenth-century General Land Office survey notes to reconstruct historical vegetation patterns. These maps provide a coarse-scale view of the distribution of major natural community types and help identify landscapes that historically supported fire-dependent forests, barrens, prairies, and wetlands.

The Cadillac-Manistee project implemented in 2022 was the first application of the fire needs assessment model to identify RFDS (Lincoln et al. 2022). The project combined the prescribed fire needs assessment model with field evaluation of geomorphology, vegetation composition, and recovery potential to guide targeted surveys, which identified 16 previously undocumented natural community EOs within the District. The initial project demonstrated that landscape-scale modeling could guide targeted surveys and improve the efficiency of identifying RFDS.

Surveys conducted in 2024 and 2025 built on the 2022 assessment by identifying and evaluating additional RFDS, refining conservation priorities, and developing site-specific stewardship recommendations. These RFDS include both natural

community EOs and non-EO areas with recovery potential. We present the non-EO RFDS as project areas that may lack some attributes of high-quality natural communities but retain sufficient native composition, ecological structure, and suitable landscape context to improve through prescribed fire and other stewardship.

Extending stewardship outward from high-quality natural communities into surrounding project areas can improve ecological integrity, expand habitat for fire-dependent species, and begin rebuilding connections characteristic of the historical shifting mosaic (Pile Knapp et al. 2024). This report provides site descriptions and recommendations to protect priority conservation targets and guide long-term stewardship across the surrounding fire-dependent landscape.



Turtle Bowl Prairie supports high-quality dry sand prairie vegetation and is documented as a natural community EO. The occurrence can serve as an anchor for recovery by extending prescribed fire and other stewardship into the surrounding landscape, expanding fire-dependent vegetation and strengthening connections among nearby RFDS.

METHODS

Site Selection

We identified survey targets by using the prescribed fire needs assessment model to locate stands with high relative ecological need for prescribed fire, then refined the targets through evaluation of spatial data, existing natural community EOs, and recommendations from biologists familiar with the Cadillac-Manistee District. The prescribed fire needs assessment model used to guide this project is described in Cohen et al. (2021) and in the initial Cadillac-Manistee District report (Lincoln et al. 2022). MNFI originally developed the model for lands administered by the DNR and later modified it for the Cadillac-Manistee District. The model integrates stand-level forest data (USDA 2024) with spatial information on physiographic region, landform, *circa*-1800 vegetation, slope, aspect, and documented occurrences of high-quality natural communities and rare species. Stand-level data were crosswalked to MNFI natural community types (Cohen et al. 2015; Cohen et al. 2025) and evaluated using information on community fire dependence and estimated fire frequency. These variables were combined using GIS-based multicriteria decision analysis to generate a relative prescribed fire needs score for each stand. Model weights were based on literature review and expert opinion rather than empirical statistical analysis. Further description of the model is provided in Appendix 1.

Surveys conducted in 2024 and 2025 built upon the model output and findings from the initial 2022 field season. Areas with concentrations of high-scoring stands were reviewed using aerial imagery, topographic maps, surficial geology, *circa*-1800 vegetation, existing natural community and rare species records, and observations from previous surveys. Particular attention was given to landforms and landscape settings with the potential to support fire-dependent natural communities that were underrepresented during the 2022 surveys (Lincoln et al. 2022). Survey targets were also identified by District staff, and field priorities were refined as new information emerged during surveys.

Field Surveys

We conducted targeted natural community surveys within survey targets of the Cadillac-Manistee District during the 2024 and 2025 growing seasons. Qualitative meander surveys were used to evaluate natural community classification, boundaries, and attributes. While conducting surveys, we documented vegetation composition and structure, soils, landform and hydrologic setting, natural ecological processes, current and historical disturbances, invasive species, threats, and stewardship needs. Field observations were supplemented through interpretation of current and historical aerial imagery and GIS data. Survey

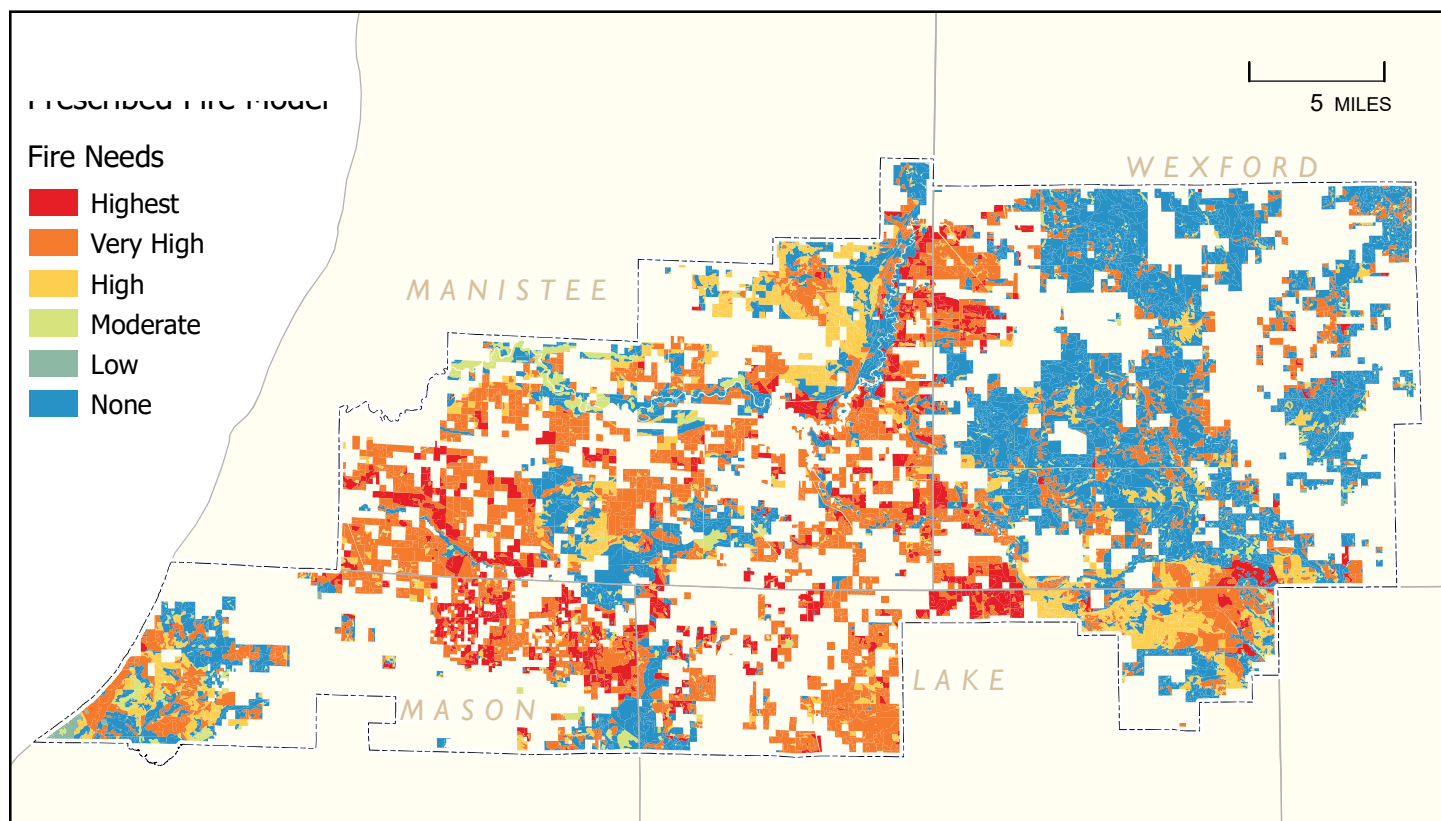


Figure 4. Output of the prescribed fire needs assessment model for the Cadillac-Manistee District.

methods followed those developed by MNFI for evaluating Ecological Reference Areas on state forest land (Cohen et al. 2008, 2009).

Sites were evaluated using MNFI and Natural Heritage methodology, which considers condition, size, and landscape context when assessing natural community quality (Faber-Langendoen et al. 2008, 2015). Sites meeting established MNFI criteria (MNFI 1988) were documented as natural community element occurrences (EOs), entered into the MNFI Natural Heritage Database, and assigned an overall rank ranging from A to D. Sites that did not meet EO criteria but retained characteristic vegetation, structural legacies, or other recovery potential were documented as non-EO RFDS. Where appropriate, EOs and other RFDS were grouped into project areas to support coordinated stewardship planning.

For each documented natural community EO, plant species data were compiled using the Universal Floristic Quality Assessment Calculator (Reznicek et al. 2014; Freyman et al. 2016). Floristic quality

assessment uses coefficients of conservatism (C values) assigned to plant species to calculate Mean C and Floristic Quality Index (FQI). C values range from 0 to 10 and reflect a species' fidelity to natural habitats and tolerance of disturbance. Species strongly associated with specialized or minimally disturbed habitats receive high values, whereas widespread species tolerant of disturbance receive low values. Values are assigned by regional experts and may vary among regions. Mean C represents the average C value across all species recorded, and FQI is calculated by multiplying Mean C by the square root of total species richness.

Michigan sites with an FQI of 35 or greater are considered floristically important from a statewide perspective, while scores greater than 50 indicate exceptional conservation value (Herman et al. 2001). Because FQI increases with species richness, Mean C may provide a less size-dependent indicator of floristic condition (Matthews et al. 2015; Slaughter et al. 2015). Complete species lists are provided in Appendix 4.



Surveying Koenig Oak-Pine Barrens with geologist Trevor Hobbs (formerly with Cadillac-Manistee District), whose field interpretation of complex glacial geology helped clarify relationships among landforms, soils, and fire-dependent vegetation.

RESULTS

The MNFI prescribed fire needs assessment model was used to generate fire-need scores for 251,459 acres across the Cadillac-Manistee District (Table 2). Approximately 143,140 acres (56.9%) received high, very high, or highest fire-need scores, including 114,980 acres (45.7%) classified as very high or highest. An additional 9,588 acres (3.8%) received moderate scores, and 902 acres (0.4%) received low scores. The remaining 97,829 acres (38.9%) received a score of zero, indicating no identified need for prescribed fire under the model. Field surveys targeted areas with concentrations of the highest fire-need scores.

During the 2024 and 2025 field seasons, we documented 11 new natural community EOs representing eight community types in the Cadillac-Manistee District of the Huron-Manistee National Forest including bog (1), clay bluff (1), dry-mesic northern forest (2), hillside prairie (1), intermittent wetland (1), oak-pine barrens (3), wet-mesic prairie (1), and wet-mesic sand prairie (1). We also expanded two previously documented EOs: the hillside prairie along the Pine River and the oak-pine barrens near Black Lake (Table 3). Results presented below focus on natural community EOs documented or expanded during the 2024 and 2025 surveys. Previously documented EOs are included where necessary to describe the broader ecological and management context of newly documented sites.

The following sections present survey results by geographic and ecological grouping, beginning with the larger river-corridor complexes followed by geographically discrete wetlands and barrens. This order is intended to organize related findings rather than provide a strict ranking of conservation value. Conservation significance varies among sites based on natural community rarity, ecological condition, landscape context, restoration potential, and opportunities for implementation. Ultimately, the prioritization and implementation of management actions depend on several factors within the Forest Service, and the site-specific recommendations below are intended to support those internal agency processes. Broader stewardship principles and approaches for applying these findings across the District are developed in the Discussion section that follows.

Each natural community account begins with a summary of community type, conservation rank, EO rank, size, floristic quality, location, and EO identification number. Floristic metrics include Floristic Quality Index (FQI), Mean C, and species richness (SR); species richness represents the total number of species documented, with the percentage of native species shown in parentheses.



The Pine River Woods dry-mesic northern forest supports mature white pine on the slopes above the Pine River. Nearby hillside prairie, oak-pine barrens, and dry sand prairie form part of a priority conservation corridor supporting numerous fire-dependent systems.

Table 2. Area and percentage of the Cadillac-Manistee District of the Huron-Manistee National Forest by modeled fire-need category.

Fire Need	Stands	Acres	Percent
Highest	718	23,775	9.5%
Very High	3,101	91,205	36.3%
High	1,322	28,160	11.2%
Moderate	1,249	9,588	3.8%
Low	50	902	0.4%
None	3,876	97,829	38.9%
Total	10,316	251,459	

Table 3. Natural community element occurrences (EOs) documented or updated during the 2024–2025 surveys, organized by natural community type. An asterisk (*) indicates a previously documented EO updated during this study. Global (G) and state (S) ranks indicate the rarity and vulnerability of each community type globally and within Michigan: 1 = critically imperiled; 2 = imperiled; 3 = vulnerable; 4 = apparently secure; and 5 = secure. EO ranks integrate condition, size, and landscape context: A = excellent; B = good; C = fair; and D = poor. The Results section groups nearby sites by geography and shared stewardship context; corresponding Results group and page numbers are provided for each EO. Complete descriptions of G and S ranks are provided in Appendix 2, and species lists are provided in Appendix 4.

EOID	Site Name	Overall Rank	Size (ac)	Compartments	Stands	Results Group	Page Number
<i>Bog (G3G5/S4)</i>							
28104	Hoag Lake Bog	CD	2.5	338	14	5	27
<i>Clay Bluff (GNR/S2)</i>							
28452	Manistee River Bluffs	C	24.1	406, 46, 45, 34	Numerous	2	16
<i>Dry-mesic Northern Forest (G4/S3)</i>							
28459	Pine River Woods	C	70.9	8	7, 19, 21	1	12
28456	Manistee Valley Woods	C	57.2	414	10, 37, 41	3	21
<i>Hillside Prairie (G3/S1)</i>							
*26243	Pine River Hillside Prairie	B	14.4	8, 9	21, 22, 24, 34, 37, 38	1	12
28455	Manistee River Hillside Praire	C	2.3	414	41, 33	3	21
<i>Intermittent Wetland (G2/S3)</i>							
24254	Morton-Nuremberg Wetlands	B	81.8	353	56	4	25
<i>Oak-pine Barrens (G3/S2)</i>							
*26328	Black Lake Oak-Pine Barrens	CD	35.0	334	37, 30	6	29
27660	Koenig Oak-Pine Barrens	CD	85.7	331	4	7	31
28448	Little Round Barrens	CD	42.5	395	4, 7	8	33
28449	O'Connell Barrens	CD	17.6	393	43	8	33
<i>Wet-mesic Prairie (G2/S1)</i>							
27659	Manistee River Prairie	B	19.0	308, 406, 46, 34	Numerous	2	16
<i>Wet-mesic Sand Prairie (G2G3/S2)</i>							
28103	Hoag Lake Prairie	CD	3.2	338	14	5	27

*updated previously documented sites



The prairies along the Manistee River were some of the most ecologically captivating to survey. Despite threats from dispersed camping and invasive species, 14 prairie terraces support 126 native plant species and comprise the largest documented wet-mesic prairie in Michigan. Their historical relationship with fire and potential need for fire stewardship remain uncertain and warrant further investigation.

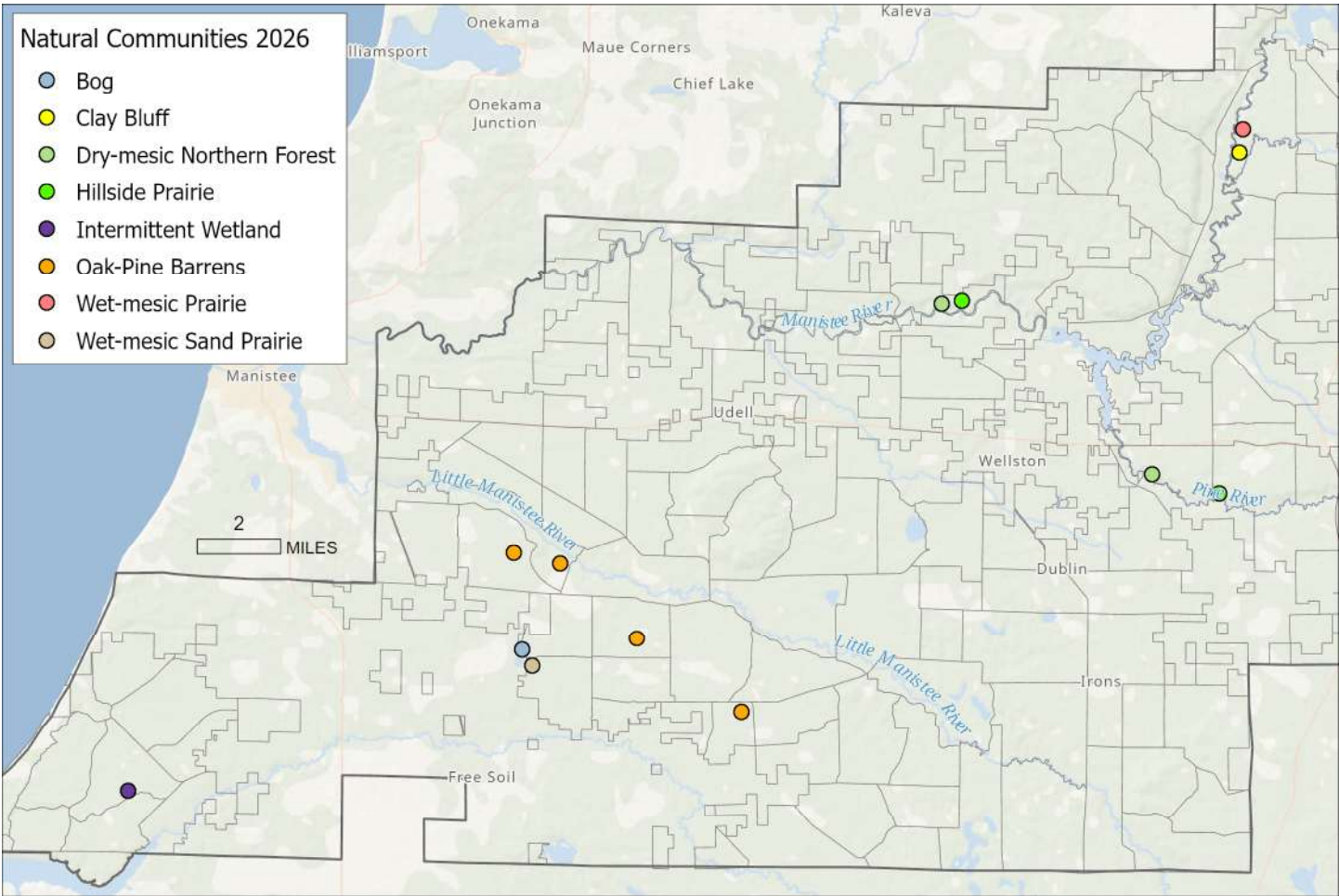


Figure 5. Natural community EOs documented or updated during the 2024 and 2025 surveys.

1. The Pine River Corridor

Pine River Hillside Prairie

Natural Community Type: Hillside Prairie

Rank: G3 S1 vulnerable globally and critically imperiled in Michigan

Element Occurrence Rank: B – Good Occurrence.

Size: 14.4 acres; FQI: 48.4; Mean C: 3.9; SR: 154 (85.7% native)

Location: Compartments 8, 9; Stands 21, 22, 24, 34, 37, 38

Element Occurrence Identification Number: 26243

Pine River Woods

Natural Community Type: Dry-mesic Northern Forest

Rank: G4 S3 apparently secure globally and vulnerable in Michigan

Element Occurrence Rank: C – Fair Occurrence.

Size: 70.9 acres; FQI: 40.2; Mean C: 4.7; SR: 73 (97.3% native)

Location: Compartments 8; Stands 7, 19, 21

Element Occurrence Identification Number: 28459

The Pine River Corridor between Highways M-55 and M-37 supports a significant concentration of natural communities that were first documented in 2022. Six additional hillside prairie openings were documented during the 2024-2025 surveys, expanding the Pine River Hillside Prairie to 14.4 acres over 16 openings along nearly 8 km of river. Surveys also documented Pine River Woods, a 70.9-acre dry-mesic northern forest occupying steep south-facing slopes above the river. These communities occur in a landscape that retains considerable connectivity between high-quality natural communities. Previously documented oak-pine barrens and dry sand prairie occur in Compartment 9, adjacent to some of the hillside prairie openings. There are also degraded wet-mesic prairie openings

in old meander scars at the base of some slopes. The corridor is protected as part of the federally designated Pine River Wild and Scenic River.

Pine River Hillside Prairie occurs on exceptionally steep south- and west-facing slopes where the river has exposed a heterogeneous mixture of sand, gravel, clay, and locally calcareous material. Variation in substrate, slope position, aspect, canopy cover, and erosion produces substantial differences in species composition and ecosystem structure among openings. Most are less than 1 acre and range from nearly treeless prairie to sparse oak-pine savanna embedded within mature forest. The ground layer is generally graminoid-dominated primarily

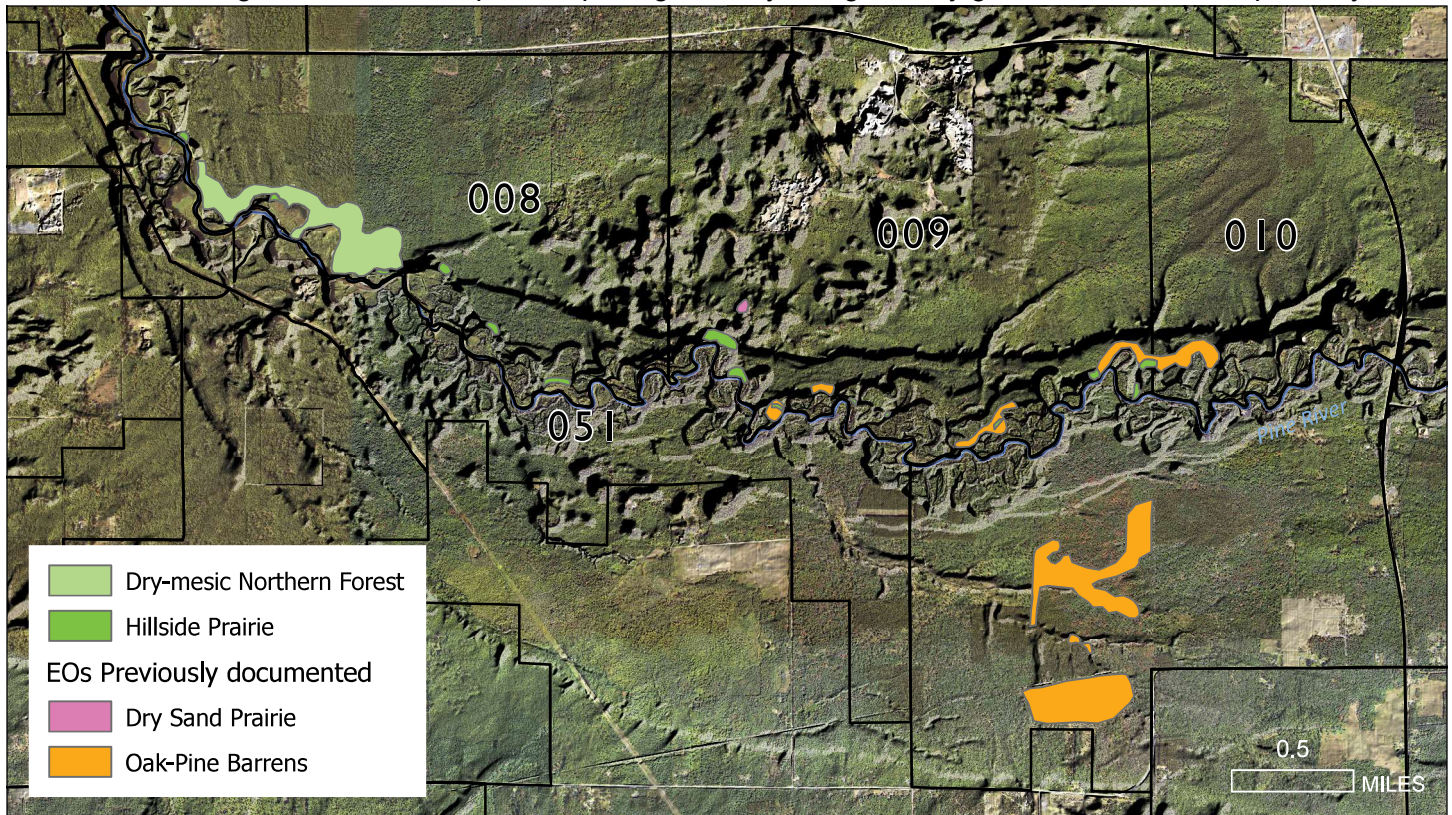


Figure 6. Locations and boundaries of the Pine River Woods and Pine River Hillside Prairie EOs documented or updated during the 2024–2025 surveys. Previously documented oak-pine barrens and dry sand prairie EOs are shown for landscape context.

by little bluestem (*Schizachyrium scoparium*), poverty grass (*Danthonia spicata*), big bluestem (*Andropogon gerardii*), and Pennsylvania sedge (*Carex pensylvanica*). Characteristic forbs include butterfly-weed (*Asclepias tuberosa*), hoary puccoon (*Lithospermum canescens*), northern bedstraw (*Galium boreale*), veiny pea (*Lathyrus venosus*), and northern blazing-star (*Liatris scariosa*).

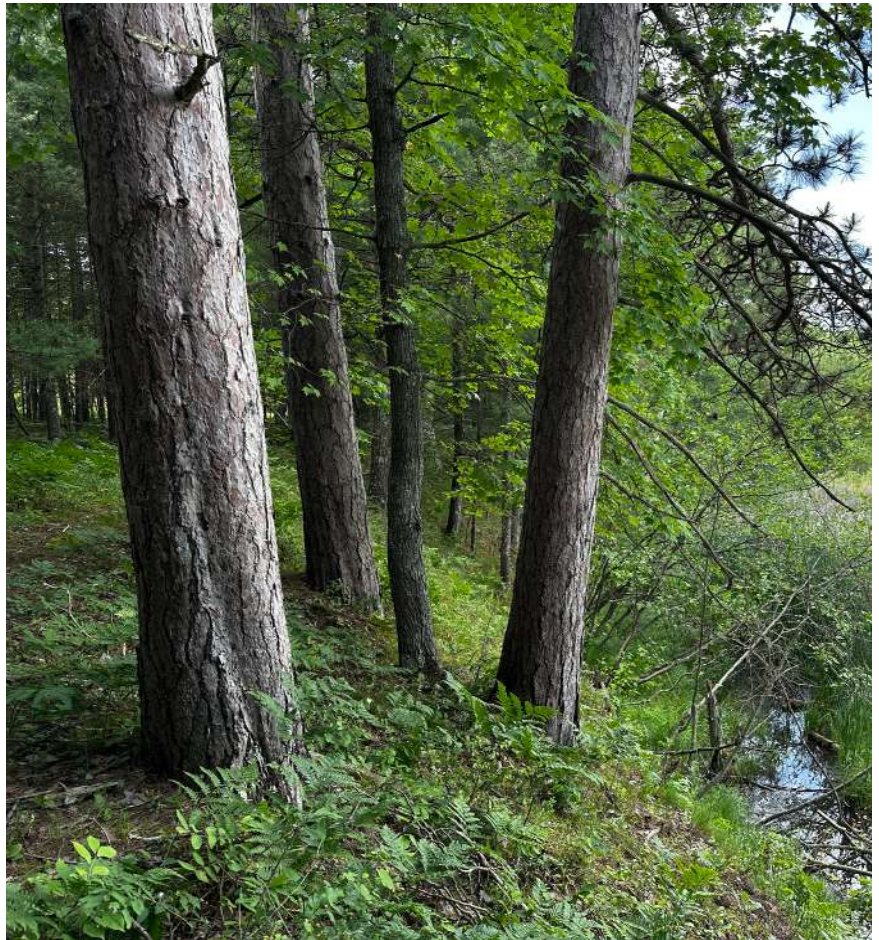
The Pine River Hillside Prairie is the largest documented hillside prairie in Michigan and represents a northern expression of hillside prairie with a different landscape context from occurrences

in southern Lower Michigan. Southern examples generally developed within broader prairie and savanna landscapes, whereas the Pine River openings occupy small, river-cut slopes embedded within forest, where steep topography, droughty glacial deposits, erosion, and recurrent fire maintain localized prairie vegetation. Although several openings have been degraded by recreational use, most remain in good condition with diverse native vegetation and limited invasive species. Its large size, good condition, and landscape context support a rank of B.



MNFI botanist Connor Wojtowicz surveys a hillside prairie opening along the Pine River.

