

Ecosystem Assessment Project: Bernard W. Baker Sanctuary
21145 15 Mile Rd, Bellevue, MI 49021

Capstone Assignment for Herbaceous Flora and Ecosystems, EAS 501.003
Project Period: September 2021-November 2021

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Figure 1. Sunrise on the Meadow and Marshland Trail. Bernard W. Baker Sanctuary, March 28, 2021.

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Abstract

The Bernard W. Baker Sanctuary is a 980-acre nature preserve in Calhoun County, Michigan. It is actively managed by the Michigan Audubon Society and is a known refuge for nesting Sandhill Cranes. Baker Sanctuary is bordered primarily by single family homes and is located within the agricultural and rural-residential matrix that encompasses southwestern Michigan. It contains a partially restored 200-acre wetland—Big Marsh Lake—where over 200 avian species have been observed. The land is subdivided into several parcels that contain a variety of natural communities such as floodplain forest, wet meadow, and tamarack swamp. Additionally, there are ongoing prairie and wetland restoration projects at the site which are currently at various stages of completion (Michigan Audubon). Prior to anthropogenic activity, Baker Sanctuary was comprised of mixed oak savanna, mixed conifer swamp, and shrub swamp-emergent marsh that evolved with fire as a component of the landscape. By the mid-1800's most of the upland had been converted to agriculture, and a portion of the wetlands were drained for the same purpose. The preserve was purchased in 1941 by Bernard W. Baker of Marne, Michigan and subsequently donated to the Michigan Audubon Society. At the time he described the site as a grouping of wetlands containing irregular sedge and grass “arms” reaching into tamarack and mixed-hardwood forest, with a ridge of second-growth oaks on one side of the property. Combined with the “tamarack peninsulas” that are mixed into the wetland, the forested upland sites that surround Big Marsh Lake provide a buffer that allows for the nesting of cranes (Walkinshaw, 1950). In the years following the establishment of the preserve farming practices ceased, as did the annual fire treatments. Management was limited for the next 50 years, and most of the grassy uplands were colonized by exotic woody plant species. The current management objectives at the Bernard W. Baker Sanctuary are the preservation of existing wetland and forested habitat fragments as well as the restoration of oak openings that previously characterized large portions of the land. This will improve diversity, as well as provide habitat for other imperiled species in Michigan.

Introduction

An ecological assessment was conducted of the restored mesic prairie at the Bernard W. Baker Sanctuary in Bellevue, Michigan to evaluate the site with scientific methodology and to provide an informative resource to future stewards of the land. This site was intensified with row-crop agriculture for roughly 100 years prior to its incorporation as part of the preserve in the mid-20th century. Since that time the hedgerows have grown in and in some areas the old fields have succeeded to a mixture of native and exotic woody species. It is the goal of the Michigan Audubon society to restore this ecosystem to something resembling the oak savanna that characterized it prior to intervention by homesteading European settlers. This will improve floral and faunal diversity, increase ecosystem services, and provide migrating, nesting, and foraging habitat for threatened and endangered avian species.