Pine River Woods is a mature, second-growth oak-pine forest with a canopy dominated by black oak (*Quercus velutina*) and white oak (*Q. alba*), with white pine (*Pinus strobus*), northern red oak (*Q. rubra*), big-tooth aspen (*Populus grandidentata*), and red pine (*P. resinosa*). Most canopy trees are approximately 90 to 140 years old, and scattered white pine have begun to extend above the canopy to form a supercanopy. The ground layer is dominated by graminoid species, while barrens species including wild lupine (*Lupinus perennis*), harebell (*Campanula rotundifolia*), dwarf dandelion (*Krigia virginica*), and common frostweed (*Crocianthemum canadense*) persist near upper slopes and transitions to hillside prairie. The forest's diversity reflects variation in slope position, aspect, and moisture together with transitions among forest, hillside prairie, and barrens. Although historical logging removed the oldest trees and fire exclusion has allowed red maple (*Acer rubrum*) to increase, the forest retains characteristic composition, high native diversity, limited invasive species, and a good landscape context.



Pine River Woods features a canopy of maturing oak and pine over hillsides with diverse vegetation.

Management Recommendations

Manage Pine River Hillside Prairie and Pine River Woods as components of a connected fire-dependent corridor, while tailoring stewardship to the distinct needs and sensitivities of prairie openings, steep forested slopes, and accessible uplands. Protect the hillside prairie from recreational impacts that accelerate erosion. Install signs at river access points and above sensitive slopes to discourage climbing, camping, and repeated foot traffic while directing visitors toward more durable access locations. Close unnecessary two-tracks where they facilitate access to sensitive areas and continue protecting the broader corridor through its Wild and Scenic River designation. Treat localized invasive species where practical, prioritizing autumn olive (*Elaeagnus umbellata*) and oriental bittersweet (*Celastrus orbiculatus*) before they expand. The steep terrain will limit treatment options within some openings.

Include the hillside prairie, adjacent oak-pine barrens, dry sand prairie, dry-mesic northern forest, and surrounding fire-dependent uplands within large prescribed-burn units. The prairie openings are maintained partly by steep slopes, drought, erosion, and edaphic conditions and do not need to be

targeted directly with fire. However, fires conducted on adjacent uplands should be allowed to creep onto the slopes where practical. Avoid constructing firebreaks or conducting unnecessary mop-up on erosion-prone slopes. Apply one to three burns per decade, with higher frequency during initial treatment of areas where open barrens conditions are declining. Include fall burns when feasible and allow patchy fire behavior to maintain refugia within the corridor.

Allow Pine River Woods to continue developing older forest structure while minimizing mechanical disturbance. Use prescribed fire in a manner that limits mortality of mature canopy pines, including the white pine beginning to reestablish a supercanopy. Where tree and shrub encroachment is eliminating barrens structure on accessible uplands, limited mechanical treatment may follow prescribed fire and should retain large, old, open-grown oaks and mature red and white pine. Avoid mechanical treatment on the steep valley slopes. Do not supplement the native flora within mapped EOs except where severe anthropogenic erosion prevents natural recovery; if revegetation is necessary, use local genotypes obtained from within or near the corridor.



A degraded wet-mesic prairie opening occupies the river terrace in the foreground and transitions upslope to high-quality hillside prairie embedded within high-quality forest on the steep Pine River valley slope. Where feasible, these communities and the surrounding fire-dependent forests should be incorporated into landscape-scale prescribed-burn units.

2. Manistee River Prairies and Bluffs

Manistee River Prairie

Natural Community Type: Wet-mesic Prairie

Rank: G2 S1 imperiled globally and critically imperiled in Michigan

Element Occurrence Rank: B – Good Occurrence.

Size: 19.0 acres; FQI: 45.0; Mean C: 3.7; SR: 148 (85.1% native)

Location: Compartments 308, 406, 46, 34; Stands: Numerous

Element Occurrence Identification Number: 27659

Manistee River Bluffs

Natural Community Type: Clay Bluff

Rank: GNR S2 not yet ranked globally and imperiled in Michigan

Element Occurrence Rank: C – Fair Occurrence.

Size: 24.1 acres; FQI: 22.6; Mean C: 2.8; SR: 65 (76.9% native)

Location: Compartments 406, 46, 45, 34; Stands: Numerous

Element Occurrence Identification Number: 28452

The Manistee River Prairies and Bluffs occur between Hodenpyl Dam and the Tippy Dam backwaters within a largely forested and comparatively undeveloped river corridor. Surveys documented 14 wet-mesic prairie terraces distributed along approximately 14 km of river and 20 clay bluffs extending across approximately 10 km. Both occurrences substantially expand the known geographic ranges of these natural community types. The Manistee River Prairies are the first documented wet-mesic prairie from this ecoregion, while the Manistee River Bluffs are the first clay bluff documented away from the Great Lakes shoreline. At 19.0 and 24.1 acres, respectively, they are also the largest documented occurrences of either community type in Michigan.

Manistee River Prairie occurs on low terraces, abandoned channels, and depositional surfaces maintained by flooding, fluctuating water levels, sediment deposition, ice scour, groundwater seepage, and river erosion. Composed of 14 prairie openings that range from 0.3 to 4.4 acres, this prairie is dominated by little bluestem (*Schizachyrium scoparium*), fringed brome (*Bromus ciliatus*), green bulrush (*Scirpus atrovirens*), and big bluestem (*Andropogon gerardii*). A population of the rare species Canadian milk-vetch (*Astragalus canadensis*, special concern) was also documented. Condition varies among openings, with several supporting diverse assemblages of conservative species and others locally dominated by non-natives including



The Manistee River Prairie terraces (foreground) are diverse and influenced by flooding, sediment deposition, ice scour, groundwater seepage, and river erosion. The Manistee River Bluffs (across the river) are influenced by aspect of steep slopes, river erosion, and periodic slumping of clay-rich sediments.

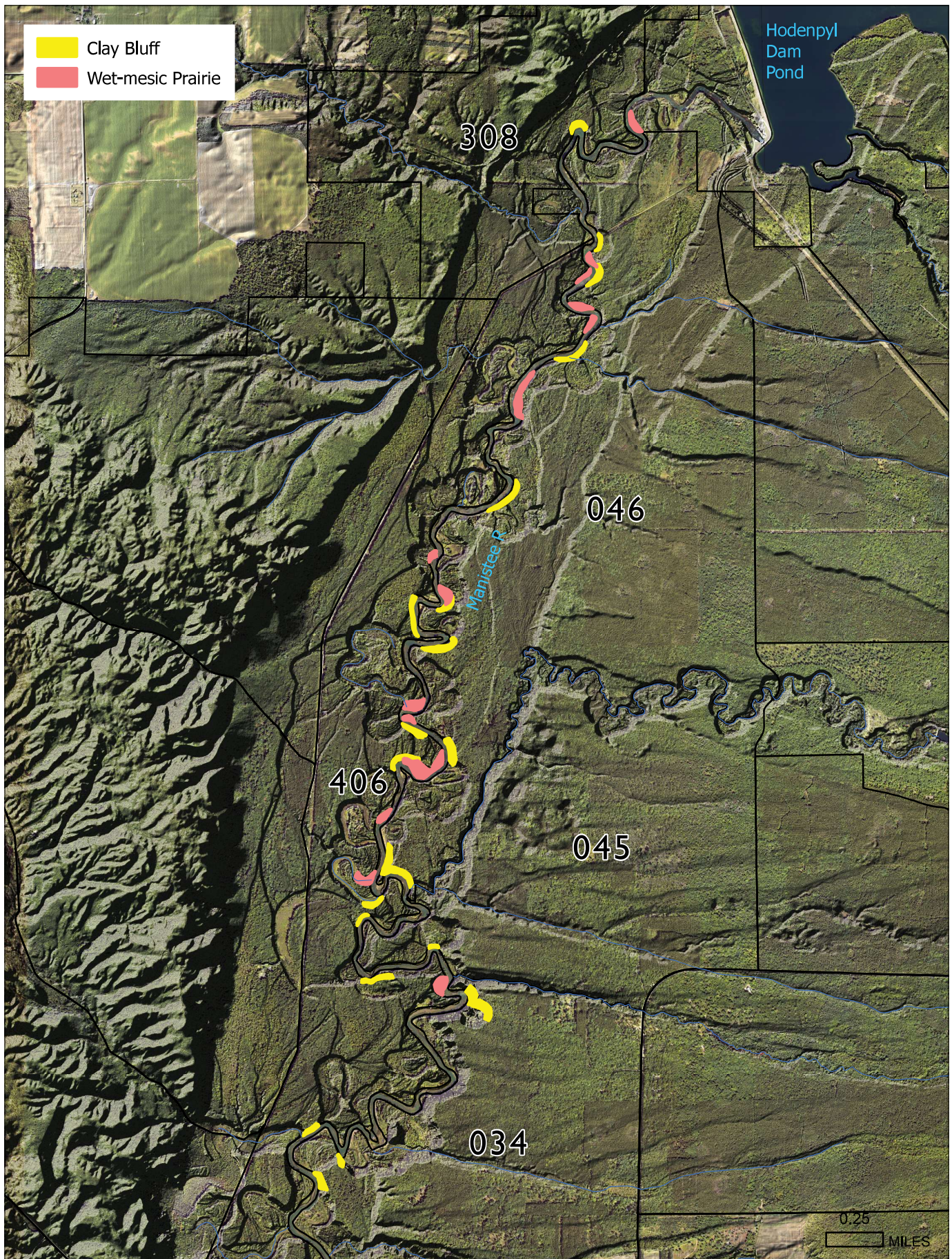


Figure 7. Locations and boundaries of the Manistee River Prairies and Manistee River Bluffs EOs. The Manistee River Prairies EO comprises 14 wet-mesic prairie terraces, and the Manistee River Bluffs EO comprises 20 clay bluff polygons between Hodenpyl Dam and the Tippy Dam backwaters.

redtop (*Agrostis gigantea*), Kentucky bluegrass (*Poa pratensis*), tall fescue (*Schedonorus arundinaceus*), narrow-leaved cattail (*Typha angustifolia*), or autumn olive (*Elaeagnus umbellata*). Despite these impacts, its exceptional size, floristic diversity, and landscape context give the occurrence the highest overall rank (B, or Good) among Michigan's documented wet-mesic prairies. Wet-mesic prairies documented in southern Michigan are embedded in savanna landscapes that frequently burned historically. The Manistee River Prairie represents a northern, river-associated expression maintained principally by fluvial and groundwater processes rather than frequent fire.

The origin and persistence of these prairie terraces are not fully understood. However, their repeated occurrence on similar river terraces, characteristic wet-mesic prairie flora, and high native diversity support their interpretation as natural prairie openings rather than anthropogenic clearings. Flooding, seepage, sediment movement, ice scour, and historical fire likely interacted to maintain open conditions. Historically, more extensive fire-dependent communities on the surrounding landscape may have supplied native propagules following major disturbance. Because those native seed sources are now greatly diminished and invasive species are widespread, similar disturbances today may be less likely to produce the same recovery of native vegetation. This increases the conservation significance of the surviving terraces.



Canadian milk-vetch, a state special concern species, was documented within the Manistee River Prairies.



Although embedded within a fire-dependent landscape, the Manistee River Prairies and bluffs have uncertain relationships with fire and should be evaluated individually when planning stewardship.

Manistee River Bluffs consist of extremely steep, sparsely vegetated slopes maintained by groundwater seepage, river erosion, and periodic slumping of clay-rich sediments. Some bluffs support a thin sand cap and superficially resemble hillside prairie, but active seepage, extensive clay exposures, and the prevalence of species with wetland affinities distinguish them from hillside prairie.

Characteristic species include grass-of-Parnassus (*Parnassia glauca*), swamp betony (*Pedicularis lanceolata*), rough-leaved goldenrod (*Solidago patula*), long-leaved aster (*Symphyotrichum robynsonianum*), and broad-leaved cattail (*Typha latifolia*). Past logging operations used some steep river slopes as rollways to move logs from adjacent uplands to the river, locally disturbing vegetation and contributing to concentrations of invasive species. This disturbance creates substantial variation in slope condition and can make natural clay bluffs difficult to distinguish from logging-created openings. The mapped occurrences were limited to slopes exhibiting active erosion and sloughing consistent with natural clay-bluff processes; the most degraded and ambiguous openings were excluded.

Management Recommendations

Manage the prairie terraces and clay bluffs as interrelated features of the Manistee River corridor by allowing natural erosion, slumping, and sediment movement to continue while avoiding activities that accelerate erosion or otherwise disrupt natural hydrologic and geomorphic processes. Evaluate the extent to which Hudenpyl Dam has altered downstream hydrology, sediment transport, and erosion before using current flow rates as a reference for future management planning. Retain wide forested buffers between the prairie terraces and clay bluffs and intensive forestry operations to protect groundwater recharge, limit runoff, and avoid destabilizing slopes. Do not stabilize naturally eroding clay bluffs.

Direct dispersed camping and other recreational use away from the highest-quality occurrences and toward designated or previously degraded sites that do not support characteristic vegetation, particularly in prairie terraces. In high-use areas, provide designated trails, stairways, or other durable access routes to the river to reduce trampling, informal trail development, and damage to steep slopes.



Manistee River Bluffs consist of extremely steep, sparsely vegetated slopes maintained by groundwater seepage, river erosion, and repeated slumping of clay-rich sediments.

Active management should prioritize invasive species that threaten otherwise high-quality vegetation. Treat autumn olive and localized populations of narrow-leaved cattail and reed (*Phragmites australis* var. *australis*) where control is feasible and unlikely to cause greater disturbance. Fire is a secondary and uncertain management consideration for the prairie terraces because flooding, seepage, sediment movement, and ice scour appear to be the dominant processes maintaining open conditions. If prescribed fire is used, begin with carefully selected experimental treatments in areas adjacent to fire-adapted uplands that are affected by woody encroachment and monitor the response of native and invasive vegetation.

Additional research should evaluate how dam operations influence flooding, sediment deposition, erosion, ice scour, groundwater conditions, and the long-term persistence of the prairie terraces and clay bluffs. Future inventory should also search for additional examples of both natural community types along the Manistee River and other large river systems. Several terraces and river-associated openings were observed but could not be fully evaluated, and additional clay bluffs may have been overlooked or interpreted solely as logging-era disturbances.



Trash associated with informal camp sites on prairie terraces was commonly observed. Because these prairie terraces attract dispersed camping that can cause localized disturbance, recreational use should be directed away from the highest-quality occurrences.



Sections of the Manistee River Prairie occur along 14 km of the river between the Hodenpyl and Tippy Dams. These are diverse and variable openings on terraces and are typically dominated by native graminoids.

3. Manistee Valley

Manistee Valley Woods

Natural Community Type: Dry-mesic Northern Forest

Rank: G4 S3 apparently secure globally and vulnerable in Michigan

Element Occurrence Rank: C – Fair Occurrence.

Size: 57.2 acres; FQI: 43.2; Mean C: 5.2; SR: 69 (95.7% native)

Location: Compartment 414; Stands 10, 37, 41

Element Occurrence Identification Number: 28456

Manistee River Hillside Prairie

Natural Community Type: Hillside Prairie

Rank: G3 S1 vulnerable globally and critically imperiled in Michigan

Element Occurrence Rank: C – Fair Occurrence.

Size: 2.3 acres; FQI: 29.1; Mean C: 3.5; SR: 69 (85.5% native)

Location: Compartment 414; Stands 33, 41

Element Occurrence Identification Number: 28455

The Manistee Valley site occurs along the north side of the Manistee River between High Bridge Road and Tippy Dam within the federally designated Wild and Scenic River corridor. Surveys documented a 57.2-acre dry-mesic northern forest (Manistee Valley Woods) and a 2.3-acre hillside prairie (Manistee River Hillside Prairie) on steep south- and southwest-facing valley slopes. These natural communities occur within a largely contiguous landscape that also includes mesic northern forest and degraded but potentially recoverable wet-mesic prairie on an abandoned meander scar below the hillside prairie. Strong gradients in slope, aspect, soils, and proximity to the river support substantial ecological variation across a relatively small area.

Manistee Valley Woods is a maturing, second-growth oak-pine forest with a 100- to 140-year-old canopy dominated by northern red oak (*Quercus rubra*), white pine (*Pinus strobus*), red pine (*P. resinosa*), and white oak (*Q. alba*), with white pine and red pine locally forming a supercanopy. Several fire-scarred red pine may represent remnants of the forest preceding nineteenth-century logging, including one tree more than 130 years old with at least three fire scars. Graminoids are dominant, including Pennsylvania sedge (*Carex pensylvanica*), hair grass (*Avenella flexuosa*), and rough-leaved rice-grass (*Oryzopsis asperifolia*). Wild lupine (*Lupinus perennis*), black oatgrass (*Piptochaetium avenaceum*), hairy bush-clover (*Lespedeza hirta*), and sweetfern (*Comptonia*

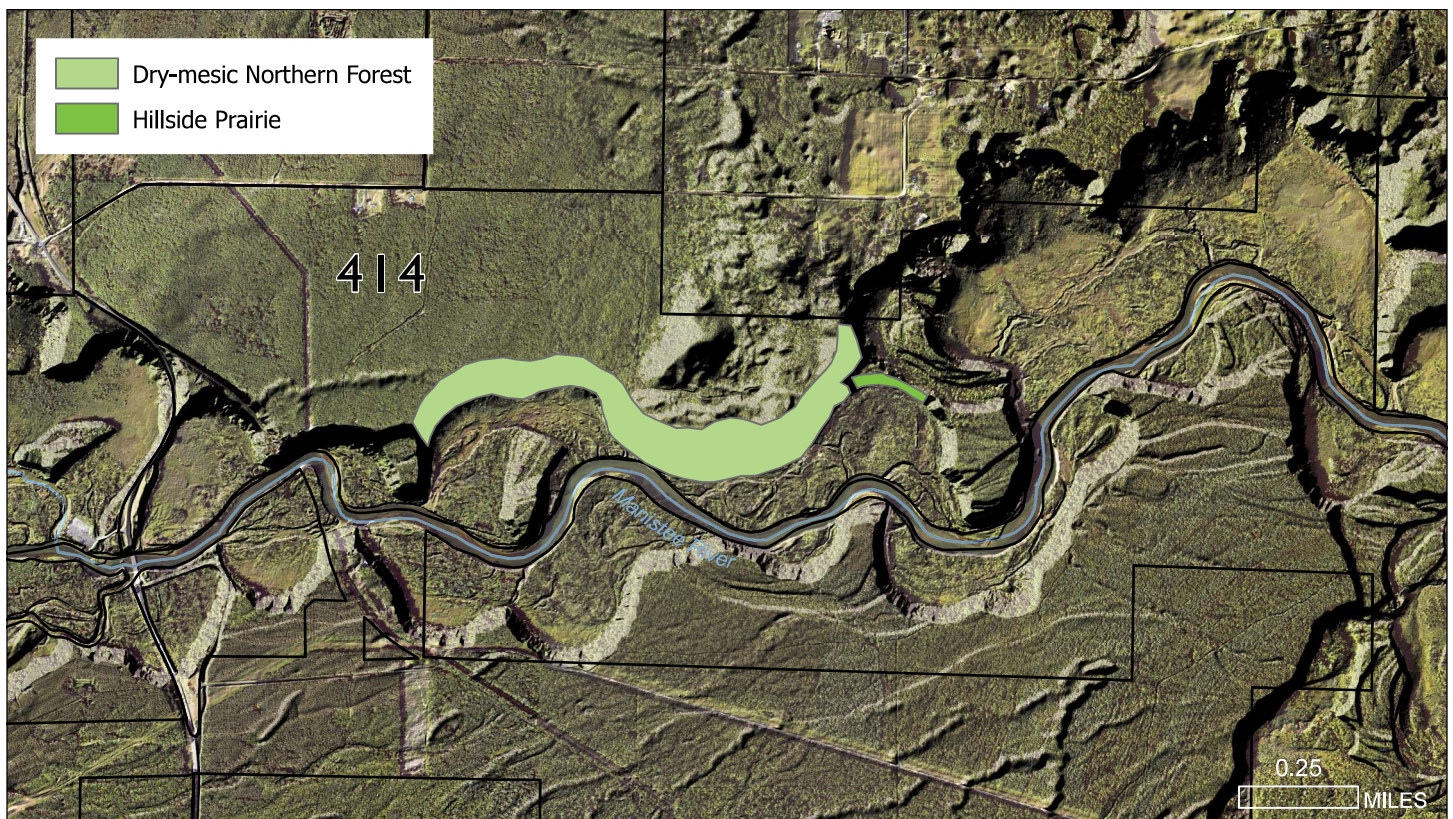
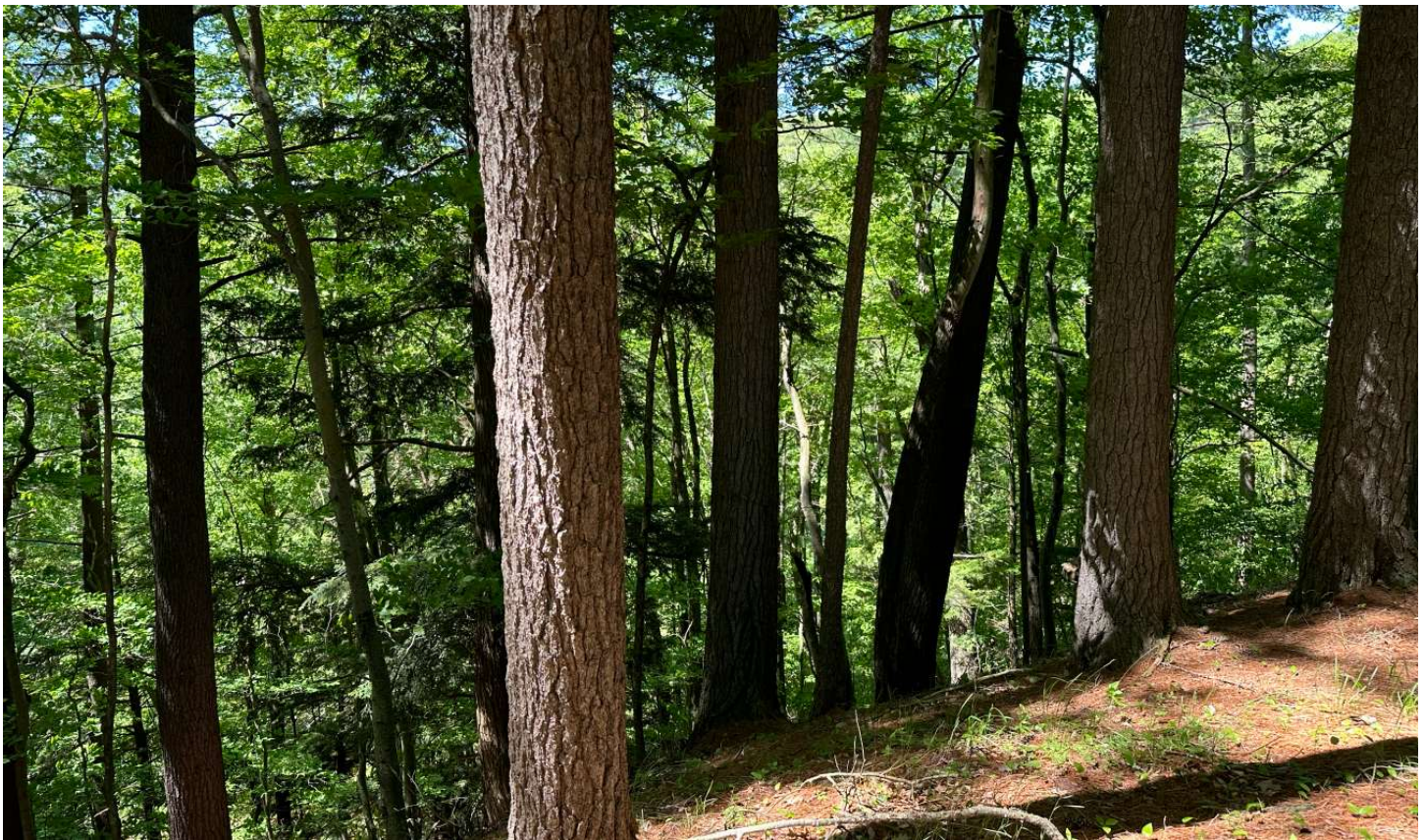


Figure 8. Locations and boundaries of the Manistee Valley Woods and Manistee River Hillside Prairie EOs.



Manistee Valley Woods (top) features a maturing canopy of oak and pine on the steep slopes above the river. The nearby Manistee River Hillside Prairie (bottom) is small but supports very diverse vegetation.

peregrina) persist along the upper slope and rim, reflecting the historical influence of fire and a landscape characterized by barrens species. Although the forest lacks the older structure of the highest-quality examples and red maple and American beech are increasing under fire suppression, it retains characteristic composition, high native diversity, limited invasive species, and good landscape context. Narrow bands of mature natural red pine observed below Tippy Dam were not fully evaluated during these surveys. These areas may contain additional fire-scar evidence and should be evaluated as part of future fire-history reconstruction.

Manistee River Hillside Prairie occurs on a steep southwest-facing slope with fine, alkaline loamy sands and gravel. The southwest aspect, steep slope, and droughty soils have limited woody encroachment

and maintained open conditions despite the absence of recent fire. The ground layer includes little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), Indian paintbrush (*Castilleja coccinea*), northern bedstraw (*Galium boreale*), hoary puccoon (*Lithospermum canescens*), and other characteristic prairie species. Autumn olive (*Elaeagnus umbellata*) is locally abundant, but the prairie remains diverse for its size and retains fair to good condition within an intact landscape. The presence of vegetation characteristic of fire-dependent communities and fire scars on red pine growing on nearby slopes indicate that fire clearly influenced the surrounding landscape. However, fire's role in maintaining this particular hillside prairie is less certain because the prairie transitions abruptly into mesic northern forest, which is not considered a fire-influenced natural community.



The Manistee River Hillside Prairie occupies a steep slope above degraded but potentially recoverable wet-mesic prairie on an abandoned meander scar. The hillside prairie and adjacent Manistee Valley Woods occur within a complex river valley landscape that also includes mesic northern forest, creating a mixture of fire-dependent and non-fire-dependent communities. Despite this complexity, the hillside prairie, dry-mesic northern forest, degraded wet-mesic prairie, and adjacent fire-dependent uplands should be incorporated into large prescribed-burn units while avoiding unnecessary fire within mesic northern forest.

Management Recommendations

The Manistee Valley is best managed as an interconnected landscape of mature forest, prairie openings, and other fire-dependent communities, with stewardship focused on maintaining existing ecological integrity while restoring fire across compatible portions of the valley. Maintain broad, unfragmented forested buffers along the valley slopes and avoid intensive forestry, new roads, or trail expansion within the buffers. Allow Manistee Valley Woods to continue developing older structural characteristics through time. Retain large living trees, snags, coarse woody debris, developing supercanopy pines, and fire-scarred legacy trees. Avoid mechanical treatments on the steep slopes, where disturbance could damage soils, destabilize slopes, and disrupt transitions among dry-mesic northern forest, hillside prairie, mesic northern forest, and riparian prairie openings. Treat autumn olive throughout the hillside prairie before it expands further and reduces the effectiveness of future prescribed fire. Treat other localized invasive species along the North Country

Trail and within adjacent prairie openings where control is practical.

Include the hillside prairie, dry-mesic northern forest, degraded wet-mesic prairie, and adjacent fire-dependent uplands within large prescribed-burn units. The North Country Trail and adjacent mesic northern forest provide logical control features that may reduce the need to construct new firebreaks. Emphasize low-to moderate-severity surface fire while minimizing mortality of mature canopy pines and retaining fire-scarred trees. Because topography and alkaline soils appear sufficient to maintain the hillside prairie, prescribed fire should restore a broader landscape process rather than target the opening directly. Monitor vegetation response within the hillside prairie and degraded wet-mesic prairie to evaluate the role of fire and their potential for improvement. Evaluate mature natural red pine below Tippy Dam for additional fire-scar evidence to develop more specific fire-regime recommendations.



Fire-scarred red pines along the Manistee River were observed in a few places and may record a history extending through Indigenous stewardship and warrant continued fire-history research.

4. Morton-Nuremberg Wetlands

Natural Community Type: Intermittent Wetland

Rank: G2 S3 imperiled globally and vulnerable in Michigan

Element Occurrence Rank: B – Good Occurrence.

Size: 81.8 acres; FQI: 41.2; Mean C: 5.6; SR: 54 (100% native)

Location: Compartment 353; Stand 56

Element Occurrence Identification Number: 24254

Morton-Nuremberg Wetlands consist of four shallow depressions totaling 81.8 acres near the Nordhouse Dunes Wilderness Area. The intermittent wetland is characterized by shallow peat over saturated to inundated sand. Individual wetlands range from 1.2 to 41.1 acres and vary in peat depth, soil moisture, and associated plant species composition and abundance. The depressions grade into surrounding dry northern forest and oak-pine barrens, with wet-mesic sandy margins surrounding seasonally inundated centers. Soils generally consist of shallow to deep peaty sand over wet sand, with localized muck deposits and pH ranging from 4.5 to 7.0. This variation produces well-developed vegetation zones ranging from wet-mesic sand prairie along some margins to both ponded depressions and bog vegetation within the wettest areas.

The ground layer is graminoid-dominated, with blue-joint (*Calamagrostis canadensis*), few-seeded sedge (*Carex oligosperma*), black-fruited spike-rush (*Eleocharis melanocarpa*), twig-rush (*Cladium mariscoides*), cordgrass (*Spartina pectinata*), and three-way sedge (*Dulichium arundinaceum*) prevalent

across the complex. Leatherleaf (*Chamaedaphne calyculata*) is locally dominant and zones of persistent ponding feature pondweeds (*Stuckenia filiformis* and *Potamogeton oakesianus*). The occurrence is very large and generally in excellent condition, with intact fluctuating hydrology, pronounced vegetation zonation, high native diversity, and almost no non-native vegetation. Extensive surrounding natural cover and limited fragmentation further contribute to its conservation value. Off-road vehicle use is a source of degradation in local areas, however, and threatens native vegetation through soil disturbance and the introduction and spread of invasive species.

Management Recommendations

Manage the four Morton-Nuremberg wetlands as part of the surrounding fire-dependent landscape by protecting natural hydrology, reducing ATV impacts, treating invasive species, and maintaining open vegetation through prescribed fire. Maintain the natural fluctuating hydrology of the wetland complex by avoiding ditching, drainage, road construction, or other activities that alter surface-water movement or groundwater conditions. Restrict off-road vehicle

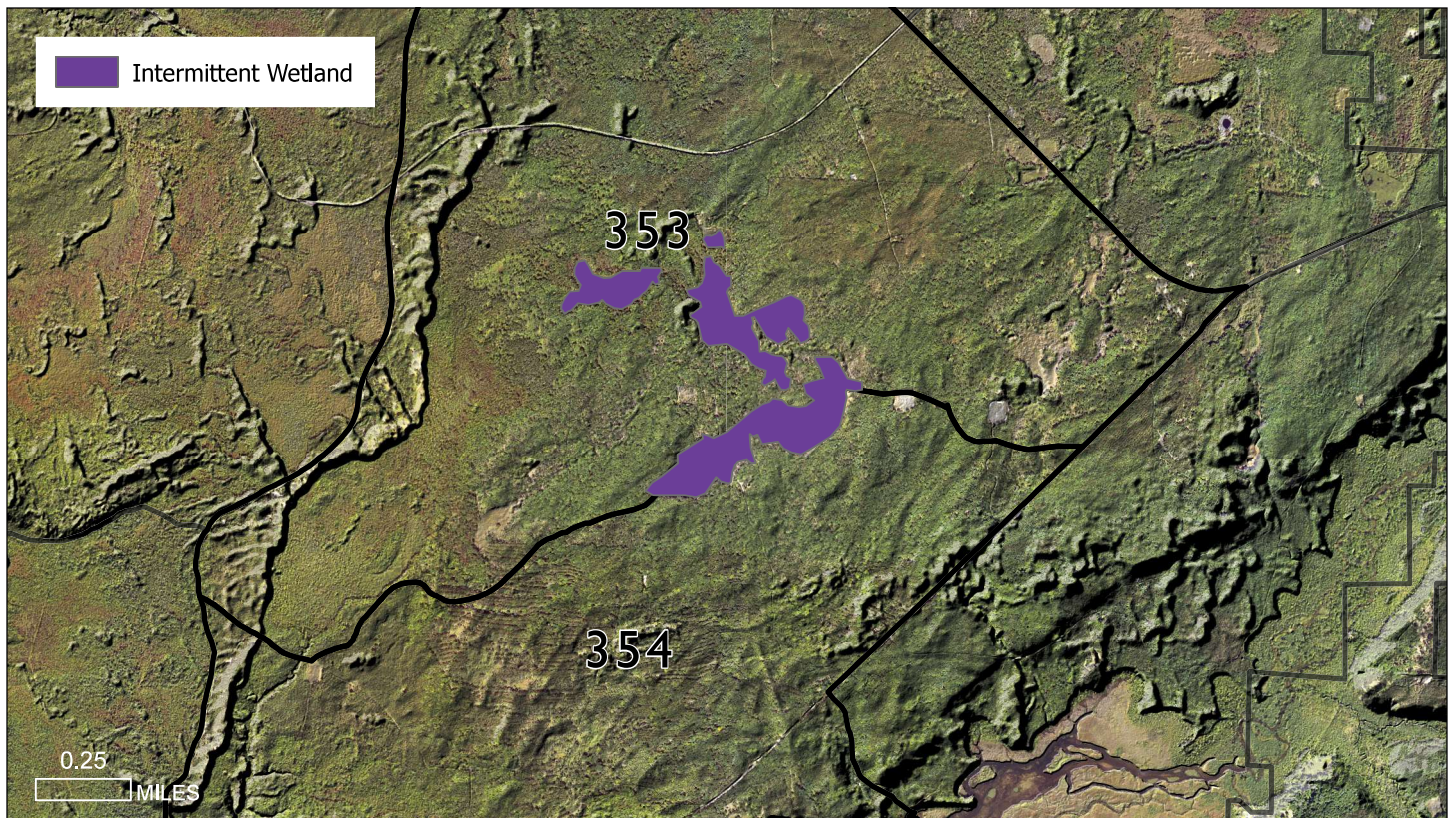


Figure 9. Location and boundaries of the Morton-Nuremberg Wetlands EO.

access to prevent soil disturbance and reduce the introduction and spread of invasive species. Use gates, downed trees, or other barriers at access points where they will not interfere with wetland hydrology. Monitor and treat localized reed canary grass (*Phalaris arundinacea*) before it expands into high-quality native vegetation.

Apply prescribed fire across the intermittent wetlands and surrounding oak-pine landscape to maintain graminoid dominance, limit woody encroachment, and improve ecological connectivity among the four wetland patches. Include multiple adjacent stands within burn units rather than treating each depression separately. Conduct burns when seasonal flooding does not prevent effective fire spread. Monitor fire effects to refine the frequency and timing needed to maintain native vegetation without damaging sensitive peat soils.



Although generally in good condition, the intermittent wetlands have been damaged by ATV use, increasing their vulnerability to invasive species. Photo by T.J. Bassett.



The Morton-Nuremberg Wetlands comprise four shallow, graminoid-dominated depressions totaling 81.8 acres near the Nordhouse Dunes Wilderness Area. Embedded within a fire-dependent landscape, the intermittent wetlands have received repeated prescribed burns that will ideally continue as part of broader landscape-scale fire stewardship. Photo by T.J. Bassett.

5. Hoag Lake

Hoag Lake Bog

Natural Community Type: Bog

Rank: G3G5 S4 vulnerable to secure globally and apparently secure in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 2.5 acres; FQI: 17.4; Mean C: 3.9; SR: 20 (90.0% native)

Location: Compartment 338; Stand 14

Element Occurrence Identification Number: 28104

Hoag Lake Prairie

Natural Community Type: Wet-mesic Sand Prairie

Rank: G2G3 S2 imperiled to vulnerable globally and imperiled in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 3.2 acres; FQI: 27.0; Mean C: 3.9; SR: 48 (72.9% native)

Location: Compartment 338; Stand 14

Element Occurrence Identification Number: 28103

Hoag Lake Bog and Hoag Lake Prairie occupy a small kettle depression north of Hoag Lake within the Huron-Manistee National Forest. The 2.5-acre bog occupies the wettest center of the depression and grades outward into 3.2 acres of wet-mesic sand prairie along its upper margins. Increasing elevation and depth to the water table produce distinct vegetation zones, from sphagnum-dominated peat at the center through seasonally wet prairie along the margins to young dry northern forest beyond the depression. The surrounding uplands support fire-suppressed oak-pine barrens and young oak-pine forest, with public lake access and private residences nearby.

The bog consists of two low peat mounds dominated by leatherleaf (*Chamaedaphne calyculata*) and sphagnum moss, separated from the surrounding prairie by narrow zones of standing water, exposed peat, and wiregrass sedge (*Carex lasiocarpa*). The wet-mesic sand prairie is dominated by cordgrass (*Spartina pectinata*), black-fruited spike-rush (*Eleocharis melanocarpa*), and other graminoids, with hedge-nettle (*Stachys hyssopifolia*), pale-spike lobelia (*Lobelia spicata*), switchgrass (*Panicum virgatum*), and bushy aster (*Symphyotrichum dumosum*). The prairie has well-developed zonation and retains a moderate diversity of characteristic species, but it is small and supports a large proportion of

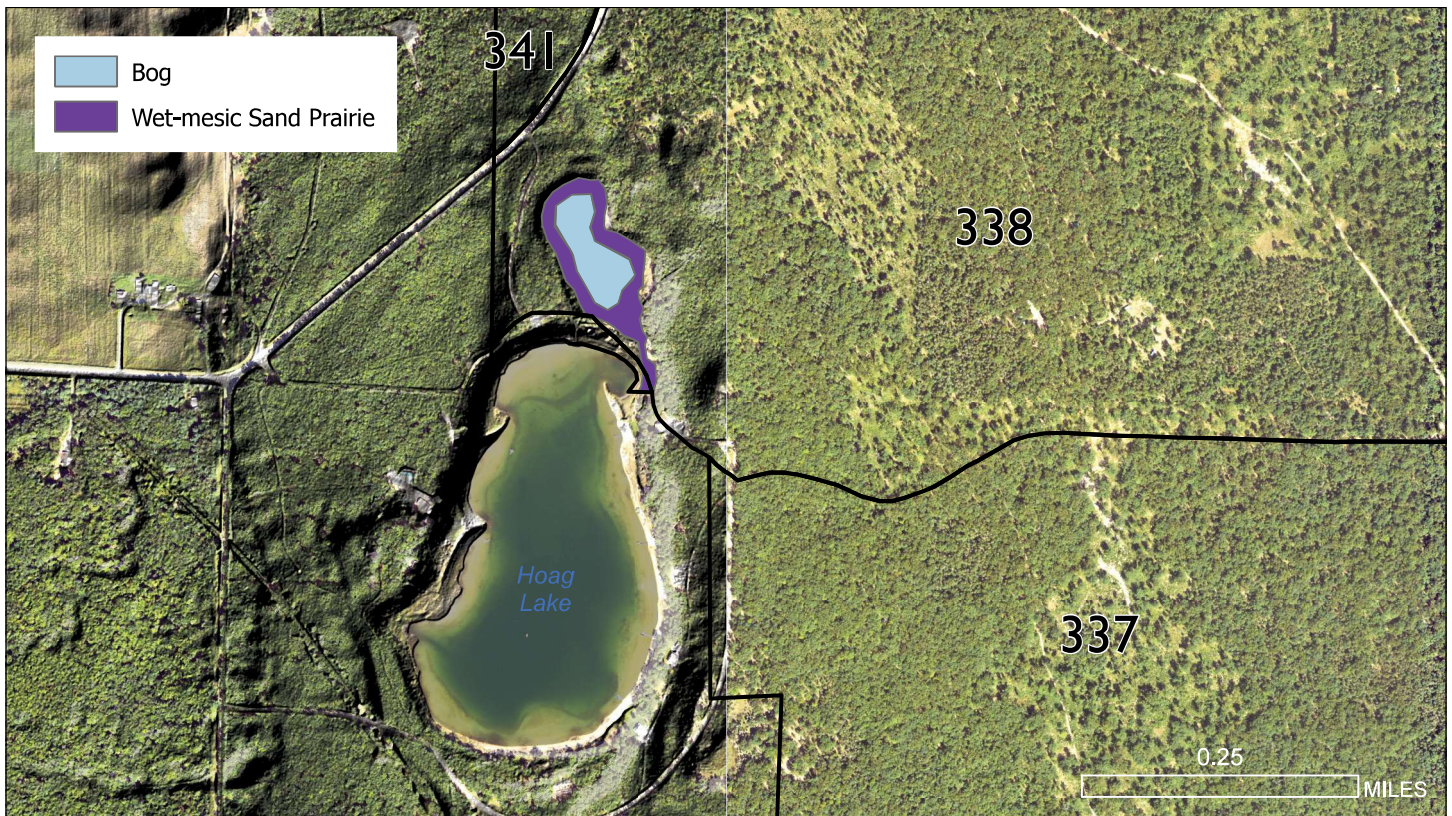


Figure 10. Locations and boundaries of the Hoag Lake Bog and Hoag Lake Wet-Mesic Sand Prairie EOs.

non-native species. The bog is also very small but retains representative composition, intact hydrology, and good internal zonation. Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) occur within both communities, and treated common reed (*Phragmites australis* var. *australis*) was observed near the bog.

Management Recommendations

Manage Hoag Lake Bog and Hoag Lake Prairie as connected vegetation zones within a single kettle depression, while coordinating hydrologic protection, invasive species control, and prescribed fire with stewardship of the surrounding fire-dependent uplands. Maintain the hydrology and vegetation zonation of the kettle depression by avoiding ditching, drainage, soil disturbance, or intensive forestry near the wetland margins. Treat Canada thistle and bull thistle and any surviving reed before they expand within the bog or wet-mesic sand prairie. Include the complex within prescribed burns conducted across the surrounding young dry northern forest and oak-pine barrens, allowing fire to enter the prairie and bog margins where conditions permit while avoiding firebreak construction or mechanical disturbance within the depression. Monitor vegetation response and hydrology following burns to ensure that management maintains characteristic native vegetation without damaging peat soils.



Hoag Lake Prairie wet-mesic sand prairie occurs along the north shore of Hoag Lake, forming a diverse transition between wetland and upland communities. Photo by T.J. Bassett.



Hoag Lake Bog (bottom) consists of two peat mounds dominated by leatherleaf and sphagnum moss separated from the surrounding prairie by narrow zones of standing water and exposed peat. Photo by T.J. Bassett.

6. Black Lake

Black Lake Oak-Pine Barrens

Natural Community Type: Oak-Pine Barrens

Rank: G3 S2 vulnerable globally and imperiled in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 35.0 acres; FQI: 40.3; Mean C: 5.2; SR: 60 (93.3% native)

Location: Compartment 334; Stands 37, 30

Element Occurrence Identification Number: 26328

Black Lake Oak-Pine Barrens consists of two separate polygons. The first, documented in 2022, occurs adjacent to a small wetland complex centered on Black Lake, where the oak-pine barrens intergrades with wet-mesic sand prairie and intermittent wetlands. These high-quality wetland communities support representative native vegetation but are threatened by localized infestations of non-native common reed (*Phragmites australis* var. *australis*) and narrow-leaved cattail (*Typha angustifolia*). The barrens polygon adjacent to the lake is small and has been degraded by historic furrowing, pine planting, and prolonged fire exclusion. Although its structure and diversity are poor relative to higher-quality barrens, characteristic ground-layer species persist, including black oatgrass (*Piptochaetium avenaceum*), june grass (*Koeleria macrantha*), poverty grass (*Danthonia spicata*), and hoary puccoon (*Lithospermum canescens*).

Surveys in 2025 expanded the oak-pine barrens occurrence to include a second kettle depression approximately 900 m east of the original polygon. The eastern polygon consists of numerous small barrens openings separated by patches of nearly closed-



Black Lake Barrens comprises two separate polygons. The western portion of the oak-pine barrens occurs along a wetland and transitions to wet-mesic sand prairie and then intermittent wetland.

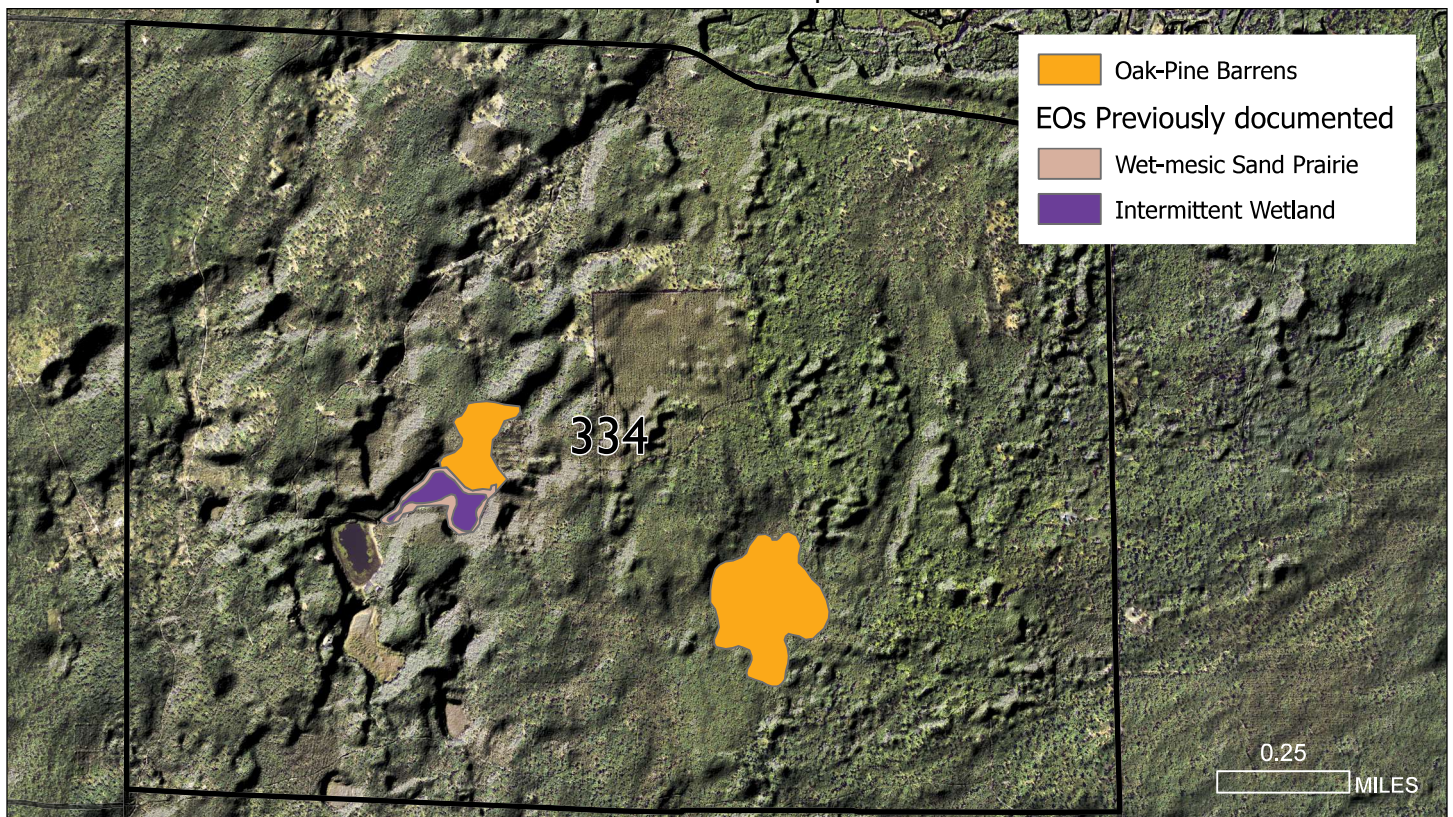


Figure 11. Locations and boundaries of the natural community EOs at Black Lake.

canopy oak forest. Openings support a diverse and conservative barrens flora that includes bird-foot violet (*Viola pedata*), clasping milkweed (*Asclepias amplexicaulis*), Hill's thistle (*Cirsium hillii*, special concern), common frostweed (*Crocianthemum canadense*), and racemed milkwort (*Polygala polygama*) beneath scattered jack pine (*Pinus banksiana*) and old, stunted white oak (*Quercus alba*). Canopy closure is high (85-100%) in approximately half of the polygon, with barrens vegetation generally restricted to the openings. The expanded occurrence remains in fair to poor condition because high-quality openings are small and isolated by closed-canopy forest. However, the persistence of characteristic species across the depression suggests that the site remains recoverable.

Management Recommendations

The barrens openings persist within a broader fire-adapted landscape of kettle depressions, oak-pine forest, pine plantations, wetlands, and isolated pockets of characteristic barrens vegetation. The two polygons provide cores that could be expanded and connected through sustained prescribed fire and carefully sequenced mechanical treatments. This landscape provides an opportunity to apply the stewardship approach already demonstrated elsewhere in the District, using existing remnants to guide the recovery of a larger and more connected barrens system.

Apply repeated prescribed fire across the largest practical management area, including the mapped barrens, intervening fire-adapted forests, adjacent pine plantations, wetlands, and nearby kettle depressions. An initial target of approximately three burns per decade is appropriate for reversing woody encroachment and evaluating vegetation response. Treat non-native common reed and narrow-leaved cattail within the intermittent wetland and wet-mesic sand prairie before those populations expand.

Following initial prescribed fire, prevent soil disturbance during mechanical treatments where dense oak saplings and closed-canopy forest continue to isolate barrens openings. Forestry mowing may be appropriate within portions of the eastern polygon if existing openings and soils can be protected. As barrens structure improves within the mapped occurrence, selectively thin adjacent fire-adapted forests and pine plantations where the ground layer responds positively to fire. Retain large, old white oak, black oak, eastern white pine, red pine, and jack pine throughout the management unit. Evaluate whether the trail crossing the eastern polygon could be relocated if recreational use interferes with prescribed fire or fragments recovering barrens vegetation.



Black Lake Barrens was expanded in 2025 following the identification of additional openings east of Black Lake. The eastern polygon comprises numerous small barrens openings separated by patches of nearly closed-canopy oak forest. These openings support a diverse suite of barrens indicator species.

7. Koenig Oak-Pine Barrens

Natural Community Type: Oak-Pine Barrens

Rank: G3 S2 vulnerable globally and imperiled in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 85.7 acres; FQI: 37.9; Mean C: 4.7; SR: 65 (95.4% native)

Location: Compartment 331; Stand 4

Element Occurrence Identification Number: 27660

Koenig Oak-Pine Barrens occupies 85.7 acres of relict dune fields on sandy outwash south of the Little Manistee River. The oak-pine barrens is characterized by variable canopy composition and closure. The canopy includes a cohort of open-grown black oak (*Quercus velutina*) and white oak (*Q. alba*) approximately 135 to 140 years old and a younger cohort of jack pine (*Pinus banksiana*), northern pin oak (*Q. ellipsoidalis*), and white oak established following timber harvest during the 1960s. Subtle ridges, swales, and moisture gradients create a heterogeneous mosaic ranging from relatively open areas dominated by jack pine to nearly closed-canopy oak forest. Small openings distributed throughout the occurrence retain characteristic barrens vegetation, including big bluestem (*Andropogon gerardii*), poverty grass (*Danthonia spicata*), June grass (*Koeleria macrantha*), hoary puccoon (*Lithospermum canescens*), wood betony (*Pedicularis canadensis*), common frostweed (*Crocianthemum canadense*), and wood lily (*Lilium philadelphicum*).



Prolonged fire suppression has reduced the size of openings, suppressed herbaceous vegetation, and isolated the highest-quality patches. Pennsylvania

Koenig Oak-Pine Barrens features areas of nearly closed-canopy oak forest between numerous small barrens openings.

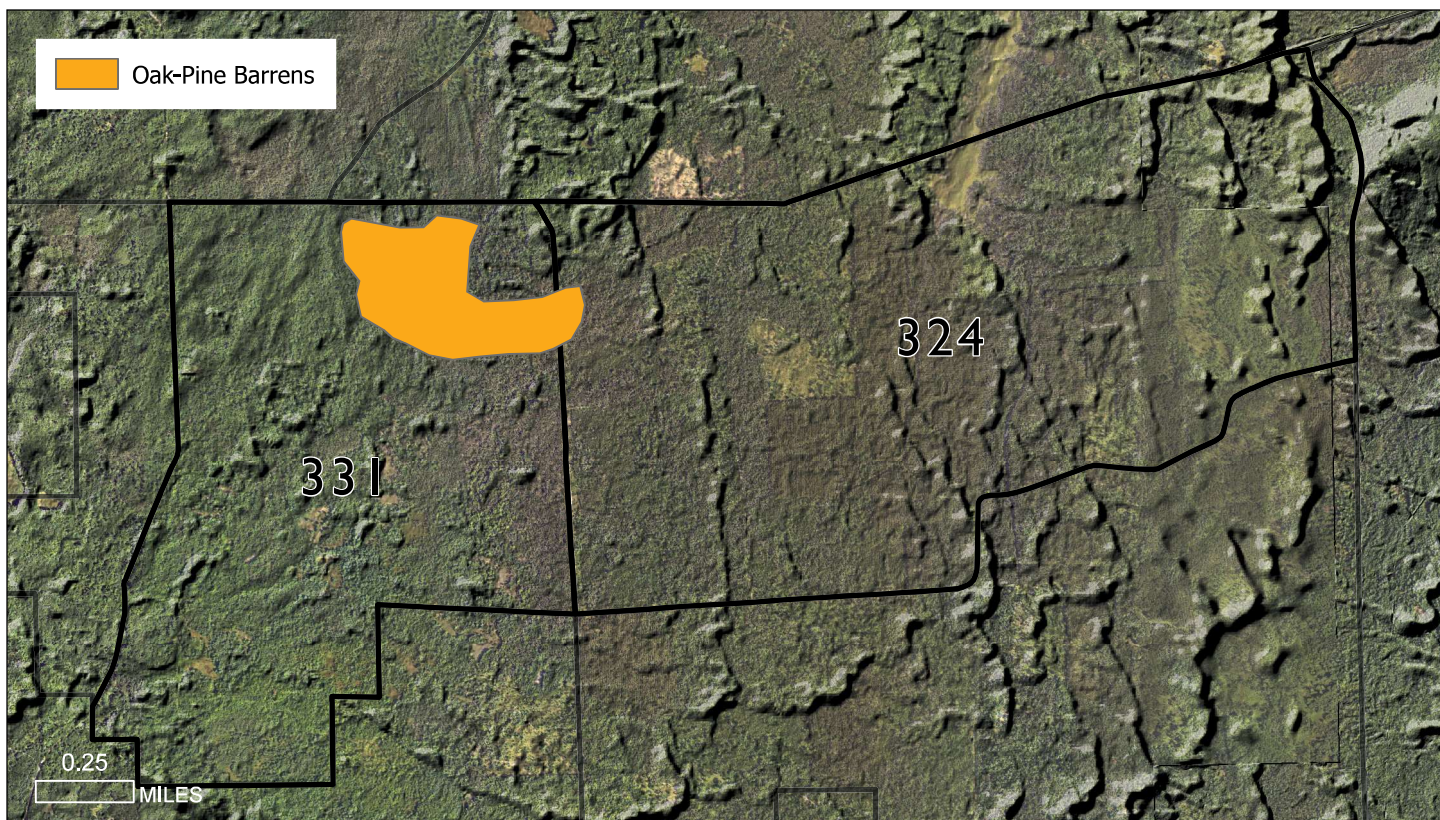


Figure 12. Location and boundary of the Koenig Oak-Pine Barrens EO.

sedge (*Carex pensylvanica*) and hair grass (*Avenella flexuosa*) dominate much of the ground layer and form dense thatch in more degraded areas. Subtle localized furrowing associated with past timber harvest has also reduced herbaceous diversity, but invasive species remain infrequent and characteristic open-grown oaks and conservative barrens species persist. Evidence of at least six fires was apparent in the rings of a red pine stump immediately adjacent to the occurrence, with 26, 9, 11, 12, and 10 years between fires. Although the occurrence currently has poor barrens structure, its moderate size, conservative native flora, limited invasive species, and surviving structural legacies indicate substantial potential for recovery.

Management Recommendations

Small barrens openings with conservative native vegetation persist within a heterogeneous mosaic of relict dune ridges and swales supporting oak forest and jack pine. Together with surviving open-grown oaks, these openings provide cores that can guide recovery of a larger and more connected barrens system. Recovery should be driven primarily by recurrent low-severity fire, with limited woody vegetation control used only where fire alone is

insufficient. Restore recurrent fire, initially aiming for two low- to moderate-intensity prescribed burns within approximately five years to reduce accumulated litter, increase herbaceous expression, and condition fuels for subsequent burns. Thereafter, continue prescribed fire at intervals sufficient to prevent canopy closure and loss of barrens vegetation while retaining the existing cohort of open-grown oaks. Adjust the frequency, seasonality, and severity of subsequent burns based on vegetation response and fuel conditions.