Bernard W. Baker Sanctuary

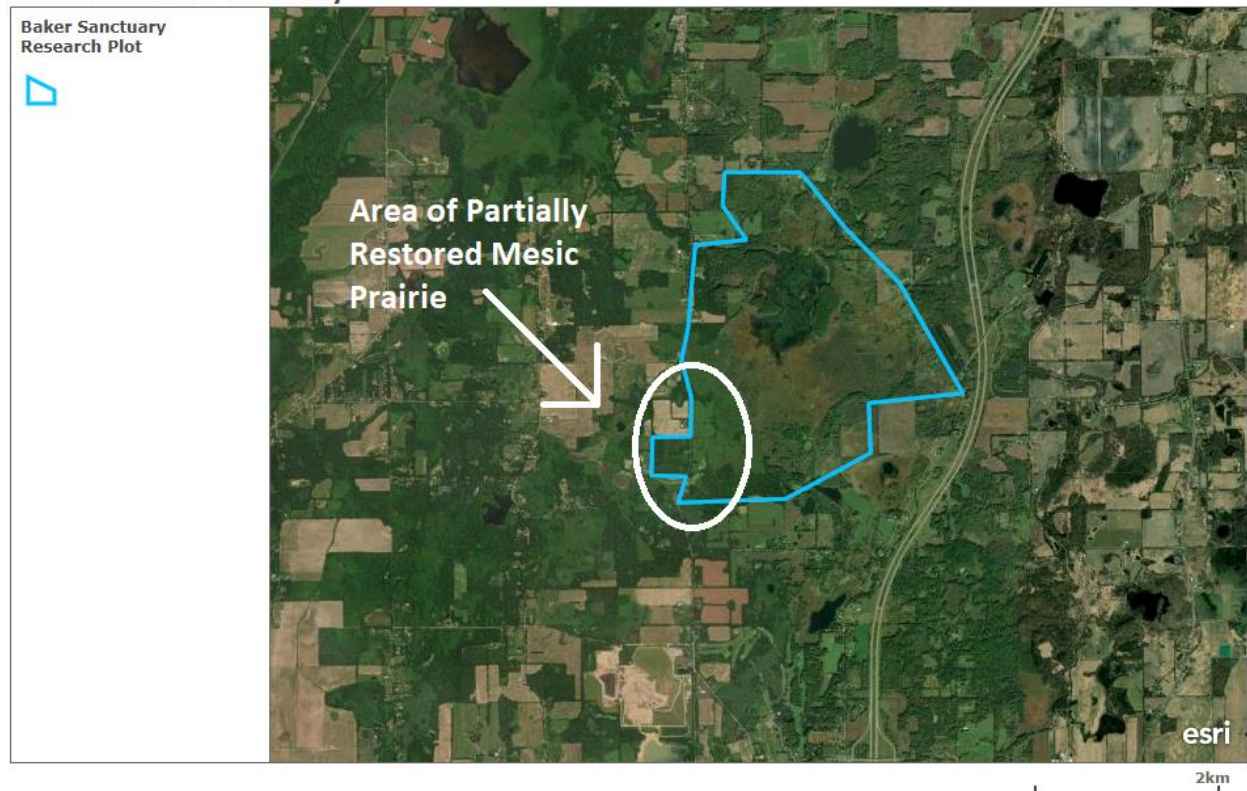


Figure 2. Boundaries of the Bernard W. Baker Sanctuary created with the University of Michigan ArcGIS Online portal. The area within the white oval represents the general location of the restored mesic prairie patches that are the focus of this analysis.

Methods

Vegetation at the Baker Sanctuary was surveyed on three occasions between September and November 2021. These were meander surveys which focused on the species composition of the partially restored mesic prairie upland. For each survey, participants utilized the existing “Meadow and Marshland” trail system to access different portions of the habitat. Herbaceous plant identification was the prime focus of two of these visits, and woody species were recorded as well. On the third site visit, DBH measurements were taken of the woody species within a randomly selected 100x100 ft quadrat. During this outing, five random soil samples from across the mesic prairie were evaluated for their soil textural properties and pH.

Herbaceous species richness was recorded electronically using the iNaturalist app, and that species list was evaluated using the Universal FQA Calculator tool available at UniversalFQA.com to produce a final plant list for the site. Soil texture was evaluated by hand using the textural triangle and soil acidity was assessed in the field using a portable pH kit.

Integrated field maps with historical feature layer overlays were produced using the ArcGIS Online portal available to students at the University of Michigan, Subscription ID: 1416867292.

Results

Natural Communities

Baker Sanctuary is an extensive preserve complex located in southwestern Michigan that covers nearly three-square miles. It is comprised of several natural communities—habitats that contain groups of species that occur repeatedly together, interact with each other, and function at an equilibrium independently from anthropogenic input (Cohen et al., 2015). Prior to intervention by European settlers, the land that comprises the current sanctuary was a matrix of mixed oak savanna, oak-hickory forest, mixed shrub swamp- emergent marsh and mixed conifer swamp. By the mid-nineteenth century nearly all the arable land was cleared and converted to agriculture, and additional land that was periodically saturated was drained so it could also be put into production. Farmers grew row crops and grazed livestock on some upland sites. They also continued applying nearly annual burn treatments to their fields as well as Big Marsh Lake. When the preserve was established over 70 years ago nearly all management activities ceased, and the land was left undisturbed. This allowed the old fields to succeed to dense thickets of exotic species such as European Buckthorn (*Rhamnus cathartica*), Autumn Olive (*Elaeagnus umbellata*), and Amur Honeysuckle (*Lonicera maackii*).

In the past two decades the Michigan Audubon Society has endeavored to restore portions of this land to resilient stable states that resemble their historical natural communities. Currently, Baker Sanctuary contains portions of restored mesic prairie and dry-mesic southern forest in areas of higher elevation. These ecosystems are reminiscent of the oak savanna which historically dominated the upland areas of the site. The palustrine group of natural communities that currently occupy other areas of the preserve is comprised of southern hardwood swamp, prairie fen, submergent marsh, emergent marsh, southern wet meadow, southern shrub-carr, and rich tamarack swamp.