Where prescribed fire alone does not adequately reduce woody encroachment, treat black cherry (*Prunus serotina*) and other mesophytic trees and shrubs with targeted herbicide application or low-impact mechanical treatments. Retain large, old white oak, northern pin oak, white pine, and jack pine as well as red pine saplings during mechanical treatments. Avoid additional soil disturbance within historically furrowed areas. Do not supplement the native flora through seeding or planting; the occurrence retains sufficient conservative barrens vegetation to recover through reintroduction of ecological processes.



Several openings within Koenig Oak-Pine Barrens support diverse flora, including concentrations of conservative barrens indicators such as prairie brome, wood lily, and hoary puccoon. Despite fire suppression and locally closed canopy, the site retains strong potential for recovery primarily through prescribed fire.

8. O'Connell Barrens, Turtle Bowl Prairie, and Little Round Barrens

O'Connell Barrens

Natural Community Type: Oak-Pine Barrens

Rank: G3 S2 vulnerable globally and imperiled in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 17.6 acres; FQI: 35.0; Mean C: 4.6; SR: 58 (89.7% native)

Location: Compartment 393; Stand 43

Element Occurrence Identification Number: 28449

Turtle Bowl Prairie (Documented in 2020)

Natural Community Type: Dry Sand Prairie

Rank: G3 S2 vulnerable globally and imperiled in Michigan

Element Occurrence Rank: C – Fair Occurrence.

Size: 5.7 acres; FQI: 30.2; Mean C: 4.9; SR: 38 (92.1% native)

Location: Compartment 393; Stand 14

Element Occurrence Identification Number: 24190

Little Round Barrens

Natural Community Type: Oak-Pine Barrens

Rank: G3 S2 vulnerable globally and imperiled in Michigan

Element Occurrence Rank: CD – Fair to Poor Occurrence.

Size: 42.5 acres; FQI: 33.4; Mean C: 4.5; SR: 56 (91.1% native)

Location: Compartment 395; Stands 4, 7

Element Occurrence Identification Number: 28448

This area contains prairie and barrens remnants within an extensive oak-pine landscape that has a long history of management. O'Connell Barrens and nearby Turtle Bowl Dry Sand Prairie are separated by a narrow band of dry oak-pine forest with recovery potential. Several smaller openings with characteristic barrens vegetation persist in the forests around these remnants. Little Round Barrens occurs farther east and is more isolated, separated from the other two remnants by an unpaved road and extensive dry oak-pine forest. Together, these sites provide multiple ecological cores within a fire-adapted landscape.

Turtle Bowl Prairie was documented in 2020 as a 5.7-acre, C-rank (fair), dry sand prairie occupying a shallow, frost pocket depression surrounded by oak-pine forest. The opening supports a graminoid-dominated ground layer characterized by Pennsylvania sedge (*Carex pensylvanica*), poverty grass (*Danthonia spicata*), hair grass (*Avenella flexuosa*), and little bluestem (*Schizachyrium scoparium*). Conservative species include cylindrical blazing-star (*Liatris cylindracea*), bird-foot violet (*Viola pedata*), showy goldenrod (*Solidago speciosa*), and racemed milkwort (*Polygala polygama*).

Ongoing stewardship at O'Connell Barrens has maintained approximately 40% canopy cover while retaining open-grown oaks and a diverse barrens flora. The 17.6-acre occurrence supports black oatgrass (*Piptochaetium avenaceum*), little bluestem, big bluestem (*Andropogon gerardii*), common frostweed (*Crocianthemum canadense*), and other characteristic species. O'Connell Barrens is relatively small and lacking an older cohort of trees,

but management has improved structure through the application of fire and mechanical reduction of the canopy and the site qualifies as a natural community EO. Together, O'Connell Barrens, Turtle Bowl Prairie, and openings within the surrounding forest function as valuable cores for continued landscape-scale recovery.

Little Round Barrens is a separate 42.5-acre oak-pine barrens occurrence where recent management with prescribed fire and canopy reduction has improved the condition, increasing the quality to EO status. However, the site has extensive patches of simplified herbaceous composition, recent canopy mortality from severe prescribed fire, and localized invasive species. A study investigating turtle use at Little Round Barrens documented nesting eastern box turtles (*Terrapene carolina carolina*, state threatened) and wood turtles (*Glyptemys insculpta*, state threatened) following prescribed burns and canopy reduction. This demonstrates that stewardship that improves vegetative composition and structure can also benefit turtles and other wildlife species. The documented improvement of O'Connell Barrens and Little Round Barrens, together with the earlier documentation of Turtle Bowl Prairie, helped establish both the ecological rationale and practical support for expanding RFDS inventory and stewardship across the District.

Management Recommendations

O'Connell Barrens, Turtle Bowl Prairie, and Little Round Barrens provide multiple cores for recovery across the surrounding fire-dependent landscape but should be managed as two distinct units: a

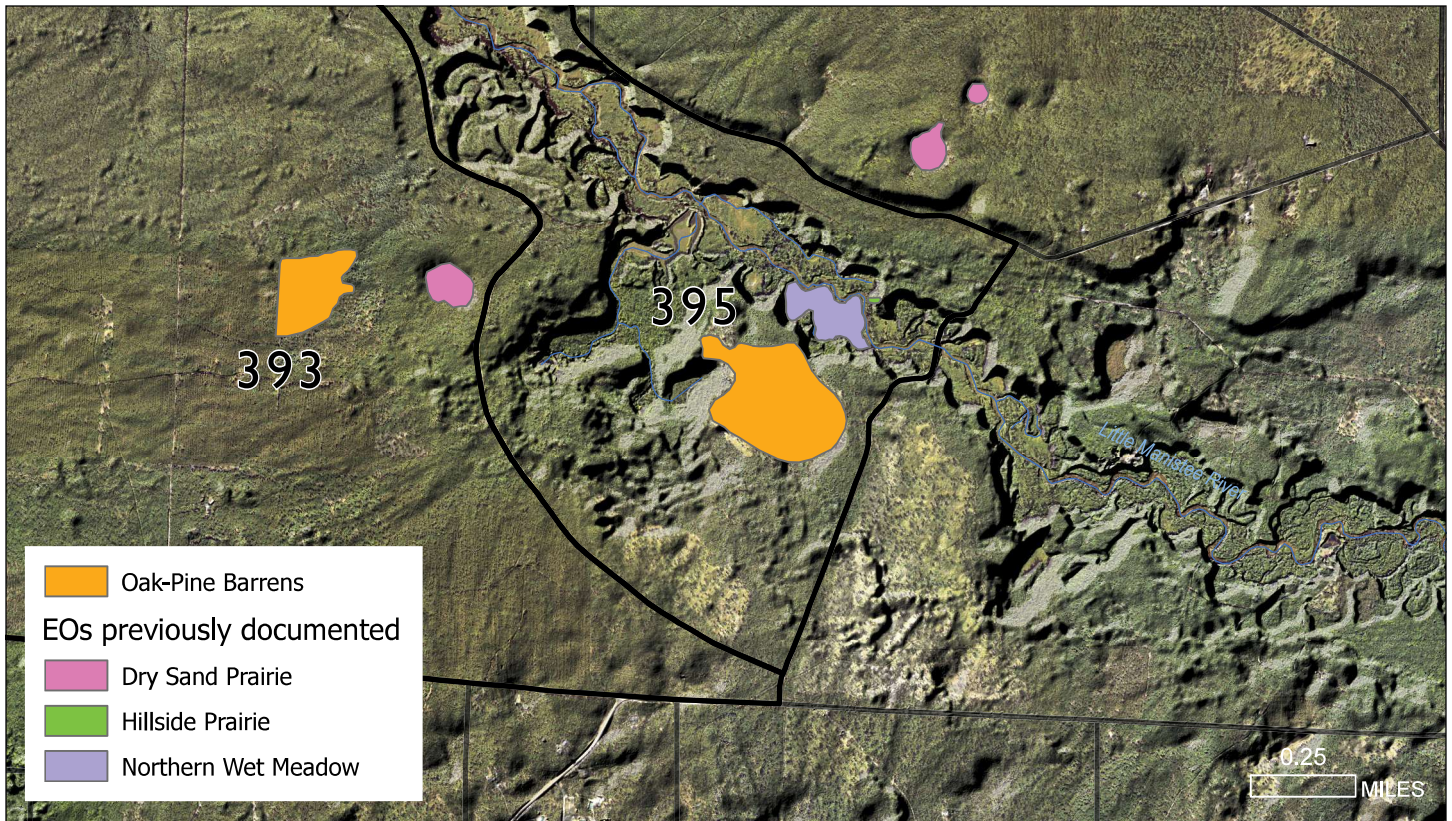


Figure 13. Locations and boundaries of O’Connell Barrens and Turtle Bowl Dry Sand Prairie in Compartment 393 and Little Round Oak-Pine Barrens in Compartment 395. A previously documented northern wet meadow occurs along the Little Manistee River, with a dry sand prairie documented in 2022 on the opposite side of the river.



Management has expanded open barrens structure at Little Round into adjacent forest. Although recent high-severity fire has killed some of the canopy trees, Little Round Barrens retains characteristic barrens structure and composition and should improve with continued stewardship, particularly regular prescribed fire.

connected western complex centered on O'Connell and Turtle Bowl and a separate eastern unit centered on Little Round. Manage O'Connell Barrens, Turtle Bowl Prairie, the intervening dry oak-pine forest, and nearby barrens openings together within the western complex. Apply repeated low- to moderate-severity prescribed fire across the largest practical burn units, using existing roads as control features and avoiding new firebreaks within prairie or barrens vegetation. Expand outward from the strongest concentrations of characteristic species rather than creating open structure in compositionally weak forests. Additional mechanical treatment is likely unnecessary within O'Connell but may be appropriate in the surrounding forest where vegetation responds positively to fire.

Manage Little Round as a separate burn unit extending from the existing road network to the Little Manistee River. Expanding fire across this area would incorporate the mapped occurrence, the managed opening to the south, intervening forest that retains scattered barrens vegetation, and mature pine forest along the river slopes. Future burns

should emphasize low-severity surface fire and avoid conditions that promote crown torching or excessive heating around slash piles. Apply fire cautiously on the steep river slopes to retain mature pines. Where additional mechanical treatment is necessary, proceed incrementally from existing remnant openings, target black cherry and other undesirable woody species, minimize soil disturbance, and retain large open-grown oaks and mature pines.

Protect Turtle Bowl and Little Round as important nesting areas for eastern box turtles and wood turtles. Coordinate burn timing and implementation with ongoing turtle research, maintain unburned refugia through patchy fire, and restrict off-road vehicle use within Turtle Bowl and other sensitive openings. Treat localized invasive species where practical and avoid using prairie or barrens openings as landings or staging areas. Do not supplement species composition within mapped EOs; existing native vegetation should provide the foundation for continued recovery through prescribed fire and carefully sequenced management.



Long-term stewardship of O'Connell Barrens through prescribed fire and woody vegetation reduction has improved the remnant's condition. Future work could expand barrens structure and connect nearby openings that support characteristic vegetation.

Additional RFDS

Surveys also identified fire-dependent systems that did not meet MNFI criteria for recognition as natural community EOs but retain characteristic vegetation, mature trees, or other ecological legacies that provide a basis for improvement through stewardship (Table 4). These areas expand conservation opportunities beyond mapped EOs by increasing the extent of fire-dependent landscapes where management can improve ecological condition.

A notable example is an extensive dry-mesic northern forest west of the Manistee River on morainal slopes above the river valley. This forest was not documented as an EO because of localized younger forest inclusions, low herbaceous diversity in some areas, dispersed camping impacts, and structural and compositional changes associated with fire suppression. Nevertheless, numerous fire-scarred red pine stumps document the historical influence

of recurrent fire, and New Jersey tea (*Ceanothus americanus*), huckleberry (*Gaylussacia baccata*), wild lupine (*Lupinus perennis*), and other barrens-associated species persist locally. The forest retains mature trees, embedded expressions of oak-pine barrens, and strong potential for management using prescribed fire and ecological silviculture. This area may be well suited for applying MNFI's natural red pine guidance (Lincoln and Wojtowicz 2026) on accessible uplands while avoiding timber harvest on steep slopes above the river corridor.

Other RFDS project areas include fire-suppressed barrens and jack pine systems that also provide habitat for fire-dependent wildlife. Recent nesting by Kirtland's warbler (*Setophaga kirtlandii*, state threatened) illustrates the potential for RFDS stewardship to complement compatible wildlife-management objectives. The various RFDS project



Several fire-suppressed pine barrens remnants retain recovery potential. In jack pine-dominated sites, mechanical treatments may be needed before prescribed fire to reduce the risk of high-severity fire. Recent Kirtland's warbler nesting on the District further supports investment in their recovery.

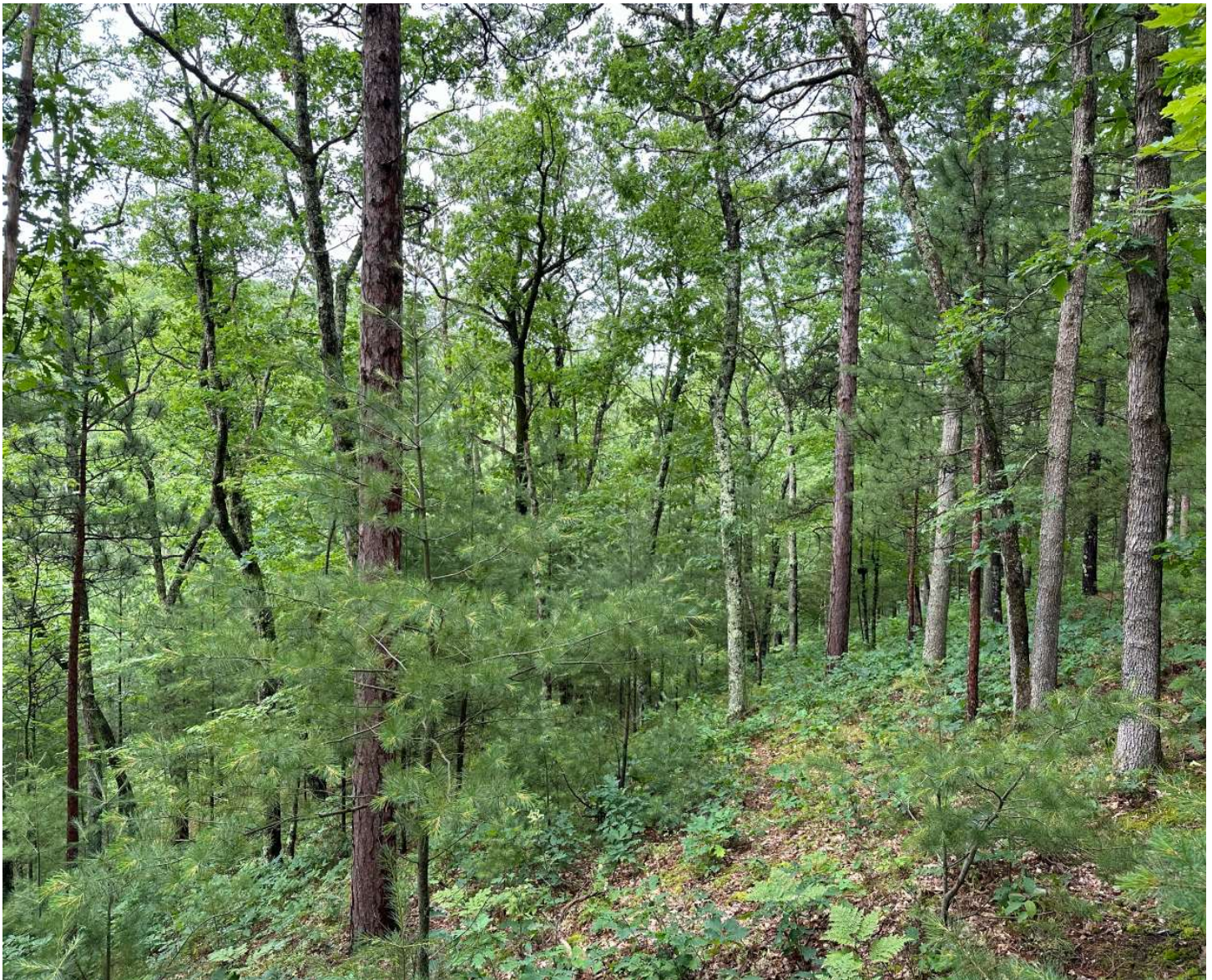
Table 4. Recoverable fire-dependent systems that do not currently meet natural community element occurrence (EO) criteria. We present these non-EO RFDS as potential project areas with significant conservation value that would benefit from holistic management including prescribed fire application and alternative silvicultural approaches. These RFDS retain sufficient native vegetation and ecological legacies to contribute to broader recovery efforts, may qualify for EO recognition following continued stewardship, and are candidates for prescribed fire conducted in support of compatible objectives such as Kirtland's warbler management.

Compartment	Primary Stands	Community Description and Recovery Potential	Stewardship Considerations
326	6, 7	Pine barrens with closed-canopy jack pine, scattered open-grown white oak, and localized barrens vegetation. Canopy closure and the limited distribution of characteristic species currently preclude EO recognition, but prescribed fire may produce sufficient improvement.	Apply prescribed fire, control black cherry, and burn again within five years. Consider winter mastication if fire alone does not sufficiently reduce canopy density.
381		Pine barrens with closed-canopy jack pine and consistently distributed but relatively low-diversity barrens vegetation. Canopy structure and low floristic diversity currently preclude EO recognition. Potential for Kirtland's warbler habitat.	Reduce canopy density as needed, apply prescribed fire, control black cherry, and burn again within five years. Consider winter mastication where appropriate.
3	2, 5, 7	Dense jack pine with scattered barrens indicators, a deep moss layer, and low herbaceous diversity. The area has potential for recovery as pine barrens while also improving Kirtland's warbler habitat.	Use mastication to reduce canopy density and create patchy structure while retaining mature trees and concentrations of characteristic vegetation. Follow with low-severity prescribed fire and monitor vegetation response.
407/408	407: 11, 12, 14, 18, 19, 40, 52; 408: 9, 17–19, 30, 36, 40	Relatively young dry-mesic northern forest with localized timber-harvest impacts, low herbaceous diversity, trails, and dispersed camping. The area nevertheless retains natural community transitions and recovery potential.	Limit dispersed camping, protect steep slopes from harvest, apply ecological silviculture on accessible uplands, and reconstruct fire history.
393	11, 15, 17	Oak-pine barrens associated with O'Connell Barrens and Turtle Bowl Dry Sand Prairie. These stands provide an opportunity to expand outward from the high-quality EOs and increase the extent and connectivity of oak-pine barrens across the intervening landscape.	Incorporate these stands into prescribed burns centered on O'Connell Barrens and Turtle Bowl Dry Sand Prairie. Expand outward from the strongest vegetation responses, using selective canopy reduction only where fire supports characteristic barrens vegetation. Retain open-grown oaks, mature pine, shrubs, and other structural legacies to develop a larger, connected oak-pine barrens landscape.
51	3, 5, 6, 9, 11, 12, 17	Several small oak-pine barrens remnants support varying concentrations of characteristic vegetation. Their proximity to ongoing barrens stewardship in Compartment 7 provides opportunities for coordinated recovery efforts.	Apply prescribed fire where practical and coordinate treatments with ongoing work in Compartment 7. Narrow public ownership adjacent to private property may limit opportunities for larger burn units.
51	13, 16, 21	Steep slopes appear to support extensive, potentially high-quality dry-mesic northern forest. Additional surveys are needed and may support expansion of the EO documented along the north side of the Pine River.	Conduct additional surveys to evaluate condition and delineate community boundaries. Protect steep slopes from timber harvest and recreational disturbance. Prescribed fire may be difficult because of adjacent private ownership.
323	14	Fire-suppressed pine barrens in Stand 14 support herbaceous vegetation characteristic of nearby wet-mesic sand prairie. Although the area has largely converted to closed-canopy jack pine forest and most grasses persist only vegetatively, the retained ground layer indicates considerable recovery potential.	Establish a larger project area encompassing Stands 14, 25, 35, and the intervening smaller stands, complementing ongoing habitat work. Apply prescribed fire and evaluate vegetation response before canopy reduction. Avoid placing burn breaks within the diverse wetland-upland ecotone.
7	18	Stand 18 contains oak-pine barrens remnants with varying concentrations of characteristic vegetation. Nearby barrens stewardship within Compartment 7 provides an opportunity to expand and connect ongoing recovery efforts.	Incorporate Stand 18 into prescribed burns and other stewardship within the compartment. Thin intervening forests and plantations to improve connectivity among priority stands, and manage plantations toward natural forest and barrens conditions.
302	13, 33, 1, 24, 34, 5, 7, 32	Large potential pine barrens project area containing plantations and several barrens indicators. Stand 1 has already received prescribed fire, while characteristic vegetation persists in Stand 13 following a relatively high-severity burn. Although a lower overall priority, previous fire treatments provide a foundation for continued recovery.	Pair ecological silviculture with repeated prescribed fire to develop more natural, heterogeneous conditions. Use lower-severity fire in future treatments to strengthen barrens vegetation while limiting damage to retained timber.

areas summarized in Table 4 vary in composition, structure, and landscape setting, so specific treatments should be tailored to each area.

Stewardship should build upon existing native composition and structure rather than drastically modify them through extensive canopy reduction, soil disturbance, or planting. Appropriate treatments include invasive species control, targeted woody vegetation reduction, protection of mature trees and sensitive soils, and especially prescribed fire. We recommend that prescribed fire be applied as a landscape process using large burn units bounded by durable existing features such as roads, rivers, and established trails. Where operationally feasible, burn units can be designed to allow fire to move across natural community transitions, travel up and down

slopes, and extinguish naturally at wetlands, mesic forests, or other low-fuel boundaries. We recommend avoiding the construction of internal firebreaks and unnecessary mop-up on sensitive slopes and ecotones. In jack pine–dominated systems, repeated low-severity prescribed fire can reduce fuel accumulation, maintain herbaceous barrens vegetation, retain mature jack pine and red pine, and promote heterogeneous natural regeneration. We recommend applying fire at relatively frequent intervals and adjusting its frequency based on vegetation response and fuel conditions. Mechanical treatments should be limited and sequenced after initial fire where practical, allowing vegetation response to identify where additional canopy reduction is warranted.



Extensive dry-mesic northern forest occurs on broad morainal slopes above the Manistee River. Although localized impacts and fire suppression currently preclude EO designation, the forest retains mature trees and potential for recovery to an improved condition. Reintroducing prescribed fire, reducing recreation impacts where feasible, and allowing time for recovery may improve plant diversity, wildfire resilience, and ecological integrity. Ecological silviculture may be appropriate on accessible uplands, while forests on steep slopes are recommended to remain unharvested.

Recreational use poses a localized but significant threat to sensitive sites along the Manistee River corridor. A recent assessment of the Manistee River Trail found that visitor use was concentrated along the river and that dispersed campsites outnumbered designated campsites nearly fivefold, emphasizing the need for proactive recreation planning around sensitive natural communities (Perry et al. 2026). Dispersed camping, vegetation trampling, informal trail development, firewood gathering, and soil disturbance were observed within multiple prairie openings. Because many terraces are small and isolated, even modest recreational impacts can affect a substantial proportion of an occurrence.

Recreation management would ideally prioritize closure of campsites within high-quality prairie

terraces, along high-quality bluffs, within the highest quality forests along trails, or in areas connected by multiple informal access trails. Dispersed camping can be consolidated at locations selected for their relatively low ecological integrity, where continued use would not damage high-quality natural communities or other sensitive resources. Limiting the expansion of user-created campsites and informal trails would protect sensitive vegetation while maintaining recreational opportunities elsewhere along the corridor. Recreation corridors should also be monitored for invasive species, with new or localized populations treated before they expand into high-quality prairie openings. Closed camp sites and nearby areas of sensitive vegetation can be monitored to evaluate recovery and detect displacement of recreational impacts.



The open terraces of the Pine River corridor attract concentrated recreational use, placing some of the District's rarest natural communities in close proximity to dispersed camping. Directing recreation toward durable sites while protecting the highest-quality terraces can reduce impacts without diminishing visitor access to the corridor.

DISCUSSION

The Cadillac-Manistee District supports a matrix of forests, barrens, prairies, and wetlands whose distribution reflects interactions among landform, soils, hydrology, geomorphic processes, and the historical influence of frequent fire across much of the landscape. Prairies, barrens, and associated fire-dependent forests were part of a shifting mosaic in which recurrent fire moved across community boundaries and interacted with local environmental conditions to maintain varied composition and structure. Although fire suppression and land-use change have fragmented and simplified this landscape, remaining high-quality natural communities and other areas with recovery potential provide a foundation for landscape-scale conservation and stewardship of fire-dependent systems.

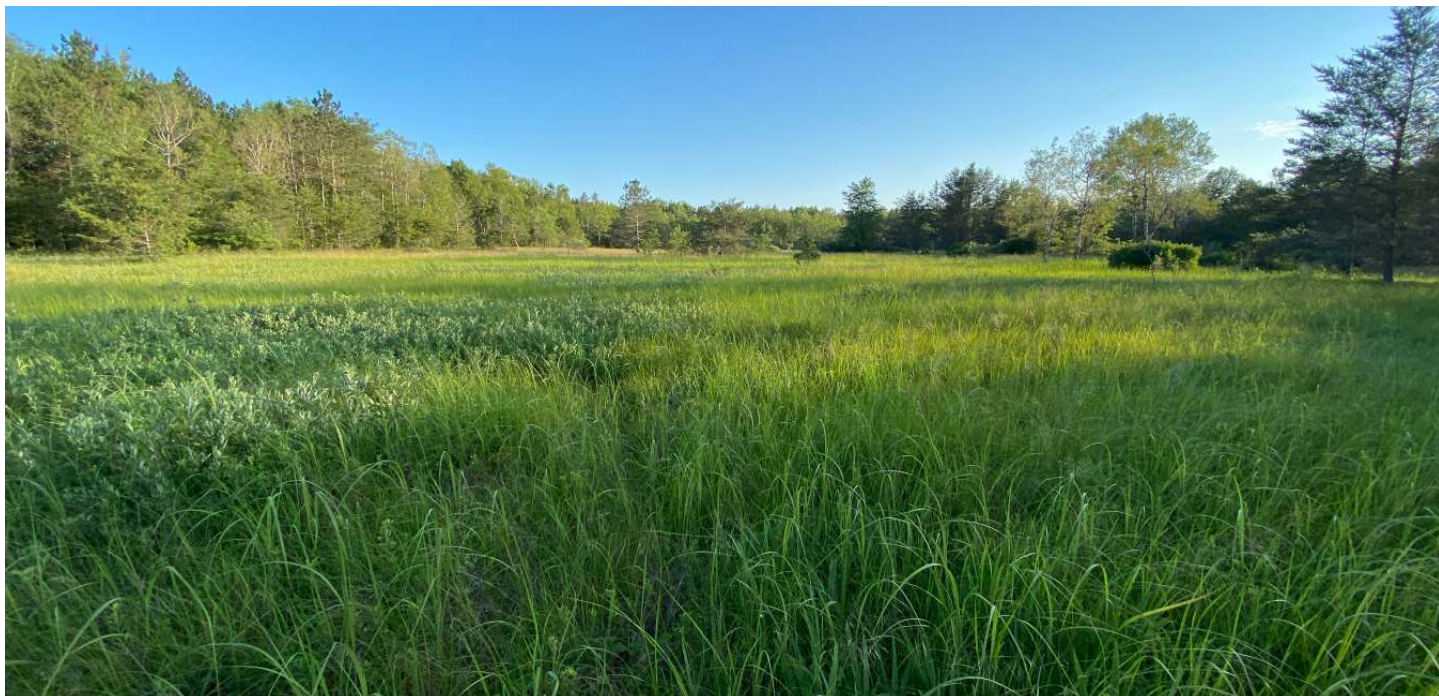
MNFI's prescribed fire needs assessment model indicates that the ecological need for fire is widespread across the 251,459-acre Cadillac-Manistee District, with more than half of the District receiving high, very high, or highest scores. The model provides a practical tool for identifying where recovery opportunities persist. This landscape-scale assessment guided targeted field surveys toward areas where model scores, aerial photo interpretation, and input from Forest Service staff indicated the greatest potential for high-quality fire-dependent natural communities.

Together, the model and field surveys demonstrate the value of combining landscape-scale analysis with targeted surveys to identify remaining fire-dependent systems, refine conservation priorities, and direct management across connected landscapes rather than confining stewardship to isolated natural community remnants.

Effectiveness of the Approach

During the 2024 and 2025 field seasons, we documented 11 new natural community element occurrences (EOs) and expanded 2 previously mapped EOs in the Cadillac-Manistee District of the Huron-Manistee National Forest. The earlier phase of this project, conducted in 2022, added 16 EOs representing 6 natural community types and updated 2 others. Across both phases, the project documented 27 high-quality natural community EOs encompassing 801 acres. Surveys also identified several additional potential project areas where management could extend beyond mapped natural community EOs and improve recoverable fire-dependent systems (RFDS). Collectively, these findings substantially increased the known number and extent of high-quality natural community EOs and other RFDS on the District.

The 2022 surveys identified new natural community EOs at a higher rate than the 2024 and 2025 surveys, an expected result because landscapes with the



Yonkers Prairie was initially documented in 1988 as an intermittent wetland and reclassified as wet-mesic sand prairie following surveys in 2022. That reassessment revealed the site to be an example of a much rarer natural community and elevated its conservation significance. Yonkers is now one of the District's highest conservation priorities, illustrating how this project has refined understanding of fire-dependent systems and directly improved conservation prioritization.

highest modeled fire-need scores were evaluated first. Even where surveys did not document new EOs, they improved understanding of natural community distribution and condition and identified project areas where stewardship could extend beyond mapped occurrences. Because surveys were targeted rather than comprehensive, these results should not be interpreted as a complete inventory of the District. The model is most effective as a prioritization tool used in combination with field expertise, and additional significant communities likely remain outside the highest-priority modeled landscapes.

Expanding Survey Priorities Beyond Model Outputs

Not all survey targets were derived from the prescribed fire needs assessment model. Additional targets were selected based on the rarity and conservation significance of communities documented during earlier surveys, associations between those communities and particular landforms, and the identification of analogous settings elsewhere across the District. In 2022, we documented a hillside prairie along the Pine River with adjacent oak-pine barrens. Pine River Hillside Prairie represented a substantial range expansion for hillside prairie and was among the most significant conservation priorities identified during the earlier phase of this project. Because hillside prairie is critically imperiled in Michigan and vulnerable to extirpation, subsequent surveys emphasized the search for additional occurrences along the Pine and Manistee Rivers.

Surveys along the Pine River consistently found hillside prairies associated with steep slopes along the river, prompting investigation of similar landforms along the Manistee River. However, instead of new examples of hillside prairie, the surveys along the Manistee River identified extensive clay bluff (Manistee River Bluffs) on slopes above the river and wet-mesic prairie (Manistee River Prairie) on adjacent terraces. Together with Pine River Hillside Prairie, the Manistee River Prairie and Manistee River Bluffs represent important range expansions for all three natural community types and are the largest known examples of each in Michigan. The project therefore did more than add occurrences to the natural community database; it fundamentally improved understanding of the regional distribution and extent of these communities and contributed to the ongoing revision of Michigan's natural community classification.

The prescribed fire needs assessment model provided a foundation for prioritizing targets, while repeated field observations revealed associations among landforms, geomorphic processes, and rare natural communities that had not previously been recognized. Incorporating these observations into subsequent surveys allowed us to target analogous landscapes that had not been prioritized by the model. The documentation of extensive river-associated wet-mesic prairie and clay bluff illustrates the value of combining landscape-scale analysis with iterative field investigation and pattern recognition.



Surveys documented extensive clay bluffs above the Manistee River and wet-mesic prairie along river terraces. Together with hillside prairie, these occurrences substantially expand the known ranges of all three natural community types and represent their largest documented examples in Michigan.

Implications for Stewardship

The results of this project reinforce the central stewardship principle developed in the 2022 report: protect high-quality natural communities while extending stewardship into other fire-dependent areas with recovery potential (Lincoln et al. 2022). Natural community EOs remain essential conservation targets and provide reference conditions for recovery, but they represent only a portion of the remaining conservation opportunity. Many areas that do not meet EO criteria retain characteristic species, mature trees and other structural features, and suitable landscape context that provide a foundation for recovery through stewardship without requiring reconstruction of community composition and structure (Pile Knapp et al. 2024).

The conservation value of RFDS—including both natural community EOs and fire-dependent areas that do not meet EO criteria—derives from continuity with the landscape settings and ecological processes

that shaped them. Fire-dependent systems are not simply collections of characteristic species that can be assigned to suitable parcels or recreated through planting alone. Their identity reflects the interaction of environmental setting, biological legacies, disturbance history, and processes operating across the surrounding landscape. Even where condition has declined, some combination of surviving native species, mature and open-grown trees, structural variation, relatively intact soils, and natural transitions to adjacent communities provides a foundation for recovery that cannot be readily recreated once lost. Protecting and improving RFDS therefore conserves present-day biota while retaining the physical settings and ecological legacies needed for long-term recovery. The following sections develop this approach through the concepts of dynamic cores, fire as a landscape process, practical implementation of stewardship, and monitoring and adaptive management.



Extensive dry-mesic northern forest on the broad morainal slopes above the Manistee River illustrates the need for stewardship at a landscape scale. Prescribed fire and ecological silviculture on accessible uplands could improve forest condition, strengthen transitions among natural communities, and expand the influence of nearby dynamic cores, while steep river slopes will ideally remain unharvested.

Dynamic Cores

Native plant populations, vegetation structure, and ecological processes cannot always be sustained within isolated EO boundaries. Historically, prairie, barrens, and associated forests occurred within shifting mosaics shaped by interactions among fire, Indigenous land use, large herbivores, climate, and local environmental conditions (Cleland 1966; Albert 1995; Larson et al. 2025). Elk browsing, grazing, and physical disturbance likely interacted with recurrent fire to reduce woody vegetation and maintain structural heterogeneity, although the magnitude of that influence within the Cadillac-Manistee landscape is unknown (Cleland 1966; Baker 1983). Passenger pigeons were another consequential but now absent influence. Immense nesting colonies episodically altered forest structure, consumed large quantities of mast, and concentrated nutrients; one of the species' final great nestings extended along the Manistee River in 1878 (Mershon 1907; Ellsworth and McComb 2003). These interacting and sometimes episodic forces produced heterogeneous landscapes whose composition and structure cannot be explained by any single disturbance pattern.

Only a small fraction of the District's historically extensive fire-dependent ecosystems persists as high-quality natural communities, and the processes that sustained the broader shifting mosaic no longer function reliably. Less than 1,000 acres of high-quality natural communities were documented within the 251,459-acre Cadillac-Manistee District, although *circa*-1800 vegetation maps indicate that nearly half of the District supported fire-dependent forests and pine and oak-pine barrens occupied thousands of additional acres.

Fire suppression, landscape fragmentation, altered land use, and the loss of influential species have limited the ability of prairie and barrens vegetation to expand and contract and promoted the transition of fire-dependent forests toward more mesophytic, fire-sensitive conditions. The contemporary landscape is therefore not an intact shifting mosaic but a discontinuous set of remnants where fire-dependent systems have persisted on drought-prone river slopes, seasonally inundated depressions, frost-prone outwash landforms, and excessively drained



Little Round Barrens is a 42.5-acre oak-pine barrens where ongoing stewardship has connected three remnant barrens cores within a single project area. The District has sequenced prescribed fire with mechanical canopy thinning to restore barrens structure across the intervening fire-dependent forest, illustrating how stewardship can transform remnant barrens into dynamic cores that expand recovery beyond individual remnants. The occurrence has improved sufficiently through sustained stewardship to qualify for inclusion in the MNFI Natural Heritage Database. Research has documented nesting by eastern box turtles and wood turtles within restored openings. This demonstrates that the benefits of this approach extend beyond vegetation to broader ecological function. Continued expansion of the burn unit from the existing road network to the Little Manistee River would extend fire across a broader mosaic of barrens, fire-dependent forest, and mature pine along the river slopes, reinforcing the role of dynamic cores as anchors for landscape-scale recovery.

sands. Rather than treating these surviving examples as isolated conservation targets, the dynamic core approach uses their characteristic composition and structure to guide stewardship beyond their boundaries (Lincoln et al. 2022). Extending fire and related stewardship outward from these cores can expand fire-dependent vegetation, reconnect remnants, and provide space for prairie, barrens, and fire-dependent forest boundaries to change through time (Pile Knapp et al. 2024).

Dynamic cores provide a practical basis for extending stewardship across broader RFDS project areas and gradually rebuilding a more heterogeneous and connected fire-dependent landscape. Stewardship should prioritize dynamic cores with exemplary composition and structure rather than creating open structure where characteristic flora have been lost. In prairie and barrens systems, prescribed fire, invasive species control, and careful management of woody encroachment can prevent feedbacks among declining herbaceous fuels, reduced fire effectiveness, and increasing woody dominance from pushing open systems across thresholds that are difficult to reverse (Ratajczak et al. 2016).

Steinberg Pine Barrens provides a current example of the dynamic core approach. Documented during the initial surveys in 2022, the high-quality barrens was recently treated with low-severity prescribed fire that extended into surrounding mechanically treated areas, using the remnant community as a core for broader stewardship. Sustained management at Little Round and O'Connell Barrens has likewise improved the condition of both sites sufficiently for their addition to the MNFI Natural Heritage Database. These examples illustrate how stewardship centered on areas retaining native composition can improve ecological condition and extend recovery into surrounding RFDS.

Fire-dependent forests require a different structural objective than barrens and prairie habitats. Management of forests should retain a closed canopy and mature trees while using prescribed fire to maintain characteristic composition and heterogeneity. Across community types, the term "dynamic" reflects the use of these cores as anchors for extending stewardship into broader RFDS project areas rather than preserving them as isolated remnants. The shifting mosaic thus becomes a long-term stewardship objective rather than an assumed starting condition.



O'Connell Barrens has been managed with prescribed fire and mechanical treatments to maintain open conditions. Expanding stewardship into surrounding forests and pine plantations could connect nearby remnant openings, increase barrens habitat, and demonstrate how dynamic cores can guide recovery of fire-dependent systems.

Fire as a Landscape Process

Fire-dependent ecosystems developed in landscapes where fire crossed community transitions and operated at scales larger than most remaining EOs. Fire needs scores do not constitute prescriptions to burn every acre or establish site-specific fire-return intervals. They do, however, indicate a broad ecological need for prescribed fire across much of the District and for its application at a scale commensurate with the need identified by the model. As an illustrative planning scenario, treating areas with high fire need once per decade, those with very high need one to three times per decade, and those with the highest need four times per decade would require approximately 21,400 to 39,700 acres of prescribed fire annually. These estimates illustrate the scale of ecological need rather than provide operational targets.

Because prescribed fire capacity is limited, prioritization is necessary to direct fire where it can provide the greatest ecological benefit based on model results, site recovery phase, operational feasibility, and available funding. The scale of need also provides a strong impetus for developing large, landscape-scale burn units that improve operational efficiency, connect natural community EOs and RFDS, and allow fire to function across ecological boundaries. Strategic prioritization will be especially important for ensuring that limited burn capacity both advances recovery outward from priority cores and maintains sites already receiving repeated fire.

Fire-history research provides an independent line of evidence supporting the reintroduction of fire across these landscapes. Stambaugh et al. (2024) documented recurring fire in red pine remnants within the Manistee National Forest extending back to the sixteenth century. Before and during early European contact, the shortest recorded fire interval at individual study sites ranged from 3 to 12 years. Fire frequency varied considerably among sites and through time, with individual intervals ranging from several years to more than a century. The near absence of fire since approximately 1930 is unprecedented within the approximately 500-year record and has contributed to increasing forest density, red pine decline, and mesophication.

The variability recorded by Stambaugh et al. (2024) cautions against defining a single historical fire-return interval or burn season as the appropriate management target. These findings suggest the need for a prescribed-fire program that incorporates variation in season, frequency, and intensity while monitoring ecological responses. During the initial recovery of fire-suppressed systems, relatively frequent low- to moderate-severity burns may be necessary to reduce accumulated fuels, limit woody encroachment, and promote continuous herbaceous fuels. As composition and structure improve, burn frequency can be adjusted to the response of each system. In many fire-suppressed systems, repeated low-severity burns are likely to provide a more reliable path toward long-term ecological recovery than infrequent, high-severity fire.



Following the 2022 report, District staff applied low-severity prescribed fire at Steinberg Pine Barrens and extended the burn into surrounding mechanically treated areas. Survival of pine seedlings and retention of barrens structure reflect careful application of low-severity fire following prolonged suppression. In pine barrens, where crown fire can eliminate the structural complexity characteristic of high-quality examples, the objective is not simply to burn, but to restore fire as a frequent ecological process.

Local fire-scar evidence documented during this project supports the regional patterns described by Stambaugh et al. (2024). Evidence of at least six fires was apparent in the cross section of a red pine stump immediately adjacent to the Koenig Oak-Pine Barrens evaluated during 2024. This sequence of intervals of 26, 9, 11, 12, and 10 years between fires indicates repeated surface fire at approximately decadal intervals during much of the tree's life while also illustrating the temporal variability characteristic of historical fire regimes. A second red pine stump was recovered from between O'Connell Barrens and Turtle Bowl Prairie and shows intervals of 15, 17, and 8 years between at least four fires. Not all fires are recorded on individual trees and this represents a conservative estimate of the number of fires. Additional fire-scar sampling could further refine local fire-history reconstructions and prescribed-fire planning.

We recommend applying prescribed fire at a landscape scale rather than only within mapped community boundaries. Where operationally feasible, burn units would ideally encompass natural community EOs, surrounding RFDS, intervening fire-dependent forests, and associated wetlands. Roads, rivers, and existing trails can provide logical control features while reducing the need to construct new firebreaks. Ecotones are generally best included within burns rather than repeatedly used as control lines because they often support high biological diversity and historically allowed fire to move across natural community boundaries (Bucher and High 2002; Morgan et al. 2020). Applying fire beyond mapped remnants can also reveal previously obscured RFDS, improve connectivity, and distribute postfire herbivory across a larger area.



Left: A fire-scarred red pine stump recovered by Cadillac-Manistee District Technician Pat Laarman between O'Connell Barrens and Turtle Bowl Prairie records evidence of at least four fires. Because of their high resin content, red pine stumps can persist for decades after tree death. *Right:* An annotated cross-section from the stump shows intervals of 15, 17, and 8 years between recorded fires. It is likely that not every fire produced a scar, particularly fires of low severity. Based on this and other fire-scarred stumps from the area, we recommend applying low-severity prescribed fire at intervals of 5 to 20 years, with shorter intervals during the initial stewardship phase.

Implementing Stewardship

The stewardship recommendations below apply across both mapped natural community EOs and the broader recoverable landscape. Restoration standards indicate that stewardship should prioritize recovery of existing native composition and ecological processes, use reference communities to guide management, increase the intensity of intervention only where natural recovery potential proves insufficient, and adapt specific actions to the composition, structure, and condition of each site (Gann et al. 2026). High-quality natural community EOs provide reference information for desired composition, structure, and ecological processes and generally retain sufficient integrity to respond favorably following the reintroduction of fire and reduction of existing threats.

We provide the following general stewardship recommendations:

- Center long-term stewardship around high-quality natural communities and the best remaining dynamic cores.
- Control invasive species and reverse woody encroachment sufficiently to begin recovery of the native herbaceous layer before substantial canopy reduction.
- Use repeated prescribed fire as the priority process for maintaining and improving fire-dependent systems.
- Use prescribed fire more frequently during initial recovery to control woody encroachment and stabilize fire-dependent vegetation, then reduce frequency as conditions improve.
- Extend prescribed fire across ecotones and adjacent compatible systems rather than confining treatments to individual communities or administrative boundaries.
- Retain characteristic shrubs, legacy trees, snags, and structural variation during mechanical and forestry treatments.
- Avoid rapid or uniform canopy reduction, intensive soil disturbance, and the use of high-quality remnants as landings or fire breaks.
- Expand outward from secured cores through prescribed fire and carefully sequenced ecological silviculture.
- Monitor vegetation response and adjust the timing, frequency, and intensity of fire and mechanical treatments accordingly.
- Evaluate and address deer herbivory where browsing limits the recovery of conservative forbs, characteristic shrubs, or postfire vegetation response.



Black Lake Barrens contains several openings with characteristic barrens composition separated by closed-canopy forest. Stewardship can reconnect and expand these openings through the dynamic core approach, including repeated prescribed fire and carefully sequenced canopy reduction.

Substantial mechanical canopy reduction is most appropriate where the objective is to recover prairie or barrens vegetation and woody encroachment has degraded characteristic open or semi-open structure. In these areas, canopy reduction would ideally follow initial prescribed fire and invasive species control because rapid opening can release dense woody regeneration, facilitate invasive or ruderal species, alter fuel conditions, and further degrade the herbaceous layer (Lettow et al. 2014; Dey and Kabrick 2015; Pile Knapp et al. 2024). Complementary guidance for natural red pine, developed by MNFI with input from District silviculturists, applies this broader approach to forests beyond mapped natural community EOs (Lincoln et al. 2025; Lincoln and Wojtowicz 2026). Together, protection of high-quality natural communities, recovery of RFDS, and reintroduction of fire as a landscape process provide the clearest path toward reversing the continued loss of fire-dependent biodiversity on the Cadillac-Manistee District.

Monitoring and Adaptive Management

The long-term value of this work will depend not on the number of acres burned or management activities completed, but on whether native communities become more compositionally, structurally, and functionally representative of their natural range of variation through time. Fire is not the primary

conservation objective. It is one of the most important tools available for sustaining many fire-dependent ecosystems, but its application should be informed by ecological outcomes. Fire regimes and other treatments should then be evaluated over time and refined through adaptive management as ecosystem responses become better understood.

Restoration of fire-dependent systems remains complex and responses to prescribed fire may differ in modern, fire-suppressed landscapes. Monitoring is therefore best designed around explicit management questions, documented baseline conditions, appropriate reference communities, measurable indicators, and thresholds that trigger changes in management (Gann et al. 2026). Evaluations will ideally account for ecological variation and anticipated environmental change while focusing on ecosystem attributes that link management to ecological integrity.

Priority indicators include changes in characteristic native vegetation, invasive species abundance, woody encroachment, regeneration, and vegetation structure. Questions of particular interest include how fire timing and frequency, mechanical treatments, and deer exclusion affect floristic composition and the mean coefficient of conservatism. Permanent photo points and periodic floristic assessments provide practical methods for detecting unintended losses of



Fire stewardship is critical to the recovery of many sites identified in this report, but its effects can be both beneficial and destabilizing. At the site pictured above, high-severity fire eliminated the canopy jack pine. Although high-severity fire historically influenced these landscapes, managers should initially favor low-severity burns and monitor vegetation response as fire-starved systems are reconditioned. Fire severity, frequency, and seasonality can then be adjusted as composition, structure, and fuel conditions improve.

conservative species and refining stewardship over time. Treatment dates, burn conditions, mechanical treatments, herbicide applications, and any seed or plant material introduced should also be documented so subsequent changes can be interpreted in relation to management. Ideally, quantitative vegetation sampling would be conducted across sites to compare species assemblage, evenness, and cover and evaluate the efficacy of different treatment prescriptions across the District.

Monitoring can also guide decisions about whether supplementation of plant species is necessary. Management should allow sufficient time to evaluate recovery from surviving plants, propagule banks, and nearby populations before supplementing composition through seeding or planting. Introducing plant material prematurely can obscure the response of resident vegetation and alter local genetic composition. Where monitoring indicates that natural regeneration is insufficient, supplementation can address clearly identified compositional deficiencies using appropriate genetic sources while avoiding impacts to existing native populations (Pedrini et al. 2020; Gann et al. 2026).

Future Work

This project provides a sufficient basis for implementing stewardship priorities within identified EOs and broader RFDS project areas. Additional surveys and planning can further refine conservation priorities but should not delay action where needs are already clear. Continued collaboration with District staff, field demonstrations, presentations, and focused guidance documents will be important for incorporating these results into prescribed-fire planning, ecological silviculture, recreation management, and future conservation projects. Future work will ideally emphasize additional surveys, evaluation of the condition and classification of Research Natural Areas, and extending RFDS identification to additional Forest Service Districts.

Additional Surveys

Additional fire-dependent EOs likely remain undocumented within the District. The dry-mesic northern forest EOs along the Pine and Manistee rivers likely can be expanded, and other mature forests on steep river slopes should be periodically evaluated for inclusion within existing EOs. With time and the careful reintroduction of prescribed fire, some



A high-quality floodplain forest along the Manistee River. Future surveys should prioritize floodplain and mesic forests along river corridors, where several examples with potential for recognition as high-quality natural communities were encountered but not systematically evaluated. These forests contribute to water quality, wildlife habitat, and recreational values.

forests that do not currently meet EO criteria may continue developing older structural characteristics and improve sufficiently to qualify. These forests would ideally be buffered from intensive forestry on adjacent uplands. Narrow bands of mature natural red pine observed below Tippy Dam may contain additional fire-scar evidence and could be evaluated as part of future fire-history reconstruction.

Future targeted surveys of ecosystems that are not fire-dependent, such as mesic northern forests and wetlands along river corridors, are likely to document additional natural communities of conservation value. We encountered potentially high-quality floodplain forests and mesic northern forests in several locations during surveys targeting RFDS, but these communities were not systematically evaluated. River-associated forests contribute to the stability of steep slopes and river margins while supporting water quality, wildlife habitat, and the recreational experience of anglers and other visitors. These incidental findings are summarized separately because they fall outside the primary scope of this report (Appendix 3, Table A3-1).

There are also several previously documented natural communities outside of fire-prone landscape positions that would benefit from evaluations to update existing records (Appendix 3, Table A3-2). This project prioritized the documentation of new fire-dependent occurrences, but emergent marshes and northern wet

meadows documented during the late 1980s would benefit from evaluations using current classification, inventory, and EO-ranking methods. Reassessment would clarify their condition, refine their boundaries, and update stewardship recommendations based on improved understanding of natural community ecology during the intervening decades.

Evaluation of Research Natural Areas

Established Research Natural Areas are permanently protected to conserve representative and exceptional ecosystems, provide habitat for rare species, and serve as reference areas for research and land management. The Forest Service has established more than 430 Research Natural Areas nationally, including 52 within the 15 national forests administered in the Northern Research Station region (USDA Forest Service 2024). The Huron-Manistee National Forests include both established RNAs and Candidate Research Natural Areas (CNRAs) identified for potential designation. The long-term value of this network depends on accurate ecological classification, well-supported boundaries, current information on rare species and natural communities, and threats to these areas. Established RNAs would benefit from updated information on natural communities, rare species, and boundaries, while CNRAs require assessment to determine their suitability and support advancement toward formal designation.



Open wetlands along the Manistee River below the Tippy Dam. This project prioritized documenting new fire-dependent occurrences, but several wetlands documented in the late 1980s should be revisited using current classification, inventory, and EO-ranking methods. Reassessment would clarify their current condition, refine their boundaries, and update stewardship recommendations based on advances in MNFI's understanding of natural community ecology.

Yonkers Prairie was originally documented as an intermittent wetland in 1988. Surveys in 2022 reclassified it as wet-mesic sand prairie, expanded the documented occurrence, and found additional rare species. Wet-mesic sand prairie was not recognized in Michigan's natural community classification when Yonkers Prairie was initially evaluated. Its subsequent recognition identified Yonkers Prairie as an example of a much rarer community type, illustrating how older evaluations can underestimate the conservation value of sites within the RNA network. Stewardship of Yonkers Prairie is a significant conservation priority in the District. A similar example comes from Grand Island, which is also managed by the Forest Service. Surveys there in 2023 evaluated a Great Lakes Marsh RNA that had been mapped at 349 acres in 1989. The 2023 surveys revised the mapped extent of Great Lakes marsh from 349 acres to 46 acres and documented poor fen (19 acres), poor conifer swamp (20 acres), and wooded dune and swale complex (286 acres) within the area previously mapped as Great Lakes marsh (Cohen et al. 2024).

These examples demonstrate the value of systematically reassessing the Forest Service RNA network using the current natural community classification, survey methods, spatial data, and

conservation-ranking criteria. Field evaluation of RNAs would provide up-to-date baseline information on current condition, threats, and stewardship needs to inform conservation and management. A broader review could identify overlooked natural communities and rare species, refine boundaries, update management needs, and determine whether each RNA adequately represents the ecological features it was established to protect. The updates of Yonkers Prairie in the Cadillac-Manistee District and Great Lakes Marsh on Grand Island are unlikely to be isolated cases. Gathering current data on the network of RNAs across the Forest Service will support conservation decisions about these ecological assets.

Extending RFDS Identification

The process of applying MNFI's prescribed fire needs assessment model to identify RFDS is readily transferable to other landscapes with stand-level forest inventory data. Application of this process in the Cadillac-Manistee District guided surveys that identified previously undocumented natural communities and identified several project areas, while subsequent field investigation and pattern recognition expanded survey priorities beyond the original model outputs. Concurrent surveys also applied the RFDS framework in the Mio Ranger



A pine barrens on the Stonington Peninsula was documented by MNFI staff during an opportunistic visit in 2025. Subsequent evaluation identified it as the highest-quality pine barrens known from the Upper Peninsula and among the best documented in Michigan. Its recent recognition following only a cursory initial survey suggests that numerous RFDS may remain undocumented across Michigan's National Forests and elsewhere. This finding underscores the value of focused future surveys and the exceptional conservation opportunities created through the long-standing partnership between MNFI, the US Forest Service, and the Michigan DNR.

District, with results to be presented in a forthcoming report. Similar results could be achieved elsewhere in Michigan and across the Great Lakes region.

Within the Huron-Manistee National Forests, the Baldwin-White Cloud and Huron Shores Districts contain extensive fire-dependent landscapes but have not been systematically surveyed. Applying the prescribed fire needs assessment model to guide RFDS inventory in these Districts could identify high-quality natural communities, prioritize recoverable systems, provide managers with site-specific guidance for prescribed fire and ecological silviculture, as well as broad, landscape-scale recommendations for stewardship, monitoring, and conservation planning. Expansion across the remaining Districts would also provide an opportunity to refine the model across a broader range of ecological conditions and develop a forest-wide strategy for fire-dependent biodiversity.

Stonington Pine Barrens within the Hiawatha National Forest is the highest-quality documented pine barrens in Michigan's Upper Peninsula but has received limited systematic natural community inventory by MNFI. Additional pine barrens and associated fire-dependent systems likely remain undocumented. The Hiawatha also supports extensive natural red pine, creating a direct connection among RFDS inventory, MNFI's ongoing Sustainable Forestry Initiative work in the Newberry Forest Management Unit (Lincoln et al. 2025), and recently developed natural red pine guidance (Lincoln and Wojtowicz 2026). Extending this approach to the Hiawatha would identify priority landscapes for conservation and fire management while evaluating how well the RFDS identification process transfers to other National Forest System lands and public lands with comparable inventory data.



A recently burned oak-pine barrens on the Huron Shores Ranger District. This small, high-quality remnant occurs within a larger managed landscape where prescribed fire and canopy modification are improving barrens structure. The site illustrates how dynamic cores can anchor broader landscape recovery.

CONCLUSIONS

This project documented numerous recoverable fire-dependent systems on the Cadillac-Manistee District, identified conservation priorities, and developed targeted stewardship recommendations. Across two phases, the prescribed fire needs assessment model, aerial image interpretation, and iterative field surveys guided work that identified 27 previously undocumented natural community occurrences encompassing 801 acres and additional RFDS project areas, while improving understanding of natural community distribution on the District. These findings include Michigan's largest documented hillside prairie, wet-mesic prairie, and clay bluff and represent range expansions for all three natural community types.

The 2022 surveys of the Cadillac-Manistee District marked the initial application of MNFI's prescribed fire needs assessment model to identify RFDS (Lincoln et al. 2022). The current project, funded through Good Neighbor Authority, continued application of the approach on the Cadillac-Manistee District and extended it to the Mio District, whose results will be presented in a separate forthcoming report.

MNFI has also applied the model to identify RFDS across the Grayling, Roscommon, Newberry, Atlanta, and Traverse City State Forest Management Units. Together, these efforts have expanded what began as a regional inventory approach into a broader statewide conservation effort. Across these projects, surveys have identified Michigan's largest documented dry northern forest (Mio District) and highest-ranked documented pine barrens (Roscommon FMU). Over three field seasons, this work also increased the total documented acreage of pine barrens by nearly 32% (Lincoln et al. 2024, 2025; MNFI 2026). The repeated identification of high-quality natural communities and recoverable systems across multiple landscapes indicates that the approach can efficiently direct limited inventory and stewardship resources toward important conservation targets that might otherwise remain undocumented.