Bernard W. Baker Sanctuary

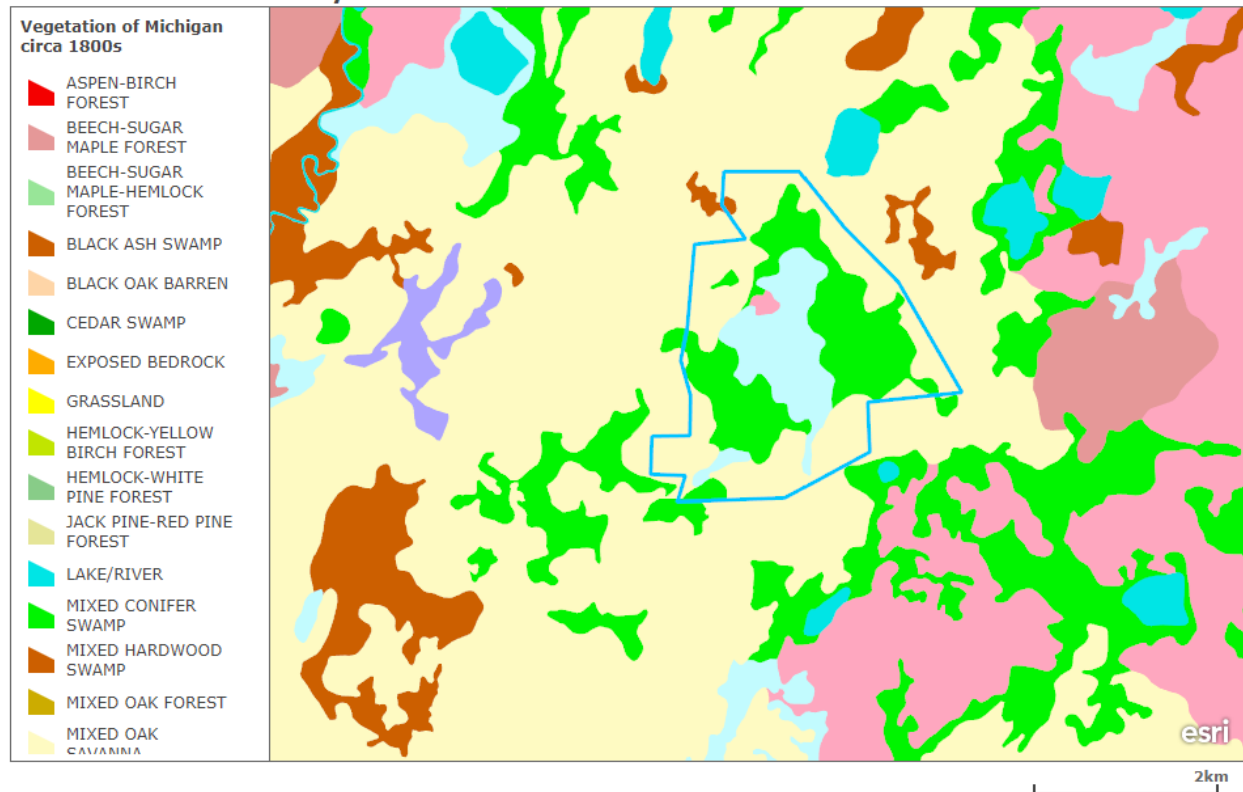


Figure 3. The overlay of feature layer "Vegetation of Michigan circa 1800s" in ArcGIS confirms that prior to European settlement the Bernard W. Baker Sanctuary was comprised primarily of mixed oak savanna (tan), oak-hickory forest (pink), mixed shrub swamp- emergent marsh (light blue), and mixed conifer swamp (green).

Size

The Baker Sanctuary is comprised of four independent parcels that touch each other. The largest, which contains Big Marsh Lake as well as the system of trails, is 987 acres. The three additional sites that share borders with the preserve are sizeable as well, and the total land area under conservation is approximately 1,600 acres, (648 hectares) in total.

Landscape Context

This site occurs within a rural, yet well developed, agricultural and residential matrix. There is a large landfill one mile southwest of the preserve that is a source of light and noise pollution, and large trucks frequently pass on the road directly adjacent to the restored forest and prairie patches. The town of Bellevue is located less than 5 miles to the north, and the sanctuary is located 15 miles northeast of the city of Battle Creek and 10 miles north of the city of Marshall as well. Because of the density of this settlement, the Baker Sanctuary is surrounded by single family homes with backyards as well as some farm fields.