These findings underscore the importance of natural heritage inventory and statewide ecological knowledge. Understanding the distribution, rarity, condition, and landscape context of natural



Kinsey Hunt Pine Barrens, one of Michigan's highest-quality pine barrens, was documented in 2024 on State Forest land in the Roscommon FMU. It was identified through an RFDS project that followed the initial Cadillac-Manistee project of 2022. Subsequent applications of this approach have identified dozens of previously undocumented natural communities, including several of statewide significance, and continue to inform our understanding of fire-dependent landscapes and shape conservation across Michigan.

communities helps individual Districts and management units prioritize stewardship within a broad conservation context. Continued application of this approach can help protect high-quality occurrences, build stewardship around dynamic cores, and extend prescribed fire and ecological silviculture into surrounding recoverable landscapes.

MNFI's prescribed fire needs assessment model identified 143,140 acres of the Cadillac-Manistee District with a high ecological need for fire. The 801 acres of high-quality natural communities identified through the two project phases provide an ecological foundation for broader stewardship. Long-term conservation success will depend not on protecting these remnants as isolated preserves, but on using them as cores to guide recovery beyond their boundaries. Natural community EOs and other RFDS project areas represent a continuum of recoverable fire-dependent systems and serve as dynamic cores from which recovery can expand. The broader fire-dependent landscape provides the space across which ecological processes can be reintroduced

and connections rebuilt, but not all of that landscape retains sufficient ecological integrity to qualify as RFDS. This approach recognizes that fire-dependent communities are neither static nor self-contained and that their long-term conservation depends on reintroducing ecological processes and strengthening connections beyond the boundaries of recognized EOs.

Subsequent surveys for RFDS have identified dozens of previously undocumented natural communities, including several of statewide significance, and continue to shape conservation of fire-dependent systems across Michigan. The long-term value of this work will ultimately be measured by whether stewardship improves the composition, structure, and function of native communities through time, not by the number of acres burned or management activities completed. Fire is not the conservation objective, but an essential tool for sustaining many fire-dependent ecosystems. Its value will depend on ecological outcomes and continued refinement of management as system responses become better understood.



This work identified recoverable fire-dependent systems across the Cadillac-Manistee District that retain ecological continuity. Fire stewardship centered on these systems offers an opportunity to protect declining biodiversity by restoring a process that once functioned at a landscape scale.

LITERATURE CITED

- Albert, D.A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: A working map and classification. USDA, Forest Service, North Central Forest Experiment Station, St. Paul, MN.
- Anderton, J.B. 1999. Native American Fire-Maintained Blueberry Patches in the Coastal Pine Forests of the Northern Great Lakes. *The Great Lakes Geographer* 6: 29-39.
- Baker, R.H. 1983. Michigan Mammals. Michigan State University Press, East Lansing, Michigan. 642 pp.
- Bucher, M.A., and M.E. High. 2002. Fire management and research for biodiversity in the Green Swamp. In W.M. Ford, K.R. Russell, and C.E. Moorman, eds., *Proceedings: The Role of Fire for Nongame Wildlife Management and Community Restoration: Traditional Uses and New Directions*. General Technical Report NE-288. USDA Forest Service, Northeastern Research Station, Newtown Square, Pennsylvania, pp. 111–115.
- Cleland, C.E. 1966. The Prehistoric Animal Ecology and Ethnozoology of the Upper Great Lakes Region. *Anthropological Papers No. 29*. Museum of Anthropology, University of Michigan, Ann Arbor. <https://doi.org/10.3998/mpub.11396632>
- Cleland, D.T., T.R. Crow, S.C. Saunders, D.I. Dickmann, A.L. Maclean, J.K. Jordan, R.L. Watson, A.M. Sloan, and K.D. Brososke. 2004. Characterizing historical and modern fire regimes in Michigan (USA): A landscape ecosystem approach. *Landscape Ecology* 19: 311–325. <https://doi.org/10.1023/B:LAND.0000030437.29258.3c>
- Cohen, J.G., B.S. Slaughter, and D.A. Albert. 2008. Natural Community Surveys of Potential Ecological Reference Areas on State Forest Lands. Michigan Natural Features Inventory, Report Number 2008-04, Lansing MI. 272 pp.
- Cohen, J.G., R.P. O'Connor, B.J. Barton, D.L. Cuthrell, P.J. Higman, and H.D. Enander. 2009. Fort Custer Vegetation and Natural Features Survey 2007-2008 Report. Michigan Natural Features Inventory, Report Number 2009-04, Lansing, MI. 46 pp plus 2 appendices.
- Cohen, J.G., M.A. Kost, B.S. Slaughter, and D.A. Albert. 2015. A Field Guide to the Natural Communities of Michigan. Michigan State University Press, East Lansing, MI. 362 pp.
- Cohen, J.G., C.M. Wilton, H.D. Enander, and T.J. Bassett. 2021. Assessing the Ecological Need for Prescribed Fire in Michigan Using GIS-Based Multicriteria Decision Analysis: Igniting Fire Gaps. *Diversity* 13(3).
- Cohen, J.G., J.M. Lincoln, and H.D. Enander. 2024. [Natural Community Surveys of Grand Island, Grand Island National Recreation Area, Lake Superior](#). Michigan Natural Features Inventory, Report No. 2024-06, Lansing, MI. 219 pp.
- Cohen, J.G., M.A. Kost, B.S. Slaughter, D.A. Albert, J.M. Lincoln, A.P. Kortenhoven, C.M. Wilton, H.D. Enander, M.E. Anderson, M.R. Parr, T.J. Bassett, and K.M. Korroch. 2025. [Michigan Natural Community Classification \[web application\]](#). Michigan Natural Features Inventory, Michigan State University Extension, Lansing, MI. Available <https://mnfi.anr.msu.edu/communities/classification>. (Accessed: July 18, 2026).
- Comer, P.J., D.A. Albert, H.A. Wells, B.L. Hart, J.B. Raab, D.L. Price, D.M. Kashian, R.A. Corner, and D.W. Schuen. 1995. Michigan's presettlement vegetation, as interpreted from the General Land Office Surveys 1816-1856. Michigan Natural Features Inventory, Lansing, MI. Digital map.
- Dey, D.C., and J.M. Kabrick. 2015. Restoration of Midwestern oak woodlands and savannas. In J.A. Stanturf, ed., *Restoration of Boreal and Temperate Forests*, 2nd ed. CRC Press, Boca Raton, Florida, pp. 401–428.
- Ellsworth, J.W., and B.C. McComb. 2003. Potential effects of passenger pigeon flocks on the structure and composition of presettlement forests of eastern North America. *Conservation Biology* 17(6): 1548–1558. <https://doi.org/10.1111/j.1523-1739.2003.00230.x>
- Faber-Langendoen, D., J. Rocchio, P. Comer, G. Kudray, L. Vance, E. Byers, M. Schafale, C. Nordman, E. Muldavin, G. Kittel, L. Sneddon, M. Pyne, and S. Menard. 2008. Overview of Natural Heritage Methodology for Ecological Element Occurrence Ranking based on Ecological Integrity Assessment Methods [Draft for Network Review]. NatureServe, Arlington, VA.
- Faber-Langendoen, D., W. Nichols, J. Rocchio, J. Cohen, J. Lemly, and K. Walz. 2015. Ecological Integrity Assessments and the Conservation Value of Ecosystem Occurrences: General Guidance on Core Heritage Methodology for Element Occurrence Ranking. NatureServe, Arlington, VA.
- Faber-Langendoen, D., J. Lemly, W. Nichols, J. Rocchio, K. Walz, and R. Smyth. 2019. Development and evaluation of NatureServe's multi-metric ecological integrity assessment method for wetland ecosystems. *Ecological Indicators* 104: 764–775.
- Farrand, W.R.; Bell, D.L. 1982. Quaternary Geology of Northern Michigan; Michigan Department of Natural Resources, Geological Survey Division: Lansing, MI, USA.
- Freyman, W.A., L.A. Masters, and S. Packard. 2016. The Universal Floristic Quality Assessment (FQA) Calculator: an online tool for ecological assessment and monitoring. *Methods in Ecology and Evolution* 7(3): 380-383
- Gann, G.D., T. McDonald, B. Walder, J. Aronson, C.R. Nelson, J.G. Hallett, M.R. Guariguata, E.K. Gonzales, F. Hua, C. Echeverria, C. Eisenberg, J. Liu, K. Decler, Z.E. Barr, D.C. Bartholomew, M. Best, R. Chazdon, A. Cliquet, J. Cortina-Segarra, H. Kalirai, K. MacCallum, A. Mosyafiani, S. Pedrini, R. Young, and K.W. Dixon. 2026. International principles and standards for the practice of ecological restoration. Third edition. *Restoration Ecology* 34: e70441. <https://doi.org/10.1111/rec.70441>
- Herman, K.D., L.A. Masters, M.R. Penskar, A.A. Reznicek, G.S. Wilhelm, W.W. Brodovich, and K.P. Gardiner. 2001. Floristic Quality Assessment with wetland categories and examples of computer applications for the State of Michigan - Revised, 2nd Edition. Michigan Department of Natural Resources, Wildlife, Natural Heritage Program, Lansing, MI. 19 pp. + appendices.
- Jenkins, D. G., E. H. Boughton, A. J. Bohonak, R. F. Noss, M. A. Simovich, and E. T. Bauder. 2021. Indicator-species and coarse-filter approaches in conservation appear insufficient alone. *Global Ecology and Conservation* 28: e01667.

- Kipfmüller, K.F., E.R. Larson, L.B. Johnson, and E.A. Schneider. 2021. Human augmentation of historical red pine fire regimes in the Boundary Waters Canoe Area Wilderness. *Ecosphere* 12: e03673.
- LANDFIRE. 2008. Vegetation Condition Class (VCC), LANDFIRE version 1.1.0. U.S. Department of the Interior, U.S. Geological Survey. Accessed 28 October 2010 at <http://landfire.cr.usgs.gov/viewer/>.
- Larson, E.R., N.M. Montano, E. Lockling, A. Ojibway, M.B. Reynolds, V.R. Zhaawendaagozikwe, L.B. Johnson, K.F. Kipfmüller, M.J. Dockry, V. Northrup, J. Savage, and R.W. Kimmerer. 2025. Indigenous fire stewardship shaped North American Great Lakes forests. *Proceedings of the National Academy of Sciences* 122(34): e2500024122. <https://doi.org/10.1073/pnas.2500024122>
- Lettow, M.C., L.A. Brudvig, C.A. Bahlai, and D.A. Landis. 2014. Oak savanna management strategies and their differential effects on vegetative structure, understory light, and flowering forbs. *Forest Ecology and Management* 329: 89–98. <https://doi.org/10.1016/j.foreco.2014.06.019>
- Lincoln, J.M., J.G. Cohen, H.D. Enander, T.J. Bassett, C.M. Wilton, and N. J. Smith. 2022. [Identifying Recoverable, Fire-Dependent Systems in the Cadillac-Manistee District of the Huron-Manistee National Forest](#). Report Number 2022-45, Lansing, MI, pp 76.
- Lincoln, J.M., T.J. Bassett, and J.G. Cohen. 2024. [Identifying Recoverable, Fire-Dependent Systems on State Forest Land](#). Report No. 2024-41, Lansing, MI.
- Lincoln, J.M., M.R. Parr, and J.G. Cohen. 2025. [Identifying Recoverable, Fire-Dependent Systems in the Newberry Forest Management Unit](#). Report No. 2025-36, Michigan Natural Features Inventory. Lansing, MI. 115 pp.
- Lincoln, J.M., and C.C. Wojtowicz. 2026. [Maintaining Natural Red Pine in Michigan: A Framework for Fire Stewardship and Ecological Silviculture](#). Report No. 2026-10, Michigan Natural Features Inventory. Lansing, MI.
- Matthews, J.W., G. Spyreas, and C.M. Long. 2015. A null model test of Floristic Quality Assessment: Are plant species' Coefficients of Conservatism valid? *Ecological Indicators* 52:1-7.
- McDonnell, M.A. 2015. *Masters of Empire: Great Lakes Indians and the Making of America*. Hill and Wang, New York, NY. 402 pp.
- Mershon, W.B. 1907. *The Passenger Pigeon*. Outing Publishing Company, New York. 225 pp.
- Michigan Natural Features Inventory (MNFI). 1988. Draft criteria for determining natural quality and condition grades, element occurrence size-classes and significance levels for palustrine and terrestrial natural communities in Michigan. Michigan Natural Features Inventory, Lansing, MI. 39 pp.
- Michigan Natural Features Inventory. 2026. Michigan Natural Heritage Database, Lansing, MI.
- Morgan, P., E.K. Heyerdahl, E.K. Strand, S.C. Bunting, J.P. Riser II, J.T. Abatzoglou, M. Nielsen-Pincus, and M. Johnson. 2020. Fire and land cover change in the Palouse Prairie-forest ecotone, Washington and Idaho, USA. *Fire Ecology* 16: 2. <https://doi.org/10.1186/s42408-019-0061-9>
- NatureServe. 2022. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://explorer.natureserve.org>. (Accessed: March 28, 2022).
- Noss, R.F. 1987. From plant communities to landscapes in conservation inventories: A look at the Nature Conservancy (USA). *Biological Conservation* 41(1): 11–37. [https://doi.org/10.1016/0006-3207\(87\)90045-0](https://doi.org/10.1016/0006-3207(87)90045-0)
- Nowacki, G.J., and M.D. Abrams. 2008. The demise of fire and “mesophication” of forests in the eastern United States. *BioScience* 58(2): 123–138. <https://doi.org/10.1641/B580207>
- Nuzzo, V. A. 1986. Extent and status of Midwest oak savanna: Pre-settlement and 1985. *Natural Areas Journal*, 6(2): 6-36.
- O'Connor, R. P., M. A. Kost, and J. G. Cohen. 2009. *Prairies and savannas in Michigan: Rediscovering our natural heritage*. Michigan State University Press, East Lansing.
- Pedriani, S., P. Gibson-Roy, C. Trivedi, C. Gálvez-Ramírez, K. Hardwick, N. Shaw, S. Frischie, G. Laverack, and K. Dixon. 2020. Collection and production of native seeds for ecological restoration. *Restoration Ecology* 28: S228–S238.
- Perry, E., D. McCole, and R. Szczytko. 2026. Huron-Manistee National Forests Trail Conditions Report: Manistee River Loop Trail. Department of Community Sustainability, Michigan State University, East Lansing, Michigan.
- Pile Knapp, L.S., D.C. Dey, M.C. Stambaugh, F.R. Thompson III, and J.M. Varner. 2024. Managing forward while looking back: reopening closed forests to open woodlands and savannas. *Fire Ecology* 20: 72. <https://doi.org/10.1186/s42408-024-00312-9>
- Ratajczak, Z., J.B. Nippert, and S.L. Collins. 2012. Woody encroachment decreases diversity across North American grasslands and savannas. *Ecology* 93(4): 697–703. <https://doi.org/10.1890/11-1199.1>
- Ratajczak, Z., J.M. Briggs, D.G. Goodin, L. Luo, R.L. Mohler, J.B. Nippert, and B. Obermeyer. 2016. Assessing the potential for transitions from tallgrass prairie to woodlands: Are we operating beyond critical fire thresholds? *Rangeland Ecology & Management* 69(4): 280–287. <https://doi.org/10.1016/j.rama.2016.03.004>
- Reznicek, A.A., M.R. Penskar, B.S. Walters, and B.S. Slaughter. 2014. Michigan Floristic Quality Assessment Database. Herbarium, University of Michigan, Ann Arbor, MI and Michigan Natural Features Inventory, Michigan State University, Lansing, MI. <http://michiganflora.net>
- Sampson, F., and F. Knopf. 1994. Prairie conservation in North America. *BioScience* 44: 418–421.
- Schaetzl, R.J., H. Enander, D. Luehmann, D.P. Lusch, C. Fish, M. Bigsby, M. Steigmeyer, J. Guasco, C. Forgacs, and A. Pollyea. 2013. Mapping the physiography of Michigan with GIS. *Phys. Geogr.* 34, 2–39.
- Slaughter, B.S., A.A. Reznicek, M.R. Penskar, and B.S. Walters. 2015. Notes on the Third Edition of the Floristic Quality Assessment of Michigan. *Wetland Science & Practice*.
- Stambaugh, M.C., J.M. Marschall, E.R. Abadir, R.P. Guyette, and D.C. Dey. 2024. Historical fire regimes from red pines (*Pinus resinosa* Ait.) across the Tension Zone in the Lower Peninsula, Michigan, USA. *Fire Ecology* 20:24. <https://doi.org/10.1186/s42408-024-00253-3>
- USDA. 2024. Field Sampled Vegetation (FSVEG), United States Department of Agriculture, Forest Service, Huron-Manistee National Forests, Cadillac, MI.
- USDA Forest Service. 2024. NRS Research Natural Areas. Northern Research Station. Available at: <https://research.fs.usda.gov/nrs/rnas> (accessed July 27, 2026).

APPENDIX 1 - MODEL DEVELOPMENT

Model Background and Natural Community Crosswalk

The prescribed fire needs assessment model is more thoroughly described in Cohen et al. (2021). MNFI originally developed the model for state lands in Michigan administered by Michigan Department of Natural Resources (DNR). The model described here was modified for the Cadillac-Manistee District. Vegetative cover of lands within the Huron-Manistee National Forest is tracked through a stands database. These stands are the foundational unit of our model. For each stand, we generated an intersection with numerous spatial data layers including datasets with information on physiographic region, landform, *circa*-1800 vegetation, slope, aspect, and occurrences of high-quality natural communities or ecosystems. We used information gleaned from this intersection as well as stand-level data to “crosswalk” or assign a natural community type to as many stands as possible. Anthropogenic systems (e.g., developed, cropland, plantations, roads, ruderal systems, and grassland plantings) were not crosswalked to a natural community type.

Over the course of four decades, MNFI has developed a classification of natural community types in Michigan (Cohen et al. 2015; Cohen et al. 2025). Part of this classification includes a detailed discussion of each natural community type’s vegetative composition and structure, soil texture and soil moisture, hydrology, and natural disturbance regime. The classification typically includes information on fire dependence and fire return interval drawn from literature review and ecological inference. Fire return interval is the time in years between two successive fires in a designated area and can be used to estimate fire frequency range. We use fire frequency range throughout to convey the range of time between fire events typical of a given natural community type irrespective of area.

Variable Selection and Data Preparation

Through literature review, evaluation of available spatial data layers, and discussion with natural resource managers and ecological experts, we identified potential variables critical for determining a site’s proclivity to support a fire-dependent ecosystem or need for prescribed fire. In selecting these variables, we tried to incorporate factors that contribute to a site’s past, current, and future relationship with fire. Because multiple variables interact at different scales in determining the characteristics of a site’s fire regime, we identified critical variables for our model at the following three spatial scales: landscape, stand, and species.

Landscape

Landscape-scale variables included physiographic region, surficial geology or landform, historic vegetation, and departure from historic disturbance regime. Physiographic regions are classified by large scale abiotic factors, such as climate and underlying bedrock, which, along with surficial geology, influence the patterning of ecosystems across landscapes. We used Schaetzl et al. (2013) for physiographic regions and Farrand and Bell (1982) for surficial geology. The data layer of surficial geology that we used includes descriptions of the glacial and post-glacial landforms as well as modifiers that convey information about soil texture properties of those landforms. Vegetation *circa* 1800 has been mapped in Michigan following interpretation of the original land surveyors’ notes (Comer et al. 1995). This spatial database of historic land cover provides useful information about how fire-prone and fire-sensitive ecosystems were patterned across Michigan. The historical legacy of ecosystems and species influences current distribution of ecosystems and their need for fire disturbance. To incorporate departure from historic fire regime we used LANDFIRE’s Vegetation Condition Class or VCC, which gauges how far removed an area is from its historic fire return interval (LANDFIRE 2008).

Stand

Stand-level variables included fire frequency range, fire dependence, aspect, slope, age, size, and presence of exemplary ecosystems or natural community element occurrences. For each stand crosswalked to a natural community type we determined the scale of fire dependence (i.e., extremely fire dependent, very fire dependent, fire dependent, fire neutral, fire sensitive, very fire sensitive, and extremely fire sensitive), fire frequency (i.e., extremely frequent, very frequent, somewhat frequent, frequent, infrequent, somewhat infrequent, very infrequent, extremely infrequent), and fire frequency range (e.g., 1-5 years, 10-20 years, 200-500 years, and >1000 years). We also assigned a level of certainty for the fire frequency range (i.e., low, medium, and high). Fire frequency ranges were derived from the literature, but in cases where there was no reference for a natural community type, we relied on expert inference and evaluated similar natural community types to assign a fire frequency range.

For natural community types with broad fire frequency ranges, such as wetland ecosystems, we modified the fire frequency range depending on the landscape context of the natural community. For example, wet meadows occurring in a fire-prone landscape were

assigned a higher fire frequency range (e.g., 10-100 years) than prairie fens nested in less combustible landscapes (e.g., 100-200 years). In terms of aspect, westerly and southerly aspects are more prone to fire than easterly and northern aspects. We used 30-meter digital elevation model (DEM) data to incorporate slope and aspect into the model. In terms of slope, flatter areas are more fire prone than areas of rugged topography. The stand database was used to derive the age and size variables. For forested systems, stand age and size-class can be used as predictors of need for fire, since certain forest types such as oak and pine forests depend on fire disturbance to foster regeneration. Within fire-dependent forested systems, there is a greater need for fire in mature systems compared to regenerating ones. For the size-class variable, we assumed there is a greater need for fire in forested stands categorized as “sawtimber” compared to “poletimber” and “seedling/sapling”. Finally, stands that have higher ecological integrity have a higher need for fire from a conservation perspective and were therefore integrated into the model using documented examples of high-quality natural communities from MNFI’s Natural Heritage Database (i.e., natural community element occurrences).

Species

We ran an intersection of Cadillac-Manistee District stands with MNFI’s rare species element occurrences and generated a list of known rare species occurrences that intersect with stands. For each of these species we researched whether or not the species is fire tolerant or fire dependent, and if the habitat the species depends on is fire dependent. We evaluated a total of 461 rare animal and plant species.

Variable Scoring

The input variables included both categorical and numerical data. For example, classes within the surficial geology layer include “end moraines of fine-textured till” and “ice-contact outwash sand and gravel,” and classes attributed to the aspect variable include “south,” “southwest,” and “west.” The variables that have numerical data are attributed with different numbering systems with different ranges. For example, for the slope variable, the data is broken into mean slope classes (e.g., ≥ 0 and ≤ 6 ; ≥ 7 and ≤ 9 ; ≥ 21 and ≤ 30), and the fire frequency range variable included 14 different classes (e.g., 1-5 years; 5-20 years; 50-100 years; 500-1000 years; > 1000 years). To combine the input variables into the same analysis, we reclassified each variable to the same relative

evaluation scale to allow for comparison across variables. Scores for most variables were scaled equally within 6 integers and ranged between 0 and 5, in order of increasing ecological need for prescribed fire (i.e., 0 = No Fire Needs or None, 1 = Low, 2 = Moderate, 3 = High, 4 = Very High, 5 = Highest).

We developed detailed scoring rules for each input variable. For example, for natural community types with a fire frequency range of 1 to 5 years, we developed the following rule: “IF Fire Frequency Range = 1-5 Years, THEN +5.” Additional examples of rules include: “IF Surficial Geology = Ice-contact outwash sand and gravel, THEN +5”; “IF Aspect = West, THEN +5”; and “IF stand is classified as ‘fire dependent’ and Mean Slope ≥ 0 AND ≤ 6 , THEN +5”.

GIS-Based Multicriteria Decision Analysis

To synthesize the data contributed by our multiple input variables into one prescribed fire needs score, we used GIS-based multicriteria decision analysis, which combines spatially referenced data and multi-attribute criteria in a problem-solving environment. This integrated analysis allows users to apply weights to input variables and combine them into a single output. We assigned weights to variables to infer relative importance to prescribed fire needs. Weighting was determined by expert opinion and not empirical statistical analysis. Weights were derived following discussions with natural resource managers and fire ecology experts and literature review on the factors that influence fire disturbance regimes and the response of landscapes, ecosystems, and species to fire. We multiplied each reclassified score by the assigned weighting factor. Assigned variable weights include x25 for Fire Frequency Range, x20 for VCC, x20 for Fire Dependence, x15 for Physiographic Region, x10 for Surficial Geology, x10 for Aspect, x10 for Slope, x5 for Circa- 1800 Vegetation, and x5 for Natural Community Element Occurrence (Figure A1). The remaining variables received a weight of one (x1), which is equivalent to no weight. For each stand, the prescribed fire needs score was calculated by summing the weighted scores for each variable, and then rescaling the final score to a 0 to 5 range. Once again, higher scores convey a higher level of ecological need for prescribed fire. See Figure A1 for a schematic of the model architecture. To visualize the scoring, the scores were assigned colors on a blue to red color gradient with higher scores corresponding to reds and displayed within GIS.

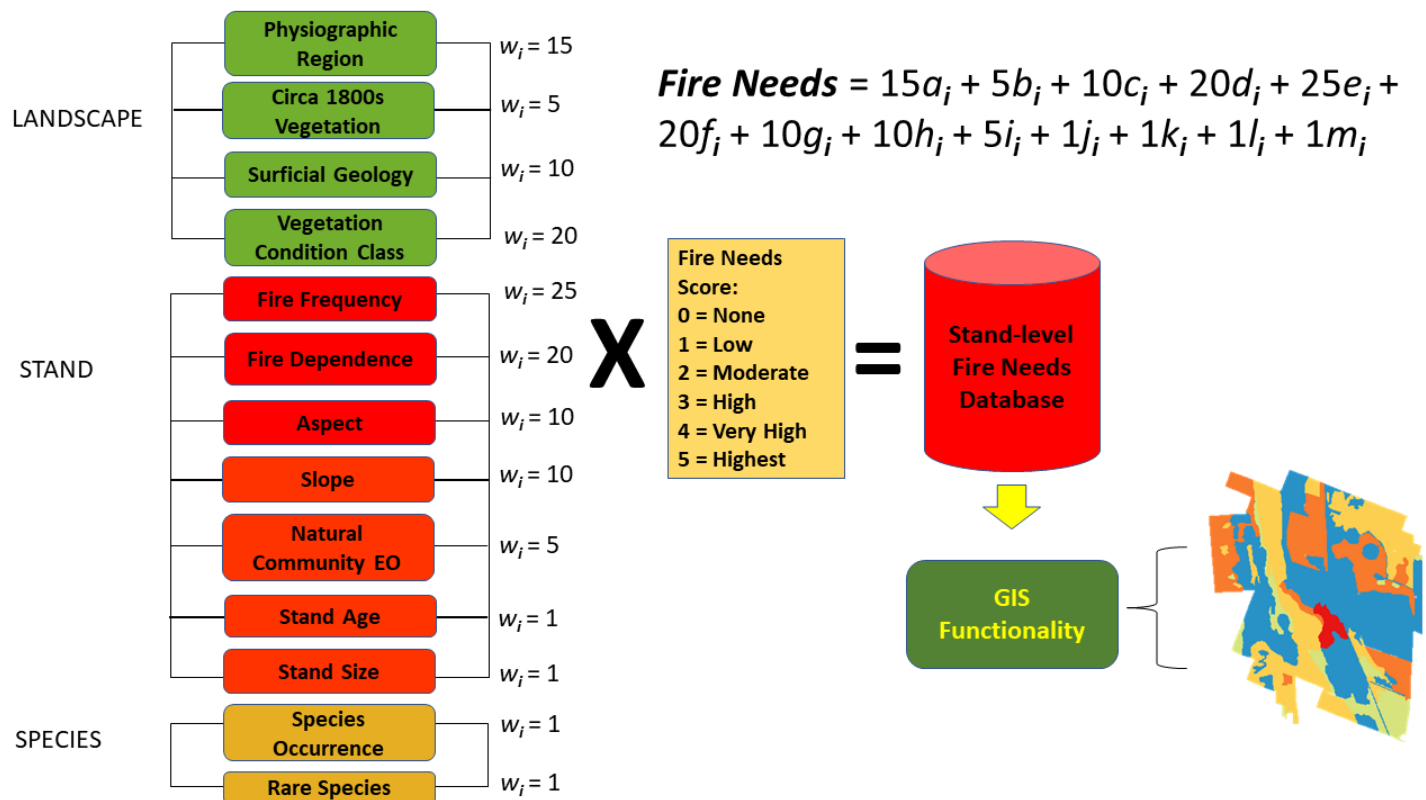


Figure A1. Overview of prescribed fire needs assessment model. This model gauges each stand's ecological need for prescribed fire based on an array of spatial variables and the presence of fire-dependent and fire-sensitive species. For each stand, multiple input variables at multiple scales were evaluated, scored, and weighted to generate an overall fire needs score. Each input variable was binned into one of three modules or submodels depending on the variable's scale (i.e., landscape, stand, and species).