Bernard W. Baker Sanctuary

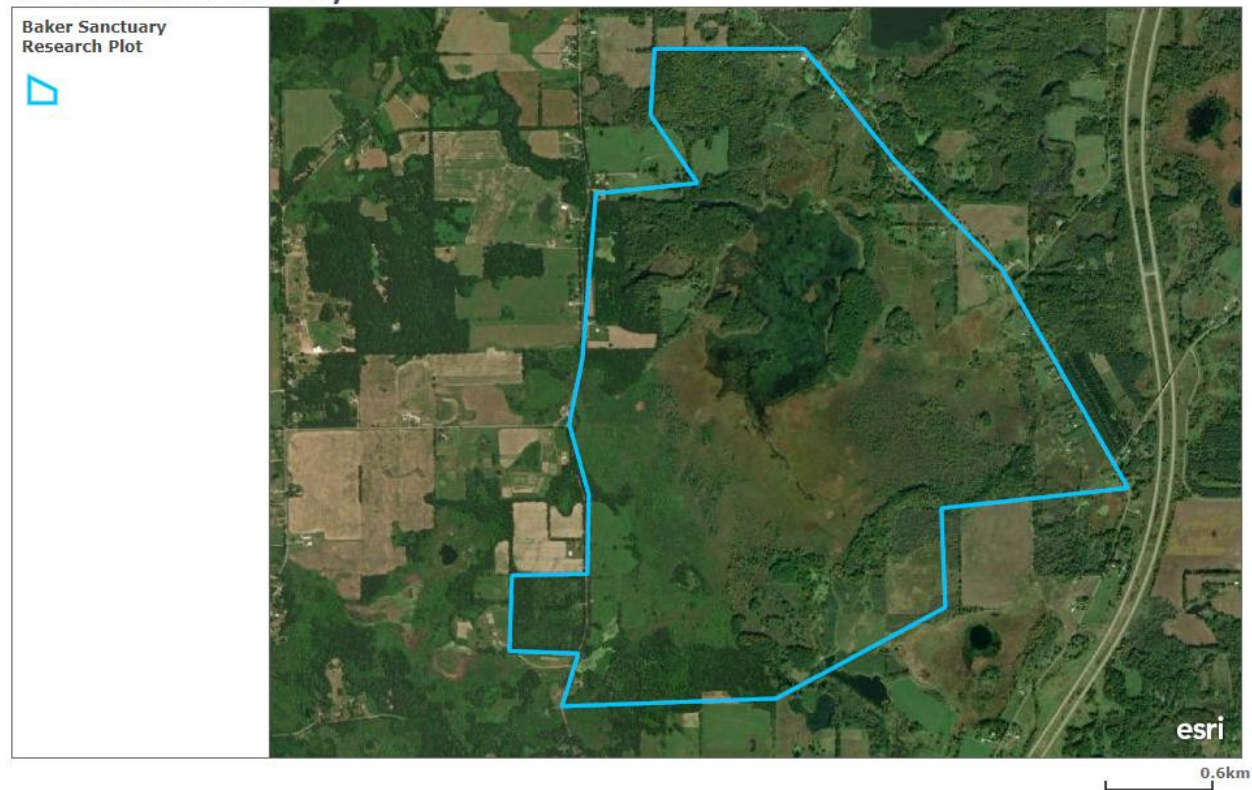


Figure 4. Boundaries of the Bernard W. Baker Sanctuary created with the University of Michigan ArcGIS Online portal.

Glacial Landform

Baker Sanctuary is located on an end moraine of coarse-textured till. Like in the rest of Michigan, the glacial history of this site directly influences its present-day soil texture, topography, and thus its ecological communities. As a glacier as it reached its maximum and subsequently retreated it deposited a large mound of debris across the landscape in the area that now contains the preserve. These mineral deposits, termed glacial till, are a heterogeneous mixture variously sized rocks and minerals that were created by the pulverization of bedrock by the advancing glacier and are deposited in an unsorted manner (Brady & Weil, 2017). The large wetland in the center of the sanctuary, Big Marsh Lake, was a glacial lake that collected water during the period of glacial retreat.

There is a channel of glacial outwash sand and gravel directly west of the site, which continues to the south and is the source of a large outwash plain. This occurred during the glacial retreat, when meltwater formed rivers and deposited outwash across a large area south of the preserve. This extensive deposition of sorted materials was due to the immense amount of water flowing from the glacier and flat topography which enabled it to spread freely over a large expanse (Brady & Weil, 2017).

Bernard W. Baker Sanctuary



Figure 5. The overlay of feature layer "Quaternary Geology of Michigan" in ArcGIS confirms that the Bernard W. Baker Sanctuary is situated on an end moraine of coarse-textured till, with medium-textured glacial till to the east and glacial outwash deposits to the west and south.

Soils

A close examination of the USDA Soils Map reveals that most of the soils constituting the restored mesic prairie uplands are primarily comprised of sandy loam, loamy sand, and loam. This is consistent with the glacial history of the site, as the parent material of the deposits that formed the end moraine was likely comprised of sandstone and limestone.

The palustrine areas of the preserve are largely Houghton muck, which is commonly found in wetland complexes. Mucks are poorly drained soils that develop when many layers of organic matter accumulate in shallow depressions within complexes of end moraines and outwash plains (National Cooperative Soil Survey). These soils are comprised of organic matter that has been completely humified; broken down into a powdery black material that no longer resembles plant material (Brady & Weil, 2017). Historically, these organic soils have often been drained for agriculture, as they are rich in nutrients. In this case most of the muck soils were not farmed and are surrounded by sandy loam or loamy sand deposits.

National Resources Conservation Service, USDA
 Web Soil Survey
 Bernard W. Baker Sanctuary
 21145 15 Mile Rd, Bellevue, MI 49021

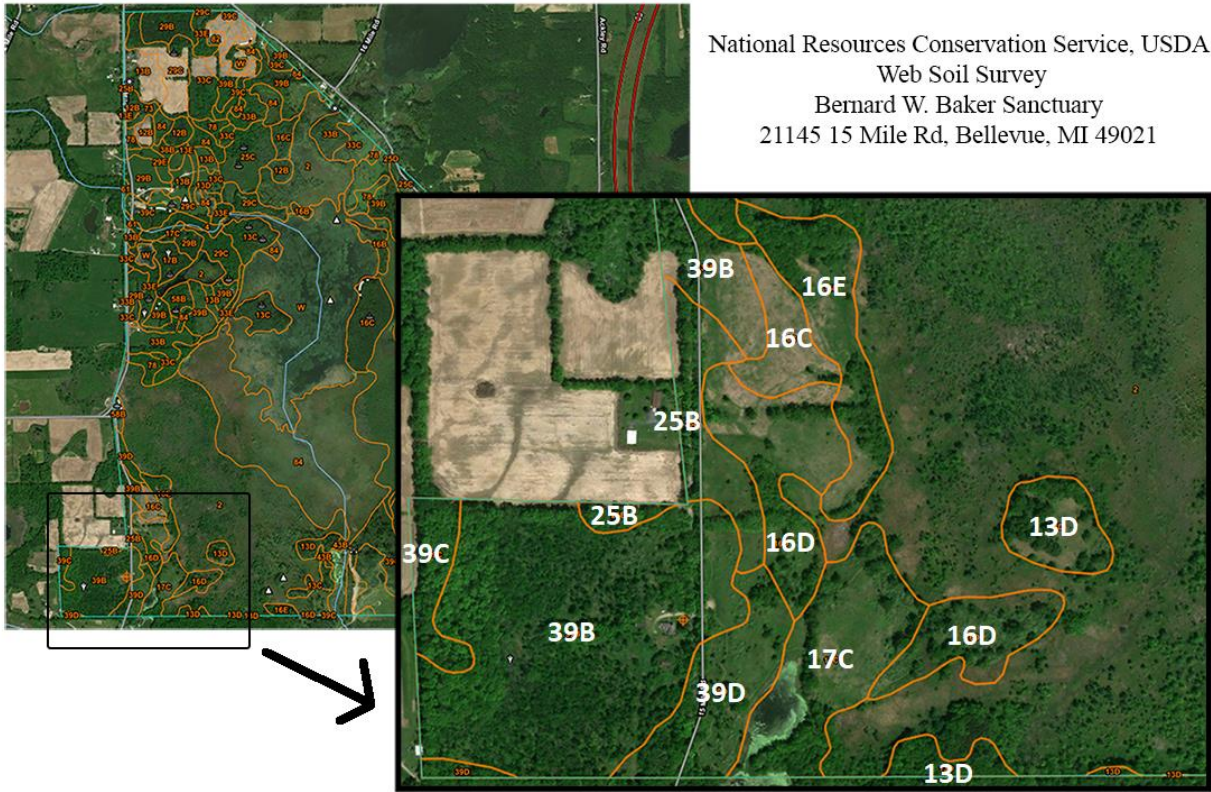


Figure 6. An enlarged USDA Web Soil Survey map indicates that most soils in the restored mesic prairie portion of the Bernard W. Baker Sanctuary are comprised of sandy loam and loamy sand.

Calhoun County, Michigan			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
13D	Spinks loamy sand, 12 to 18 percent slopes	16.5	0.90%
16C	Oshtemo sandy loam, 6 to 12 percent slopes	37.6	2.10%
16D	Oshtemo sandy loam, 12 to 18 percent slopes	16.9	0.90%
16E	Oshtemo sandy loam, 18 to 35 percent slopes	12.4	0.70%
17C	Boyer sandy loam, 6 to 12 percent slopes	14.7	0.80%
25B	Kalamazoo loam, 2 to 6 percent slopes	13.6	0.70%
39B	Morley loam, 2 to 6 percent slopes	134.9	7.40%
39C	Morley loam, 6 to 12 percent slopes	92	5.00%
39D	Morley loam, 12 to 18 percent slopes	35.5	1.90%

During the third site visit, five soil samples were collected from random locations in the restored mesic prairie. Each sample was extracted from the A horizon using a root knife, wetted with water, and soil texture was determined using the ribbon technique. After consulting with the soil textural triangle, it was determined that three of the five locations contained sandy clay loam, and the other two were comprised of sandy clay and sandy loam. It was surprising to observe the prevalence of clays in the composition because they do not appear on the USDA Soils Map. It is also possible that there was slight variation in the sample collection and analysis, which could have resulted in incorrect categorization of the samples.

The pH of the samples ranged from 6.5 to 7.5, which was expected due the calcium carbonate present in the glacial till. This data is also consistent within a larger framework, as neighboring natural communities in the preserve such as rich tamarack swamp, prairie fen, southern shrub-carr, and southern wet meadow are neutral to alkaline in pH and can occur where there is calcareous groundwater seepage from end moraines (Cohen et al., 2015).