APPENDIX 2 - 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.
- GNR** = Global rank not yet assessed. Unranked.
- 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.
- SNR** = State rank not yet assessed. Unranked.
- 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.

APPENDIX 3 - ADDITIONAL NATURAL COMMUNITY SURVEYS

Table A3-1. Non-fire-dependent natural communities requiring additional evaluation for potential EO recognition.

Compartment	Stands	Habitat Description
406	53, 55	Mesic northern forest
414	18	Mesic northern forest
414	33, 22	Mesic northern forest
423	9, 10	Floodplain forest
429	16, 15	Floodplain forest

Table A3-2. Previously documented natural community EOs recommended for updated surveys. Occurrences have outdated information or require evaluation of their condition, extent, boundaries, or classification.

EO ID	Survey Site	Compartment	Primary Stands	Community Type	Evaluation Need
4656	Browns Bayou	423	43, 25	Emergent Marsh	Evaluate extent of non-native cat-tail
10469	Browns Bayou	417	21, 15, 16	Northern Wet Meadow	Evaluate additional suitable habitat, extensive narrow-leaved cattail invasion, and areas of lowland shrub lacking characteristic meadow vegetation.
8061	Browns Bayou	417	23, 19	Rich Conifer Swamp	Not evaluated since 1987. Update the occurrence.
10688	Deer Lake Bayou	429	20	Dry-mesic Northern Forest	Not evaluated since 1987. Update the occurrence.
11509	Deer Lake Bayou	429	20	Mesic Northern Forest	Not evaluated since 1987. Update the occurrence.
10663	Borski Bayou	426	11, 12, 13	Northern Wet Meadow	Not evaluated since 1987. Mapped with northern shrub thicket and emergent marsh; update the associated occurrences.
12544	North Branch Road Marsh	322	21	Wet-mesic Sand Prairie	Not evaluated since 1995. Evaluate opportunities to recover additional habitat in surrounding stands through prescribed fire.
8259	Bear Swamp	315	1, 9	Northern Hardwood Swamp	Not evaluated since 1988. Evaluate additional suitable habitat in surrounding stands.
4434	Brandy Creek Wetlands	126	79, 76, 78	Hardwood-conifer Swamp	Not evaluated since 1987. Evaluate additional suitable habitat.
3558	Brandy Creek Wetlands	126	54, 97, 99	Muskeg	Not evaluated since 1994. Confirm the classification and boundaries.
1612	Brandy Creek Wetlands	126	100	Bog	Not evaluated since 1987. Confirm the boundaries.
7671	Hopper's Swamp	375, 374	1, 39, 65	Northern Hardwood Swamp	Not evaluated since 1987. Evaluate additional suitable habitat.

APPENDIX 4 - SPECIES LISTS

Pine River Hillside Prairie; Hillside Prairie (EO ID 26243) Species List:

Scientific name	Common name	Status	C
<i>Achillea millefolium</i>	yarrow	Native	1
<i>Agrimonia gryposepala</i>	tall agrimony	Native	2
<i>Agrostis gigantea</i>	redtop	Non-native	0
<i>Alnus incana</i>	speckled alder	Native	5
<i>Amelanchier interior</i>	serviceberry	Native	4
<i>Amelanchier spicata</i>	shadbush serviceberry	Native	4
<i>Amphicarpaea bracteata</i>	hog-peanut	Native	5
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Anemone canadensis</i>	canada anemone	Native	4
<i>Anemone cylindrica</i>	thimbleweed	Native	6
<i>Anemone virginiana</i>	thimbleweed	Native	3
<i>Antennaria howellii</i>	small pussytoes	Native	2
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Anticlea elegans</i>	white camas	Native	10
<i>Apocynum androsaemifolium</i>	spreading dogbane	Native	3
<i>Aquilegia canadensis</i>	wild columbine	Native	5
<i>Arabidopsis lyrata</i>	sand cress	Native	7
<i>Arabidopsis thaliana</i>	mouse-ear cress	Non-native	0
<i>Arenaria serpyllifolia</i>	thyme-leaved sandwort	Non-native	0
<i>Artemisia campestris</i>	wormwood	Native	5
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Asclepias tuberosa</i>	butterfly-weed	Native	5
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Bromus kalmii</i>	prairie brome	Native	8
<i>Calystegia spithamea</i>	low bindweed	Native	8
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex eburnea</i>	sedge	Native	7
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Carex tonsa</i>	sedge	Native	5
<i>Carpinus caroliniana</i>	blue-beech	Native	6
<i>Ceanothus americanus</i>	new jersey tea	Native	8
<i>Celastrus orbiculatus</i>	oriental bittersweet	Non-native	0
<i>Centaurea stoebe</i>	spotted knapweed	Non-native	0
<i>Cerastium fontanum</i>	mouse-ear chickweed	Non-native	0
<i>Cirsium arvense</i>	canada thistle	Non-native	0
<i>Cirsium hillii</i>	hills thistle	Native	8
<i>Cirsium muticum</i>	swamp thistle	Native	6
<i>Clinopodium vulgare</i>	wild-basil	Native	3
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Conyza canadensis</i>	horseweed	Native	0
<i>Coreopsis lanceolata</i>	sand coreopsis	Native	8
<i>Cornus amomum</i>	silky dogwood	Native	2
<i>Corylus cornuta</i>	beaked hazelnut	Native	5
<i>Crataegus chrysocarpa</i>	hawthorn	Native	4
<i>Crocanthemum canadense</i>	common frostweed	Native	8
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Daucus carota</i>	queen-annes-lace	Non-native	0
<i>Desmodium perplexum</i>	tick-trefoil	Native	5
<i>Dichanthelium depauperatum</i>	panic grass	Native	4
<i>Dichanthelium dichotomum</i>	panic grass	Native	7

Pine River Hillside Prairie; Hillside Prairie (EO ID 26243) Species List (Continued):

Scientific name	Common name	Status	C
<i>Dichanthelium latifolium</i>	broad-leaved panic grass	Native	5
<i>Dichanthelium xanthophyllum</i>	panic grass	Native	6
<i>Doellingeria umbellata</i>	flat-topped white aster	Native	5
<i>Elaeagnus umbellata</i>	autumn-olive	Non-native	0
<i>Elymus canadensis</i>	canada wild rye	Native	5
<i>Elymus riparius</i>	riverbank wild-rye	Native	8
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Equisetum arvense</i>	common horsetail	Native	0
<i>Equisetum hyemale</i>	scouring rush	Native	2
<i>Erigeron philadelphicus</i>	philadelphia fleabane	Native	2
<i>Erigeron pulchellus</i>	robins-plantain	Native	5
<i>Eurybia macrophylla</i>	big-leaved aster	Native	4
<i>Festuca saximontana</i>	fescue	Native	6
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Geranium maculatum</i>	wild geranium	Native	4
<i>Helianthus divaricatus</i>	woodland sunflower	Native	5
<i>Helianthus strumosus</i>	pale-leaved sunflower	Native	4
<i>Hepatica americana</i>	round-lobed hepatica	Native	6
<i>Hieracium gronovii</i>	hairy hawkweed	Native	5
<i>Hieracium kalmii</i>	kalms hawkweed	Native	3
<i>Houstonia longifolia</i>	long-leaved bluests	Native	6
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Juniperus communis</i>	common or ground juniper	Native	4
<i>Koeleria macrantha</i>	june grass	Native	9
<i>Krigia virginica</i>	dwarf dandelion	Native	4
<i>Lactuca canadensis</i>	tall lettuce	Native	2
<i>Lathyrus palustris</i>	marsh pea	Native	7
<i>Lathyrus venosus</i>	veiny pea	Native	8
<i>Lespedeza hirta</i>	hairy bush-clover	Native	7
<i>Liatris scariosa</i>	northern blazing-star	Native	5
<i>Lithospermum canescens</i>	hoary puccoon	Native	10
<i>Maianthemum canadense</i>	canada mayflower	Native	4
<i>Maianthemum racemosum</i>	false spikenard	Native	5
<i>Maianthemum stellatum</i>	starry false solomon-seal	Native	5
<i>Medicago lupulina</i>	black medick	Non-native	0
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Melilotus albus</i>	white sweet-clover	Non-native	0
<i>Minuartia michauxii</i>	rock sandwort	Native	10
<i>Monarda fistulosa</i>	wild-bergamot	Native	2
<i>Monarda punctata</i>	horse mint	Native	4
<i>Muhlenbergia mexicana</i>	leafy satin grass	Native	3
<i>Nuttallanthus canadensis</i>	blue toadflax	Native	8
<i>Oenothera biennis</i>	common evening-primrose	Native	2
<i>Oenothera parviflora</i>	evening-primrose	Native	2
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Packera paupercula</i>	balsam ragwort	Native	3
<i>Pedicularis canadensis</i>	wood-betony	Native	10
<i>Pedicularis lanceolata</i>	swamp-betony	Native	8
<i>Physalis heterophylla</i>	clammy ground-cherry	Native	3
<i>Physocarpus opulifolius</i>	ninebark	Native	4
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3

Pine River Hillside Prairie; Hillside Prairie (EO ID 26243) Species List (Continued):

Scientific name	Common name	Status	C
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Polanisia dodecandra</i>	clammy-weed	Native	5
<i>Polygonella articulata</i>	jointweed	Native	8
<i>Populus balsamifera</i>	balsam poplar	Native	2
<i>Populus grandidentata</i>	big-tooth aspen	Native	4
<i>Populus tremuloides</i>	quaking aspen	Native	1
<i>Potentilla simplex</i>	old-field cinquefoil	Native	2
<i>Prunella vulgaris</i>	self-heal	Native	0
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Pseudognaphalium obtusifolium</i>	old-field balsam	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus rubra</i>	red oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rhus copallina</i>	winged sumac	Native	3
<i>Rhus glabra</i>	smooth sumac	Native	2
<i>Rhus typhina</i>	staghorn sumac	Native	2
<i>Robinia pseudoacacia</i>	black locust	Non-native	0
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rudbeckia hirta</i>	black-eyed susan	Native	1
<i>Salix exigua</i>	sandbar willow	Native	1
<i>Sanicula marilandica</i>	black snakeroot	Native	4
<i>Sassafras albidum</i>	sassafras	Native	5
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Securigera varia</i>	crown-vetch	Non-native	0
<i>Selaginella rupestris</i>	sand club moss	Native	8
<i>Sisyrinchium angustifolium</i>	stout blue-eyed-grass	Native	4
<i>Smilax hispida</i>	bristly greenbrier	Native	5
<i>Solidago canadensis</i>	canada goldenrod	Native	1
<i>Solidago hispida</i>	hairy goldenrod	Native	3
<i>Solidago juncea</i>	early goldenrod	Native	3
<i>Symphoricarpos albus</i> var. <i>albus</i>	snowberry	Native	5
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Symphyotrichum robynsianum</i>	long-leaved aster	Native	9
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	Native	2
<i>Taenidia integerrima</i>	yellow-pimpernel	Native	8
<i>Taraxacum officinale</i>	common dandelion	Non-native	0
<i>Thuja occidentalis</i>	arbor vitae	Native	4
<i>Toxicodendron rydbergii</i>	poison-ivy	Native	3
<i>Tragopogon dubius</i>	goats beard	Non-native	0
<i>Trifolium pratense</i>	red clover	Non-native	0
<i>Trifolium repens</i>	white clover	Non-native	0
<i>Triosteum aurantiacum</i>	horse-gentian	Native	5
<i>Verbascum densiflorum</i>	mullein	Non-native	0
<i>Veronica officinalis</i>	common speedwell	Non-native	0
<i>Vicia americana</i>	american vetch	Native	5
<i>Viola adunca</i>	sand violet	Native	4
<i>Vitis riparia</i>	river-bank grape	Native	3

Pine River Woods; Dry-mesic Northern Forest (EO ID 28459) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Achillea millefolium</i>	yarrow	Native	1
<i>Amelanchier arborea</i>	juneberry	Native	4
<i>Anemone quinquefolia</i>	wood anemone	Native	5
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Aquilegia canadensis</i>	wild columbine	Native	5
<i>Arabidopsis lyrata</i>	sand cress	Native	7
<i>Asclepias exaltata</i>	poke milkweed	Native	6
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Betula papyrifera</i>	paper birch	Native	2
<i>Boechera canadensis</i>	sickle-pod	Native	7
<i>Botrypus virginianus</i>	rattlesnake fern	Native	5
<i>Brachyelytrum aristosum</i>	northern shorthusk	Native	7
<i>Bromus pubescens</i>	canada brome	Native	5
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Cerastium fontanum</i>	mouse-ear chickweed	Non-native	0
<i>Crataegus chrysocarpa</i>	hawthorn	Native	4
<i>Crocianthemum canadense</i>	common frostweed	Native	8
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Desmodium perplexum</i>	tick-trefoil	Native	5
<i>Dichanthelium columbianum</i>	panic grass	Native	5
<i>Dichanthelium commutatum</i>	panic grass	Native	9
<i>Dichanthelium depauperatum</i>	panic grass	Native	4
<i>Dichanthelium xanthophyllum</i>	panic grass	Native	6
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Epipactis helleborine</i>	helleborine	Non-native	0
<i>Eurybia macrophylla</i>	big-leaved aster	Native	4
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Galium triflorum</i>	fragrant bedstraw	Native	4
<i>Gaultheria procumbens</i>	wintergreen	Native	5
<i>Gaylussacia baccata</i>	huckleberry	Native	7
<i>Hamamelis virginiana</i>	witch-hazel	Native	5
<i>Hieracium scabrum</i>	rough hawkweed	Native	3
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Hylodesmum glutinosum</i>	clustered-leaved tick-trefoil	Native	5
<i>Juniperus communis</i>	common or ground juniper	Native	4
<i>Krigia virginica</i>	dwarf dandelion	Native	4
<i>Lathyrus ochroleucus</i>	pale vetchling	Native	8
<i>Lathyrus venosus</i>	veiny pea	Native	8
<i>Lonicera dioica</i>	red honeysuckle	Native	5
<i>Lupinus perennis</i>	wild lupine	Native	7
<i>Maianthemum canadense</i>	canada mayflower	Native	4
<i>Maianthemum racemosum</i>	false spikenard	Native	5
<i>Mitchella repens</i>	partridge-berry	Native	5
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	Native	5
<i>Parthenocissus quinquefolia</i>	virginia creeper	Native	5
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3
<i>Piptatherum pungens</i>	rice-grass	Native	9

Pine River Woods; Dry-mesic Northern Forest (EO ID 28459) Species List (Continued):

Scientific name	Common name	Status	C
<i>Poa alsodes</i>	bluegrass	Native	9
<i>Polygonatum pubescens</i>	downy solomon seal	Native	5
<i>Populus grandidentata</i>	big-tooth aspen	Native	4
<i>Potentilla simplex</i>	old-field cinquefoil	Native	2
<i>Prenanthes alba</i>	white lettuce	Native	5
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus rubra</i>	red oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Schizachne purpurascens</i>	false melic	Native	5
<i>Solidago caesia</i>	bluestem goldenrod	Native	6
<i>Solidago hispida</i>	hairy goldenrod	Native	3
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	Native	2
<i>Toxicodendron rydbergii</i>	poison-ivy	Native	3
<i>Viburnum acerifolium</i>	maple-leaved viburnum	Native	6
<i>Vitis riparia</i>	river-bank grape	Native	3

Manistee River Prairie; Wet-mesic Prairie (EO ID 27659) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Achillea millefolium</i>	yarrow	Native	1
<i>Agrostis gigantea</i>	redtop	Non-native	0
<i>Alnus incana</i>	speckled alder	Native	5
<i>Amphicarpaea bracteata</i>	hog-peanut	Native	5
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Anemone canadensis</i>	canada anemone	Native	4
<i>Anemone cylindrica</i>	thimbleweed	Native	6
<i>Anemone virginiana</i>	thimbleweed	Native	3
<i>Antennaria howellii</i>	small pussytoes	Native	2
<i>Anticlea elegans</i>	white camas	Native	10
<i>Apios americana</i>	groundnut	Native	3
<i>Apocynum cannabinum</i>	indian-hemp	Native	3
<i>Aquilegia canadensis</i>	wild columbine	Native	5
<i>Artemisia campestris</i>	wormwood	Native	5
<i>Asclepias incarnata</i>	swamp milkweed	Native	6
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Asclepias tuberosa</i>	butterfly-weed	Native	5
<i>Astragalus canadensis</i>	canadian milk-vetch	Native	9
<i>Betula papyrifera</i>	paper birch	Native	2
<i>Bromus ciliatus</i>	fringed brome	Native	6
<i>Bromus inermis</i>	smooth brome	Non-native	0
<i>Bromus kalmii</i>	prairie brome	Native	8
<i>Calamagrostis canadensis</i>	blue-joint	Native	3
<i>Caltha palustris</i>	marsh-marigold	Native	6
<i>Campanula aparinoides</i>	marsh bellflower	Native	7
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex eburnea</i>	sedge	Native	7
<i>Carex flava</i>	sedge	Native	4
<i>Carex granularis</i>	sedge	Native	2
<i>Carex hystericina</i>	sedge	Native	2

Manistee River Prairie; Wet-mesic Prairie (EO ID 27659) Species List (Continued):

Scientific name	Common name	Status	C
<i>Carex interior</i>	sedge	Native	3
<i>Carex leptalea</i>	sedge	Native	5
<i>Carex pellita</i>	sedge	Native	2
<i>Carex prairea</i>	sedge	Native	10
<i>Carex stricta</i>	sedge	Native	4
<i>Carex vesicaria</i>	sedge	Native	7
<i>Castilleja coccinea</i>	indian paintbrush	Native	8
<i>Centaurea stoebe</i>	spotted knapweed	Non-native	0
<i>Chelone glabra</i>	turtlehead	Native	7
<i>Cicuta bulbifera</i>	water hemlock	Native	5
<i>Cirsium muticum</i>	swamp thistle	Native	6
<i>Clematis virginiana</i>	virgins bower	Native	4
<i>Clinopodium vulgare</i>	wild-basil	Native	3
<i>Corylus americana</i>	hazelnut	Native	5
<i>Crataegus punctata</i>	dotted hawthorn	Native	1
<i>Cypripedium reginae</i>	showy or queens lady-slipper	Native	9
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Daucus carota</i>	queen-annes-lace	Non-native	0
<i>Desmodium canadense</i>	showy tick-trefoil	Native	3
<i>Dichanthelium implicatum</i>	panic grass	Native	3
<i>Dichanthelium latifolium</i>	broad-leaved panic grass	Native	5
<i>Elaeagnus umbellata</i>	autumn-olive	Non-native	0
<i>Elymus riparius</i>	riverbank wild-rye	Native	8
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Equisetum arvense</i>	common horsetail	Native	0
<i>Erigeron annuus</i>	daisy fleabane	Native	0
<i>Erigeron pulchellus</i>	robins-plantain	Native	5
<i>Erigeron strigosus</i>	daisy fleabane	Native	4
<i>Eupatorium perfoliatum</i>	boneset	Native	4
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	Native	3
<i>Eutrochium maculatum</i>	joe-pye-weed	Native	4
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Galium trifidum</i>	small bedstraw	Native	6
<i>Gentiana andrewsii</i>	bottle gentian	Native	5
<i>Geum rivale</i>	purple avens	Native	7
<i>Helenium autumnale</i>	sneezeweed	Native	5
<i>Helianthus giganteus</i>	tall sunflower	Native	5
<i>Helianthus strumosus</i>	pale-leaved sunflower	Native	4
<i>Heteranthera dubia</i>	water star-grass	Native	6
<i>Hieracium aurantiacum</i>	orange hawkweed	Non-native	0
<i>Hieracium caespitosum</i>	king devil	Non-native	0
<i>Hierochloa hirta</i>	sweet grass	Native	9
<i>Hypericum ascyron</i>	giant st. johns-wort	Native	8
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Iris versicolor</i>	wild blue flag	Native	5
<i>Juncus brachycephalus</i>	rush	Native	7
<i>Juncus dudleyi</i>	dudleys rush	Native	1
<i>Juniperus communis</i>	common or ground juniper	Native	4
<i>Larix laricina</i>	tamarack	Native	5
<i>Lathyrus palustris</i>	marsh pea	Native	7
<i>Leucanthemum vulgare</i>	ox-eye daisy	Non-native	0
<i>Lobelia inflata</i>	indian-tobacco	Native	0

Manistee River Prairie; Wet-mesic Prairie (EO ID 27659) Species List (Continued):

Scientific name	Common name	Status	C
<i>Lycopus americanus</i>	common water horehound	Native	2
<i>Lysimachia ciliata</i>	fringed loosestrife	Native	4
<i>Lythrum salicaria</i>	purple loosestrife	Non-native	0
<i>Maianthemum stellatum</i>	starry false solomon-seal	Native	5
<i>Medicago lupulina</i>	black medick	Non-native	0
<i>Mentha canadensis</i>	wild mint	Native	3
<i>Mentha piperita</i>	peppermint	Non-native	0
<i>Monarda fistulosa</i>	wild-bergamot	Native	2
<i>Muhlenbergia glomerata</i>	marsh wild-timothy	Native	10
<i>Oenothera parviflora</i>	evening-primrose	Native	2
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	Native	5
<i>Packera aurea</i>	golden ragwort	Native	5
<i>Parnassia glauca</i>	grass-of-parnassus	Native	8
<i>Pedicularis canadensis</i>	wood-betony	Native	10
<i>Pedicularis lanceolata</i>	swamp-betony	Native	8
<i>Phalaris arundinacea</i>	reed canary grass	Non-native	0
<i>Phleum pratense</i>	timothy	Non-native	0
<i>Physocarpus opulifolius</i>	ninebark	Native	4
<i>Pinus strobus</i>	white pine	Native	3
<i>Plantago lanceolata</i>	english plantain	Non-native	0
<i>Platanthera clavellata</i>	small green wood orchid	Native	6
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Poa palustris</i>	fowl meadow grass	Native	3
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Populus balsamifera</i>	balsam poplar	Native	2
<i>Populus tremuloides</i>	quaking aspen	Native	1
<i>Prunella vulgaris</i>	self-heal	Native	0
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	Native	8
<i>Rudbeckia hirta</i>	black-eyed susan	Native	1
<i>Rumex crispus</i>	curly dock	Non-native	0
<i>Salix bebbiana</i>	bebb's willow	Native	1
<i>Salix eriocephala</i>	willow	Native	2
<i>Salix exigua</i>	sandbar willow	Native	1
<i>Salix humilis</i>	prairie willow	Native	4
<i>Salix sericea</i>	silky willow	Native	6
<i>Schedonorus arundinaceus</i>	tall fescue	Non-native	0
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Schoenoplectus acutus</i>	hardstem bulrush	Native	5
<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	Native	4
<i>Scirpus atrovirens</i>	bulrush	Native	3
<i>Solidago altissima</i>	tall goldenrod	Native	1
<i>Solidago gigantea</i>	late goldenrod	Native	3
<i>Solidago hispida</i>	hairy goldenrod	Native	3
<i>Solidago nemoralis</i>	old-field goldenrod	Native	2
<i>Solidago rugosa</i>	rough-leaved goldenrod	Native	3
<i>Sonchus arvensis</i>	perennial sow-thistle	Non-native	0
<i>Spiranthes cernua</i>	nodding ladies-tresses	Native	4
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Symphyotrichum lateriflorum</i>	calico aster	Native	2
<i>Symphyotrichum novae-angliae</i>	new england aster	Native	3
<i>Symphyotrichum robynianum</i>	long-leaved aster	Native	9
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	Native	2
<i>Thalictrum dasycarpum</i>	purple meadow-rue	Native	3

Manistee River Prairie; Wet-mesic Prairie (EO ID 27659) Species List (Continued):

Scientific name	Common name	Status	C
<i>Thuja occidentalis</i>	arbor vitae	Native	4
<i>Tilia americana</i>	basswood	Native	5
<i>Toxicodendron rydbergii</i>	poison-ivy	Native	3
<i>Tridens flavus</i>	purpletop	Native	3
<i>Trifolium pratense</i>	red clover	Non-native	0
<i>Typha angustifolia</i>	narrow-leaved cat-tail	Non-native	0
<i>Typha latifolia</i>	broad-leaved cat-tail	Native	1
<i>Vitis riparia</i>	river-bank grape	Native	3

Manistee River Bluffs; Clay Bluff (EO ID 28452) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Achillea millefolium</i>	yarrow	Native	1
<i>Agrostis gigantea</i>	redtop	Non-native	0
<i>Arabidopsis thaliana</i>	mouse-ear cress	Non-native	0
<i>Artemisia campestris</i>	wormwood	Native	5
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Betula papyrifera</i>	paper birch	Native	2
<i>Bromus ciliatus</i>	fringed brome	Native	6
<i>Carex pellita</i>	sedge	Native	2
<i>Centaurea stoebe</i>	spotted knapweed	Non-native	0
<i>Cerastium fontanum</i>	mouse-ear chickweed	Non-native	0
<i>Cirsium arvense</i>	canada thistle	Non-native	0
<i>Daucus carota</i>	queen-annes-lace	Non-native	0
<i>Dichanthelium latifolium</i>	broad-leaved panic grass	Native	5
<i>Echinochloa muricata</i>	barnyard grass	Native	1
<i>Elaeagnus umbellata</i>	autumn-olive	Non-native	0
<i>Elymus repens</i>	quack grass	Non-native	0
<i>Epilobium ciliatum</i>	willow-herb	Native	3
<i>Equisetum arvense</i>	common horsetail	Native	0
<i>Equisetum laevigatum</i>	smooth scouring rush	Native	2
<i>Eupatorium perfoliatum</i>	boneset	Native	4
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	Native	3
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Hieracium aurantiacum</i>	orange hawkweed	Non-native	0
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Juncus brachycephalus</i>	rush	Native	7
<i>Juncus canadensis</i>	canadian rush	Native	6
<i>Juniperus communis</i>	common or ground juniper	Native	4
<i>Lathyrus palustris</i>	marsh pea	Native	7
<i>Leucanthemum vulgare</i>	ox-eye daisy	Non-native	0
<i>Maianthemum canadense</i>	canada mayflower	Native	4
<i>Melilotus albus</i>	white sweet-clover	Non-native	0
<i>Onoclea sensibilis</i>	sensitive fern	Native	2
<i>Parnassia glauca</i>	grass-of-parnassus	Native	8
<i>Pedicularis lanceolata</i>	swamp-betony	Native	8
<i>Phragmites australis</i> var. <i>americanus</i>	reed	Native	5
<i>Phragmites australis</i> var. <i>australis</i>	reed	Non-native	0
<i>Pinus strobus</i>	white pine	Native	3
<i>Platanthera aquilonis</i>	northern green orchid	Native	5
<i>Platanthera clavellata</i>	small green wood orchid	Native	6
<i>Poa compressa</i>	canada bluegrass	Non-native	0

Manistee River Bluffs; Clay Bluff (EO ID 28452) Species List (Continued):

Scientific name	Common name	Status	C
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus velutina</i>	black oak	Native	6
<i>Rhamnus alnifolia</i>	alder-leaved buckthorn	Native	8
<i>Rubus pubescens</i>	dwarf raspberry	Native	4
<i>Rubus strigosus</i>	wild red raspberry	Native	2
<i>Rudbeckia hirta</i>	black-eyed susan	Native	1
<i>Salix bebbiana</i>	bebb's willow	Native	1
<i>Salix discolor</i>	pussy willow	Native	1
<i>Salix exigua</i>	sandbar willow	Native	1
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Scirpus atrovirens</i>	bulrush	Native	3
<i>Securigera varia</i>	crown-vetch	Non-native	0
<i>Selaginella eclipses</i>	selaginella	Native	5
<i>Shepherdia canadensis</i>	soapberry	Native	7
<i>Solidago canadensis</i>	canada goldenrod	Native	1
<i>Solidago patula</i>	swamp goldenrod	Native	6
<i>Symphyotrichum firmum</i>	smooth swamp aster	Native	4
<i>Symphyotrichum robynsianum</i>	long-leaved aster	Native	9
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	Native	2
<i>Thuja occidentalis</i>	arbor vitae	Native	4
<i>Typha latifolia</i>	broad-leaved cat-tail	Native	1
<i>Viola cucullata</i>	marsh violet	Native	5
<i>Zanthoxylum americanum</i>	prickly-ash	Native	3