Baker Sanctuary Samples	Soil Type	pH
1	Sandy clay loam	7.0
2	Sandy clay	7.5
3	Sandy clay loam	7.0
4	Sandy loam	6.5
5	Sandy clay loam	7.5

Community Structure

A random field location was selected on the third site visit to the Baker Sanctuary for the analysis of a 100x100ft quadrat of restored mesic prairie. The community structure of this prairie is defined by large *Quercus ellipsoidalis* and *Quercus rubra* specimens that are either solitary in the field or sparsely lining rivulets that likely constituted old farm field boundaries. These trees constitute the overstory/canopy layer (woody plants > 20m in height). The stated goal of the Michigan Audubon Society has been to restore the site to oak savanna, so these trees are an important contributor to the function of this ecosystem. In a surprise twist there were no *Juglans nigra* species within the boundaries of our quadrat. Black walnut was propagated by those who farmed the land in the early twentieth century, and the species continues to be problematic in several other sections of the preserve.

Several *Prunus serotina* trees were also present on the site, which are a byproduct of the decrease in frequency of management activities in the prairie. These trees are present alongside the problematic woody invasive species that are overtaking other areas of the preserve. There was one *Sassafras albidum* in this quadrat, and anecdotal evidence suggests that they are more prevalent throughout portions of the preserve than what is represented in this data. Together, these two species constitute the understory/sub-canopy layer (woody plants 5-20m in height).

The tall shrub layer (woody plants 1-5m in height) was defined by *Elaeagnus umbellata*, *Rhamnus cathartica*, and *Prunus serotina* saplings. The low shrub layer (woody plants 20-100cm in

height) contained *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Rubus occidentalis*. This was dense and difficult to walk through. The ground layer (woody seedlings < 20cm in height and all herbaceous species) contained *Parthenocissus quinquefolia*, *Toxicodendron radicans*, *Sorghastrum nutans*, *Andropogon gerardii*, *Schizachyrium scoparium*, *Asclepias syriaca*, *Rudbeckia hirta*, and *Symphytotrichum pilosum*. The full list of herbaceous plants observed at the site can be found in the Plant List section.

Cover Characterization	Overstory/ Canopy Layer (woody plants > 20 m to 30 m in height)	Understory / Sub-canopy Layer (woody plants 5 m to 20 m in height)	Tall Shrub Layer (woody plants > 1 m to 5 m in height)	Low Shrub Layer (woody plants 20 cm to 100 cm in height)	Ground Layer (woody seedlings < 20 cm in height and all herbaceous species)
Closed				x	x
Patchy	x	x			
Sparse			x		
Open					
Absent					

Species	DBH	DBH	DBH
<i>Quercus ellipsoidalis</i>	69	79	
<i>Quercus rubra</i>	76	23	45
<i>Prunus serotina</i>	8	6	
<i>Sassafras albidum</i>	24		

Plant List



Figure 7. Sunrise in the restored mesic prairie. Bernard W. Baker Sanctuary, 7-1-2021.

Plant list data recorded over three site visits on the iNaturalist app was manually input into the website UniversalFQA.com to statistically analyze the floral complexity of the landscape. Floristic Quality Assessment (FQA) is a metric for determining the health of plant communities by assigning each species a coefficient of conservatism (C-value) from 1-10 based on its ability to survive pollution and habitat degradation as well as its affinity for its historical ecological communities. Plants with high C values (7-10) are likely to occur in groups that are representative of their historical associations on undisturbed sites (Freyman et al.).

To obtain an accurate floristic quality assessment, both the mean coefficient of conservatism and the floristic quality index were calculated from the plant list. The mean coefficient of conservatism is simply the C-values of each plant added together and divided by the total number of plants. To calculate the FQI, this figure is then multiplied by the square root of the total number of plants. It is possible for two sites to have similar C-values but different levels of species richness, which will result in different FQI scores. Most of the remaining undeveloped parcels of land in Michigan have FQI scores below 20. A site with an FQI score of over 35 is extremely high quality and worthy of conservation by the state (Herman, 2001).

Sampled fields in the restored mesic prairie at the Baker Sanctuary had a calculated FQI score of 24.8, indicating that the habitat is reasonably healthy and that future restoration efforts could

potentially further raise the conservation value of the land. Non-native species constitute a significant portion of the species richness (25%), which could be lowered through restoration treatments that target woody invasive shrubs and trees. Each of the three site visits occurred in the fall of 2021, so charismatic fall species make up a large portion of the list. Conducting additional meandering plant surveys in the spring and summer months would likely have a positive impact on both the FQI and species richness metrics.

Total Mean C:	3.1
Total FQI:	24.8
Native FQI:	29.1
Species Richness	64 (75% native)

Scientific Name	Common Name	Family	Native?	C	W
<i>Abutilon theophrasti</i>	velvet-leaf	Malvaceae	non-native	0	3
<i>Agrimonia pubescens</i>	soft agrimony	Rosaceae	native	5	5
<i>Apocynum cannabinum</i> ; a. <i>sibiricum</i>	indian-hemp	Apocynaceae	native	3	0
<i>Asplenium platyneuron</i>	ebony spleenwort	Aspleniaceae	native	2	3
<i>Baptisia lactea</i>	white false indigo	Fabaceae	native	9	3
<i>Bromus ciliatus</i>	fringed brome	Poaceae	native	6	-3
<i>Bromus inermis</i>	smooth brome	Poaceae	non-native	0	5
<i>Cichorium intybus</i>	chicory	Asteraceae	non-native	0	3
<i>Cirsium vulgare</i>	bull thistle	Asteraceae	non-native	0	3
<i>Coreopsis lanceolata</i>	sand coreopsis	Asteraceae	native	8	3
<i>Coreopsis tripteris</i>	tall coreopsis	Asteraceae	native	7	0
<i>Cornus foemina</i>	gray dogwood	Cornaceae	native	1	0
<i>Daucus carota</i>	queen-annes-lace	Apiaceae	non-native	0	5

<i>Decodon verticillatus</i>	whorled or swamp loosestrife	Lythraceae	native	7	-5
<i>Doellingeria umbellata</i> ; aster u.	flat-topped white aster	Asteraceae	native	5	-3
<i>Echinacea purpurea</i>	purple coneflower	Asteraceae	non-native	0	5
<i>Elaeagnus umbellata</i>	autumn-olive	Elaeagnaceae	non-native	0	3
<i>Eryngium yuccifolium</i>	rattlesnake-master	Apiaceae	native	10	0
<i>Euthamia graminifolia</i>	grass-leaved goldenrod	Asteraceae	native	3	0
<i>Eutrochium maculatum</i> ; eupatorium m.	joe-pye-weed	Asteraceae	native	4	-5
<i>Helianthus divaricatus</i>	woodland sunflower	Asteraceae	native	5	5
<i>Ilex verticillata</i>	michigan holly	Aquifoliaceae	native	5	-3
<i>Juniperus virginiana</i>	red-cedar	Cupressaceae	native	3	3
<i>Liriodendron tulipifera</i>	tulip tree	Magnoliaceae	native	9	3
<i>Lonicera maackii</i>	amur honeysuckle	Caprifoliaceae	non-native	0	5
<i>Maclura pomifera</i>	osage-orange	Moraceae	non-native	0	3
<i>Onoclea sensibilis</i>	sensitive fern	Onocleaceae	native	2	-3
<i>Panicum virgatum</i>	switch grass	Poaceae	native	4	0
<i>Parthenium integrifolium</i> ; p. hispidum	wild quinine	Asteraceae	non-native	0	5
<i>Parthenocissus quinquefolia</i>	virginia creeper	Vitaceae	native	5	3
<i>Phytolacca americana</i>	pokeweed	Phytolaccaceae	native	2	3
<i>Prunella vulgaris</i>	self-heal	Lamiaceae	native	0	0
<i>Prunus serotina</i>	wild black cherry	Rosaceae	native	2	3
<i>Pseudognaphalium obtusifolium</i> ; gnaphalium o.	old-field balsam	Asteraceae	native	2	5

<i>Quercus rubra</i>	red oak	Fagaceae	native	5	3
<i>Ratibida pinnata</i>	yellow coneflower	Asteraceae	native	4	5
<i>Rhamnus cathartica</i>	common buckthorn	Rhamnaceae	non-native	0	0
<i>Rhus typhina</i>	staghorn sumac	Anacardiaceae	native	2	3
<i>Rosa multiflora</i>	multiflora rose	Rosaceae	non-native	0	3
<i>Rubus allegheniensis</i>	common blackberry	Rosaceae	native	1	3
<i>Rudbeckia fulgida</i>	black-eyed susan	Asteraceae	native	9	-5
<i>Rudbeckia triloba</i>	three-lobed coneflower	Asteraceae	native	5	3
<i>Sambucus canadensis</i>	elderberry	Adoxaceae	native	3	-3
<i>Sassafras albidum</i>	sassafras	Lauraceae	native	5	3
<i>Schizachyrium scoparium</i> ; andropogon s.	little bluestem	Poaceae	native	5	3
<i>Scirpus cyperinus</i>	wool-grass	Cyperaceae	native	5	-5
<i>Silphium perfoliatum</i>	cup plant	Asteraceae	native	10	-3
<i>Solanum carolinense</i>	horse-nettle	Solanaceae	non-native	0	3
<i>Solidago altissima</i>	tall goldenrod	Asteraceae	native	1	3
<i>Solidago gigantea</i>	late goldenrod	Asteraceae	native	3	-3
<i>Sorghastrum nutans</i>	indian grass	Poaceae	native	6	3
<i>Symphotrichum drummondii</i>	drummonds aster	Asteraceae	native	5	5
<i>Symphotrichum lateriflorum</i> ; aster l.	calico aster	Asteraceae	native	2	0
<i>Symphotrichum novae-angliae</i> ; aster n.	new england aster	Asteraceae	native	3	-3
<i>Symphotrichum pilosum</i> ; aster p.	hairy aster	Asteraceae	native	1	3