Manistee Valley Woods; Dry-mesic Northern Forest (EO ID 28456) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Amelanchier arborea</i>	juneberry	Native	4
<i>Amphicarpaea bracteata</i>	hog-peanut	Native	5
<i>Anemone quinquefolia</i>	wood anemone	Native	5
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Apocynum androsaemifolium</i>	spreading dogbane	Native	3
<i>Aralia nudicaulis</i>	wild sarsaparilla	Native	5
<i>Asclepias exaltata</i>	poke milkweed	Native	6
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Brachyelytrum aristosum</i>	northern shorthusk	Native	7
<i>Carex eburnea</i>	sedge	Native	7
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Conopholis americana</i>	squaw-root	Native	10
<i>Crataegus chrysocarpa</i>	hawthorn	Native	4
<i>Crocanthemum canadense</i>	common frostweed	Native	8
<i>Cypripedium acaule</i>	pink lady-slipper; moccasin flower	Native	5
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Desmodium perplexum</i>	tick-trefoil	Native	5
<i>Dichanthelium dichotomum</i>	panic grass	Native	7
<i>Dichanthelium latifolium</i>	broad-leaved panic grass	Native	5
<i>Elaeagnus umbellata</i>	autumn-olive	Non-native	0
<i>Erigeron pulchellus</i>	robins-plantain	Native	5
<i>Eurybia macrophylla</i>	big-leaved aster	Native	4
<i>Fagus grandifolia</i>	american beech	Native	6
<i>Festuca subverticillata</i>	nodding fescue	Native	5

Manistee Valley Woods; Dry-mesic Northern Forest (EO ID 28456) Species List (Continued):

Scientific name	Common name	Status	C
<i>Fraxinus americana</i>	white ash	Native	5
<i>Galium lanceolatum</i>	yellow wild licorice	Native	4
<i>Galium triflorum</i>	fragrant bedstraw	Native	4
<i>Gaultheria procumbens</i>	wintergreen	Native	5
<i>Gaylussacia baccata</i>	huckleberry	Native	7
<i>Hamamelis virginiana</i>	witch-hazel	Native	5
<i>Hieracium scabrum</i>	rough hawkweed	Native	3
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Hylodesmum glutinosum</i>	clustered-leaved tick-trefoil	Native	5
<i>Hylodesmum nudiflorum</i>	naked tick-trefoil	Native	7
<i>Lathyrus ochroleucus</i>	pale vetchling	Native	8
<i>Lespedeza hirta</i>	hairy bush-clover	Native	7
<i>Lupinus perennis</i>	wild lupine	Native	7
<i>Lysimachia quadrifolia</i>	four-leaved loosestrife	Native	8
<i>Maianthemum canadense</i>	canada mayflower	Native	4
<i>Medeola virginiana</i>	indian cucumber-root	Native	10
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Mitchella repens</i>	partridge-berry	Native	5
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Pedicularis canadensis</i>	wood-betony	Native	10
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3
<i>Piptochaetium avenaceum</i>	black oatgrass	Native	10
<i>Poa alsodes</i>	bluegrass	Native	9
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Polygonatum pubescens</i>	downy solomon seal	Native	5
<i>Polypodium virginianum</i>	common polypody	Native	8
<i>Populus grandidentata</i>	big-tooth aspen	Native	4
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus rubra</i>	red oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rumex acetosella</i>	sheep sorrel	Non-native	0
<i>Sassafras albidum</i>	sassafras	Native	5
<i>Solidago caesia</i>	bluestem goldenrod	Native	6
<i>Thuja occidentalis</i>	arbor vitae	Native	4
<i>Toxicodendron rydbergii</i>	poison-ivy	Native	3
<i>Trientalis borealis</i>	star-flower	Native	5
<i>Tsuga canadensis</i>	hemlock	Native	5
<i>Vaccinium angustifolium</i>	low sweet blueberry	Native	4
<i>Viburnum acerifolium</i>	maple-leaved viburnum	Native	6

Manistee River Hillside Prairie; Hillside Prairie (EO ID 28455) Species List:

Scientific name	Common name	Status	C
<i>Achillea millefolium</i>	yarrow	Native	1
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Anemone virginiana</i>	thimbleweed	Native	3
<i>Apios americana</i>	groundnut	Native	3
<i>Apocynum androsaemifolium</i>	spreading dogbane	Native	3
<i>Apocynum cannabinum</i>	indian-hemp	Native	3
<i>Aquilegia canadensis</i>	wild columbine	Native	5
<i>Arabidopsis lyrata</i>	sand cress	Native	7

Manistee River Hillside Prairie; Hillside Prairie (EO ID 28455) Species List (Continued):

Scientific name	Common name	Status	C
<i>Arenaria serpyllifolia</i>	thyme-leaved sandwort	Non-native	0
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Asclepias tuberosa</i>	butterfly-weed	Native	5
<i>Carex eburnea</i>	sedge	Native	7
<i>Carex granularis</i>	sedge	Native	2
<i>Carex pellita</i>	sedge	Native	2
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Castilleja coccinea</i>	indian paintbrush	Native	8
<i>Ceanothus americanus</i>	new jersey tea	Native	8
<i>Centaurea stoebe</i>	spotted knapweed	Non-native	0
<i>Cirsium arvense</i>	canada thistle	Non-native	0
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Crataegus chrysocarpa</i>	hawthorn	Native	4
<i>Daucus carota</i>	queen-annes-lace	Non-native	0
<i>Desmodium perplexum</i>	tick-trefoil	Native	5
<i>Elaeagnus umbellata</i>	autumn-olive	Non-native	0
<i>Equisetum hyemale</i>	scouring rush	Native	2
<i>Erigeron pulchellus</i>	robins-plantain	Native	5
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Fraxinus americana</i>	white ash	Native	5
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Helianthus divaricatus</i>	woodland sunflower	Native	5
<i>Helianthus strumosus</i>	pale-leaved sunflower	Native	4
<i>Hepatica americana</i>	round-lobed hepatica	Native	6
<i>Lespedeza hirta</i>	hairy bush-clover	Native	7
<i>Leucanthemum vulgare</i>	ox-eye daisy	Non-native	0
<i>Lithospermum canescens</i>	hoary puccoon	Native	10
<i>Lysimachia ciliata</i>	fringed loosestrife	Native	4
<i>Maianthemum stellatum</i>	starry false solomon-seal	Native	5
<i>Monarda fistulosa</i>	wild-bergamot	Native	2
<i>Monarda punctata</i>	horse mint	Native	4
<i>Oenothera biennis</i>	common evening-primrose	Native	2
<i>Ostrya virginiana</i>	ironwood; hop-hornbeam	Native	5
<i>Packera aurea</i>	golden ragwort	Native	5
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Populus balsamifera</i>	balsam poplar	Native	2
<i>Populus grandidentata</i>	big-tooth aspen	Native	4
<i>Populus tremuloides</i>	quaking aspen	Native	1
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus rubra</i>	red oak	Native	5
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rudbeckia hirta</i>	black-eyed susan	Native	1
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Solidago gigantea</i>	late goldenrod	Native	3
<i>Solidago hispida</i>	hairy goldenrod	Native	3
<i>Solidago speciosa</i>	showy goldenrod	Native	5
<i>Sorghastrum nutans</i>	indian grass	Native	6
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Symphyotrichum robynianum</i>	long-leaved aster	Native	9
<i>Symphyotrichum urophyllum</i>	arrow-leaved aster	Native	2
<i>Thalictrum dioicum</i>	early meadow-rue	Native	6
<i>Thuja occidentalis</i>	arbor vitae	Native	4

Manistee River Hillside Prairie; Hillside Prairie (EO ID 28455) Species List (Continued):

Scientific name	Common name	Status	C
<i>Tilia americana</i>	basswood	Native	5
<i>Toxicodendron rydbergii</i>	poison-ivy	Native	3
<i>Tragopogon dubius</i>	goats beard	Non-native	0
<i>Trifolium pratense</i>	red clover	Non-native	0
<i>Vicia americana</i>	american vetch	Native	5
<i>Viola adunca</i>	sand violet	Native	4
<i>Vitis riparia</i>	river-bank grape	Native	3

Morton-Nuremberg Wetlands; Intermittent Wetland (EO ID 24254) Species List:

Scientific name	Common name	Status	C
<i>Calamagrostis canadensis</i>	blue-joint	Native	3
<i>Carex aquatilis</i>	sedge	Native	7
<i>Carex lacustris</i>	sedge	Native	6
<i>Carex lasiocarpa</i>	sedge	Native	8
<i>Carex oligosperma</i>	sedge	Native	10
<i>Carex scoparia</i>	sedge	Native	4
<i>Carex stricta</i>	sedge	Native	4
<i>Chamaedaphne calyculata</i>	leatherleaf	Native	8
<i>Cladium mariscoides</i>	twig-rush	Native	10
<i>Dichanthelium clandestinum</i>	panic grass	Native	3
<i>Dichanthelium spretum</i>	panic grass	Native	9
<i>Dulichium arundinaceum</i>	three-way sedge	Native	8
<i>Eleocharis acicularis</i>	spike-rush	Native	7
<i>Eleocharis elliptica</i>	golden-seeded spike rush	Native	6
<i>Eleocharis melanocarpa</i>	black-fruited spike-rush	Native	9
<i>Eleocharis obtusa</i>	spike-rush	Native	3
<i>Erechtites hieracifolius</i>	fireweed	Native	2
<i>Euthamia caroliniana</i>	lakes flat-topped goldenrod	Native	10
<i>Glyceria canadensis</i>	rattlesnake grass	Native	8
<i>Hypericum kalmianum</i>	kalms st. johns-wort	Native	10
<i>Hypericum majus</i>	larger canada st. johns-wort	Native	4
<i>Iris versicolor</i>	wild blue flag	Native	5
<i>Juncus biflorus</i>	two-flowered rush	Native	8
<i>Juncus canadensis</i>	canadian rush	Native	6
<i>Juncus effusus</i>	soft-stemmed rush	Native	3
<i>Juncus greenii</i>	greenes rush	Native	7
<i>Juncus pelocarpus</i>	brown-fruited rush	Native	8
<i>Leersia oryzoides</i>	cut grass	Native	3
<i>Ludwigia palustris</i>	water-purslane	Native	4
<i>Lycopus uniflorus</i>	northern bugle weed	Native	2
<i>Lysimachia lanceolata</i>	lance-leaved loosestrife	Native	9
<i>Panicum rigidulum</i>	panic grass	Native	7
<i>Panicum virgatum</i>	switch grass	Native	4
<i>Persicaria amphibia</i>	water smartweed	Native	6
<i>Persicaria punctata</i>	smartweed	Native	5
<i>Phalaris arundinacea</i>	reed canary grass	Native	0
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus strobus</i>	white pine	Native	3
<i>Populus tremuloides</i>	quaking aspen	Native	1
<i>Potamogeton oakesianus</i>	pondweed	Native	10
<i>Proserpinaca palustris</i>	mermaid-weed	Native	6
<i>Rhynchospora capitellata</i>	beak-rush	Native	6
<i>Rotala ramosior</i>	tooth-cup	Native	8

Morton-Nuremberg Wetlands; Intermittent Wetland (EO ID 24254) Species List (Continued):

Scientific name	Common name	Status	C
<i>Rubus hispidus</i>	swamp dewberry	Native	4
<i>Salix exigua</i>	sandbar willow	Native	1
<i>Salix petiolaris</i>	slender willow	Native	1
<i>Spartina pectinata</i>	cordgrass	Native	5
<i>Spiraea alba</i>	meadowsweet	Native	4
<i>Stuckenia filiformis</i>	narrow-leaved pondweed	Native	7
<i>Symphotrichum lateriflorum</i>	calico aster	Native	2
<i>Thelypteris palustris</i>	marsh fern	Native	2
<i>Triadenum fraseri</i>	marsh st. johns-wort	Native	6
<i>Veronica scutellata</i>	marsh speedwell	Native	6
<i>Viola lanceolata</i>	lance-leaved violet	Native	8

Hoag Lake Bog; Bog (EO ID 28104) Species List:

Scientific name	Common name	Status	C
<i>Agrostis scabra</i>	ticklegrass	Native	4
<i>Calamagrostis canadensis</i>	blue-joint	Native	3
<i>Carex interior</i>	sedge	Native	3
<i>Carex lasiocarpa</i>	sedge	Native	8
<i>Chamaedaphne calyculata</i>	leatherleaf	Native	8
<i>Cirsium arvense</i>	canada thistle	Non-native	0
<i>Cirsium vulgare</i>	bull thistle	Non-native	0
<i>Dulichium arundinaceum</i>	three-way sedge	Native	8
<i>Epilobium coloratum</i>	cinnamon willow-herb	Native	3
<i>Erechtites hieracifolius</i>	fireweed	Native	2
<i>Glyceria striata</i>	fowl manna grass	Native	4
<i>Lycopus americanus</i>	common water horehound	Native	2
<i>Onoclea sensibilis</i>	sensitive fern	Native	2
<i>Persicaria amphibia</i>	water smartweed	Native	6
<i>Pseudognaphalium obtusifolium</i>	old-field balsam	Native	2
<i>Scirpus cyperinus</i>	wool-grass	Native	5
<i>Thelypteris palustris</i>	marsh fern	Native	2
<i>Triadenum fraseri</i>	marsh st. johns-wort	Native	6
<i>Verbena hastata</i>	blue vervain	Native	4
<i>Viola macloskeyi</i>	smooth white violet	Native	6

Hoag Lake Prairie; Wet-mesic Sand Prairie (EO ID 28103) Species List:

Scientific name	Common name	Status	C
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Berteroa incana</i>	hoary alyssum	Non-native	0
<i>Calamagrostis canadensis</i>	blue-joint	Native	3
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Carex tomsa</i>	sedge	Native	5
<i>Carex viridula</i>	sedge	Native	4
<i>Chamaedaphne calyculata</i>	leatherleaf	Native	8
<i>Cirsium arvense</i>	canada thistle	Non-native	0
<i>Cirsium vulgare</i>	bull thistle	Non-native	0
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Crocianthemum canadense</i>	common frostweed	Native	8
<i>Dichanthelium implicatum</i>	panic grass	Native	3
<i>Dichanthelium lindheimeri</i>	panic grass	Native	8
<i>Dichanthelium linearifolium</i>	slender-leaved panic grass	Native	4
<i>Eleocharis melanocarpa</i>	black-fruited spike-rush	Native	9

Hoag Lake Prairie; Wet-mesic Sand Prairie (EO ID 28103) Species List (Continued):

Scientific name	Common name	Status	C
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Hieracium caespitosum</i>	king devil	Non-native	0
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Houstonia longifolia</i>	long-leaved bluets	Native	6
<i>Hypericum kalmianum</i>	kalms st. johns-wort	Native	10
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Hypochaeris radicata</i>	cats-ear	Non-native	0
<i>Juncus balticus</i>	rush	Native	4
<i>Krigia virginica</i>	dwarf dandelion	Native	4
<i>Leucanthemum vulgare</i>	ox-eye daisy	Non-native	0
<i>Lobelia spicata</i>	pale spiked lobelia	Native	4
<i>Lycopus americanus</i>	common water horehound	Native	2
<i>Nuttallanthus canadensis</i>	blue toadflax	Native	8
<i>Panicum virgatum</i>	switch grass	Native	4
<i>Phalaris arundinacea</i>	reed canary grass	Native	0
<i>Phragmites australis</i> var. <i>americanus</i>	reed	Native	5
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Polygala polygama</i>	racemed milkwort	Native	9
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rumex acetosella</i>	sheep sorrel	Non-native	0
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Solidago rugosa</i>	rough-leaved goldenrod	Native	3
<i>Spartina pectinata</i>	cordgrass	Native	5
<i>Spiraea alba</i>	meadowsweet	Native	4
<i>Stachys hyssopifolia</i>	hyssop hedge nettle	Native	10
<i>Symphotrichum dumosum</i>	bushy aster	Native	7
<i>Taraxacum officinale</i>	common dandelion	Non-native	0
<i>Tragopogon pratensis</i>	common goats beard	Non-native	0
<i>Verbascum thapsus</i>	common mullein	Non-native	0

Black Lake Oak-Pine Barrens; Oak-Pine Barrens (EO ID 26328) Species List:

Scientific name	Common name	Status	C
<i>Amelanchier spicata</i>	shadbush serviceberry	Native	4
<i>Anaphalis margaritacea</i>	pearly everlasting	Native	3
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Arabidopsis lyrata</i>	sand cress	Native	7
<i>Arctostaphylos uva-ursi</i>	bearberry	Native	8
<i>Asclepias amplexicaulis</i>	clasping milkweed	Native	8
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Carex siccata</i>	sedge	Native	5
<i>Carex tonsa</i>	sedge	Native	5
<i>Cirsium hillii</i>	hills thistle	Native	8
<i>Clinopodium vulgare</i>	wild-basil	Native	3
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Crataegus chrysocarpa</i>	hawthorn	Native	4
<i>Crataegus pruinosa</i>	hawthorn	Native	6

Black Lake Oak-Pine Barrens; Oak-Pine Barrens (EO ID 26328) Species List (Continued):

Scientific name	Common name	Status	C
<i>Crocianthemum canadense</i>	common frostweed	Native	8
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Dichanthelium columbianum</i>	panic grass	Native	5
<i>Dichanthelium depauperatum</i>	panic grass	Native	4
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Gaultheria procumbens</i>	wintergreen	Native	5
<i>Hieracium caespitosum</i>	king devil	Non-native	0
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Houstonia longifolia</i>	long-leaved bluets	Native	6
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Koeleria macrantha</i>	june grass	Native	9
<i>Krigia virginica</i>	dwarf dandelion	Native	4
<i>Liatris cylindracea</i>	cylindrical blazing-star	Native	5
<i>Lithospermum canescens</i>	hoary puccoon	Native	10
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Monarda fistulosa</i>	wild-bergamot	Native	2
<i>Nuttallanthus canadensis</i>	blue toadflax	Native	8
<i>Packera paupercula</i>	balsam ragwort	Native	3
<i>Panicum virgatum</i>	switch grass	Native	4
<i>Pedicularis canadensis</i>	wood-betony	Native	10
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus resinosa</i>	red pine	Native	6
<i>Piptatherum pungens</i>	rice-grass	Native	9
<i>Piptochaetium avenaceum</i>	black oatgrass	Native	10
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Polygala polygama</i>	racemed milkwort	Native	9
<i>Prunus pumila</i>	sand cherry	Native	8
<i>Prunus serotina</i>	wild black cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rubus flagellaris</i>	northern dewberry	Native	1
<i>Rumex acetosella</i>	sheep sorrel	Non-native	0
<i>Schizachne purpurascens</i>	false melic	Native	5
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Solidago hispida</i>	hairy goldenrod	Native	3
<i>Sorghastrum nutans</i>	indian grass	Native	6
<i>Symphotrichum laeve</i>	smooth aster	Native	5
<i>Vaccinium angustifolium</i>	low sweet blueberry	Native	4
<i>Viola pedata</i>	birdfoot violet	Native	9

Koenig Oak-Pine Barrens; Oak-Pine Barrens (EO ID 27660) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Amelanchier arborea</i>	juneberry	Native	4
<i>Amelanchier interior</i>	serviceberry	Native	4
<i>Amelanchier spicata</i>	shadbush serviceberry	Native	4
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Antennaria howellii</i>	small pussytoes	Native	2
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Apocynum androsaemifolium</i>	spreading dogbane	Native	3
<i>Arctostaphylos uva-ursi</i>	bearberry	Native	8
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Bromus kalmii</i>	prairie brome	Native	8
<i>Calamagrostis canadensis</i>	blue-joint	Native	3
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Crocianthemum canadense</i>	common frostweed	Native	8
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Dichanthelium columbianum</i>	panic grass	Native	5
<i>Dichanthelium latifolium</i>	broad-leaved panic grass	Native	5
<i>Dichanthelium linearifolium</i>	slender-leaved panic grass	Native	4
<i>Dichanthelium xanthophyllum</i>	panic grass	Native	6
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Equisetum laevigatum</i>	smooth scouring rush	Native	2
<i>Galium boreale</i>	northern bedstraw	Native	3
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Gaultheria procumbens</i>	wintergreen	Native	5
<i>Hieracium aurantiacum</i>	orange hawkweed	Non-native	0
<i>Hieracium scabrum</i>	rough hawkweed	Native	3
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Koeleria macrantha</i>	june grass	Native	9
<i>Lactuca canadensis</i>	tall lettuce	Native	2
<i>Lilium philadelphicum</i>	wood lily	Native	7
<i>Lithospermum canescens</i>	hoary puccoon	Native	10
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Pedicularis canadensis</i>	wood-betony	Native	10
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3
<i>Piptatherum pungens</i>	rice-grass	Native	9
<i>Piptochaetium avenaceum</i>	black oatgrass	Native	10
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Polygala polygama</i>	racemed milkwort	Native	9
<i>Populus grandidentata</i>	big-tooth aspen	Native	4
<i>Potentilla simplex</i>	old-field cinquefoil	Native	2
<i>Prunus pumila</i>	sand cherry	Native	8
<i>Prunus serotina</i>	wild black cherry	Native	2
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus ellipsoidalis</i>	hills oak	Native	4
<i>Quercus velutina</i>	black oak	Native	6

Koenig Oak-Pine Barrens; Oak-Pine Barrens (EO ID 27660) Species List (Continued):

Scientific name	Common name	Status	C
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rubus flagellaris</i>	northern dewberry	Native	1
<i>Salix humilis</i>	prairie willow	Native	4
<i>Schizachne purpurascens</i>	false melic	Native	5
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Solidago juncea</i>	early goldenrod	Native	3
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Trientalis borealis</i>	star-flower	Native	5
<i>Vaccinium angustifolium</i>	low sweet blueberry	Native	4
<i>Viola adunca</i>	sand violet	Native	4
<i>Viola sagittata</i>	arrow-leaved violet	Native	8

O'Connell Barrens; Oak-Pine Barrens (EO ID 28449) Species List:

Scientific name	Common name	Status	C
<i>Amelanchier arborea</i>	juneberry	Native	4
<i>Amelanchier spicata</i>	shadbush serviceberry	Native	4
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Antennaria howellii</i>	small pussytoes	Native	2
<i>Antennaria parlinii</i>	smooth pussytoes	Native	2
<i>Arctostaphylos uva-ursi</i>	bearberry	Native	8
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Carex siccata</i>	sedge	Native	5
<i>Ceanothus herbaceus</i>	new jersey tea	Native	9
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Dichanthelium columbianum</i>	panic grass	Native	5
<i>Dichanthelium depauperatum</i>	panic grass	Native	4
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Hieracium aurantiacum</i>	orange hawkweed	Non-native	0
<i>Hieracium caespitosum</i>	king devil	Non-native	0
<i>Hieracium scabrum</i>	rough hawkweed	Native	3
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Houstonia longifolia</i>	long-leaved bluets	Native	6
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Koeleria macrantha</i>	june grass	Native	9
<i>Krigia virginica</i>	dwarf dandelion	Native	4
<i>Liatris cylindracea</i>	cylindrical blazing-star	Native	5
<i>Lithospermum canescens</i>	hoary puccoon	Native	10
<i>Lonicera dioica</i>	red honeysuckle	Native	5
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Oryzopsis asperifolia</i>	rough-leaved rice-grass	Native	6
<i>Packera paupercula</i>	balsam ragwort	Native	3
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3
<i>Piptatherum pungens</i>	rice-grass	Native	9
<i>Piptochaetium avenaceum</i>	black oatgrass	Native	10
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Polygala polygama</i>	racemed milkwort	Native	9

O'Connell Barrens; Oak-Pine Barrens (EO ID 28449) Species List (Continued):

Scientific name	Common name	Status	C
<i>Potentilla simplex</i>	old-field cinquefoil	Native	2
<i>Prunus americana</i>	american wild plum	Native	4
<i>Prunus pumila</i>	sand cherry	Native	8
<i>Prunus serotina</i>	wild black cherry	Native	2
<i>Prunus virginiana</i>	choke cherry	Native	2
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rubus flagellaris</i>	northern dewberry	Native	1
<i>Rumex acetosella</i>	sheep sorrel	Non-native	0
<i>Schizachne purpurascens</i>	false melic	Native	5
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Solidago juncea</i>	early goldenrod	Native	3
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Tragopogon dubius</i>	goats beard	Non-native	0
<i>Vaccinium angustifolium</i>	low sweet blueberry	Native	4
<i>Viola adunca</i>	sand violet	Native	4
<i>Viola pedata</i>	birdfoot violet	Native	9

Little Round Barrens; Oak-Pine Barrens (EO ID 28448) Species List:

Scientific name	Common name	Status	C
<i>Acer rubrum</i>	red maple	Native	1
<i>Agrostis gigantea</i>	redtop	Non-native	0
<i>Amelanchier arborea</i>	juneberry	Native	4
<i>Andropogon gerardii</i>	big bluestem	Native	5
<i>Antennaria howellii</i>	small pussytoes	Native	2
<i>Apocynum androsaemifolium</i>	spreading dogbane	Native	3
<i>Arctostaphylos uva-ursi</i>	bearberry	Native	8
<i>Asclepias amplexicaulis</i>	clasping milkweed	Native	8
<i>Asclepias syriaca</i>	common milkweed	Native	1
<i>Asclepias tuberosa</i>	butterfly-weed	Native	5
<i>Avenella flexuosa</i>	hair grass	Native	6
<i>Campanula rotundifolia</i>	harebell	Native	6
<i>Carex pensylvanica</i>	sedge	Native	4
<i>Cirsium hillii</i>	hills thistle	Native	8
<i>Comandra umbellata</i>	bastard-toadflax	Native	5
<i>Comptonia peregrina</i>	sweetfern	Native	6
<i>Conyza canadensis</i>	horseweed	Native	0
<i>Crocanthemum canadense</i>	common frostweed	Native	8
<i>Danthonia spicata</i>	poverty grass; oatgrass	Native	4
<i>Dichanthelium columbianum</i>	panic grass	Native	5
<i>Dichanthelium depauperatum</i>	panic grass	Native	4
<i>Dichanthelium linearifolium</i>	slender-leaved panic grass	Native	4
<i>Elymus trachycaulus</i>	slender wheatgrass	Native	8
<i>Erechtites hieracifolius</i>	fireweed	Native	2
<i>Fragaria virginiana</i>	wild strawberry	Native	2
<i>Galium pilosum</i>	hairy bedstraw	Native	6
<i>Hieracium aurantiacum</i>	orange hawkweed	Non-native	0
<i>Hieracium venosum</i>	rattlesnake-weed	Native	6
<i>Hypericum perforatum</i>	common st. johns-wort	Non-native	0
<i>Koeleria macrantha</i>	june grass	Native	9
<i>Krigia biflora</i>	false dandelion	Native	5
<i>Lithospermum canescens</i>	hoary puccoon	Native	10

Little Round Barrens; Oak-Pine Barrens (EO ID 28448) Species List (Continued):

Scientific name	Common name	Status	C
<i>Melampyrum lineare</i>	cow-wheat	Native	6
<i>Nuttallanthus canadensis</i>	blue toadflax	Native	8
<i>Oenothera parviflora</i>	evening-primrose	Native	2
<i>Panicum capillare</i>	witch grass	Native	0
<i>Pinus banksiana</i>	jack pine	Native	5
<i>Pinus resinosa</i>	red pine	Native	6
<i>Pinus strobus</i>	white pine	Native	3
<i>Piptatherum pungens</i>	rice-grass	Native	9
<i>Piptochaetium avenaceum</i>	black oatgrass	Native	10
<i>Poa compressa</i>	canada bluegrass	Non-native	0
<i>Poa pratensis</i>	kentucky bluegrass	Non-native	0
<i>Potentilla simplex</i>	old-field cinquefoil	Native	2
<i>Prunus pumila</i>	sand cherry	Native	8
<i>Prunus serotina</i>	black cherry	Native	2
<i>Pteridium aquilinum</i>	bracken fern	Native	0
<i>Quercus alba</i>	white oak	Native	5
<i>Quercus velutina</i>	black oak	Native	6
<i>Rosa carolina</i>	pasture rose	Native	4
<i>Rubus flagellaris</i>	northern dewberry	Native	1
<i>Schizachyrium scoparium</i>	little bluestem	Native	5
<i>Symphyotrichum laeve</i>	smooth aster	Native	5
<i>Vaccinium angustifolium</i>	low sweet blueberry	Native	4
<i>Viola adunca</i>	sand violet	Native	4
<i>Viola pedata</i>	birdfoot violet	Native	9