Symphytotrichum urophyllum; aster sagittifolius	arrow-leaved aster	Asteraceae	native	2	5
Toxicodendron radicans	poison-ivy	Anacardiaceae	native	2	0
Toxicodendron vernix	poison sumac	Anacardiaceae	native	6	-5
Trifolium pratense	red clover	Fabaceae	non-native	0	3
Typha angustifolia	narrow-leaved cat-tail	Typhaceae	non-native	0	-5
Ulmus americana	american elm	Ulmaceae	native	1	-3
Vernonia gigantea	tall ironweed	Asteraceae	native	3	0
Viburnum opulus	european highbush-cranberry	Adoxaceae	non-native	0	-3
Vitis riparia	river-bank grape	Vitaceae	native	3	0

Disturbance

Baker Sanctuary has a long history of natural and anthropogenic disturbance. Prior to European settlement, the upland areas were defined by patterns of ground fire and windthrow. The wetlands were primarily manipulated by fire and beaver activity. This is a fire-dependent ecosystem, and annual treatments prevented open portions of the preserve from succeeding to oak openings. However, in the last two centuries the land has been heavily manipulated. The mesic prairie was plowed for agriculture and nearly all the trees on the upland sites were removed for fuel at the same time. The farmers also grazed livestock on the steep hills and areas of the wetlands. Burn treatments ceased in the 1950's, and the land was left untouched. In the last 50 years much of the land surrounding the preserve has been subdivided into residential plots.

Presently, other disturbances affect the landscape. Light pollution has become an issue, as has the noise associated with the high number of trucks that pass by the preserve. Portions of the restored mesic prairie have been subjected to repeated fire treatments in recent years. Additionally, woody invasives have been routinely cut from various sections of the preserve by volunteers. Herbicide stump applications have occurred intermittently along with the shrub removal, but the encroachment of problematic species has occurred at a greater rate than the treatments applied. There are also thick patches of walnut trees sprouting up in several locations along the historical crop field margins which threaten to eliminate recently restored prairie habitat. Herbivory by deer is another concern due to their overpopulation, and the Michigan Audubon Society is considering bringing in sharpshooters to cull the population.

Animal signs and sightings



Figure 8. A deer at the Bernard W. Baker Sanctuary. March 28, 2021

Deer are common in the preserve and were observed on multiple occasions. Deer paths were visible cutting through the prairies and the wetlands, and depressions where they rested were easy to identify. One Chinese mantis (*Tenodera sinensis*) observation was recorded on iNaturalist during the second site visit. Insects and small mammals are abundant everywhere in the preserve.

The preserve is a hotspot of ornithological activity, with Sandhill Cranes (*Antigone canadensis*), Canada Geese (*Branta canadensis*), and various duck species (*Anatidae spp.*) flying overhead during each site visit. The nesting cranes at the Great Marsh can be heard at sunset. Additionally, nine total surveys were conducted in the late spring and early summer of 2021 to assess avian species richness and diversity during a migration period, and 69 total species were recorded at the site during this time. This data was collected as part of an ongoing master's project overseen by University of Michigan graduate students. The table below has been condensed to account for species richness only.

	2021 Bird Survey Data		
1	Yellow-throated vireo	35	Great crested flycatcher
2	Yellow-breasted chat	36	Great blue heron
3	Yellow warbler	37	Gray catbird
4	Wood thrush	38	Field sparrow
5	Wood duck	39	European starling
6	Willow flycatcher	40	Eastern wood pewee
7	Wild Turkey	41	Eastern towhee
8	White-breasted nuthatch	42	Eastern phoebe
9	Warbling vireo	43	Eastern kingbird
10	Turkey Vulture	44	Eastern bluebird
11	Tufted titmouse	45	Downy woodpecker
12	Trumpeter swan	46	Crow
13	Tree swallow	47	Common yellowthroat
14	Swamp sparrow	48	Common grackle
15	Song sparrow	49	Cliff swallow
16	Scarlet tanager	50	Chipping sparrow
17	Sandhill crane	51	Chimney swift
18	Rose-breasted grosbeak	52	Cedar waxwing
19	Red-winged blackbird	53	Carolina wren
20	Red-headed woodpecker	54	Canada goose
21	Red-eyed vireo	55	Brown-headed cowbird
22	Red-bellied woodpecker	56	Brown thrasher
23	Pine warbler	57	Blue-winged warbler
24	Pileated woodpecker	58	Blue jay
25	Northern flicker	59	Blue-gray gnatcatcher
26	Northern cardinal	60	Black-throated green warbler
27	Mute swan	61	Black-capped chickadee
28	Mourning dove	62	Blackburnian warbler
29	Mallard	63	Barn swallow
30	Least flycatcher	64	Baltimore oriole
31	Killdeer	65	Bald eagle
32	Indigo bunting	66	American woodcock
33	House wren	67	American robin
34	Hairy woodpecker	68	American goldfinch

Management recommendations



Figure 9. Tree Swallows gather near a pond at the Bernard W. Baker Sanctuary. March 28, 2021

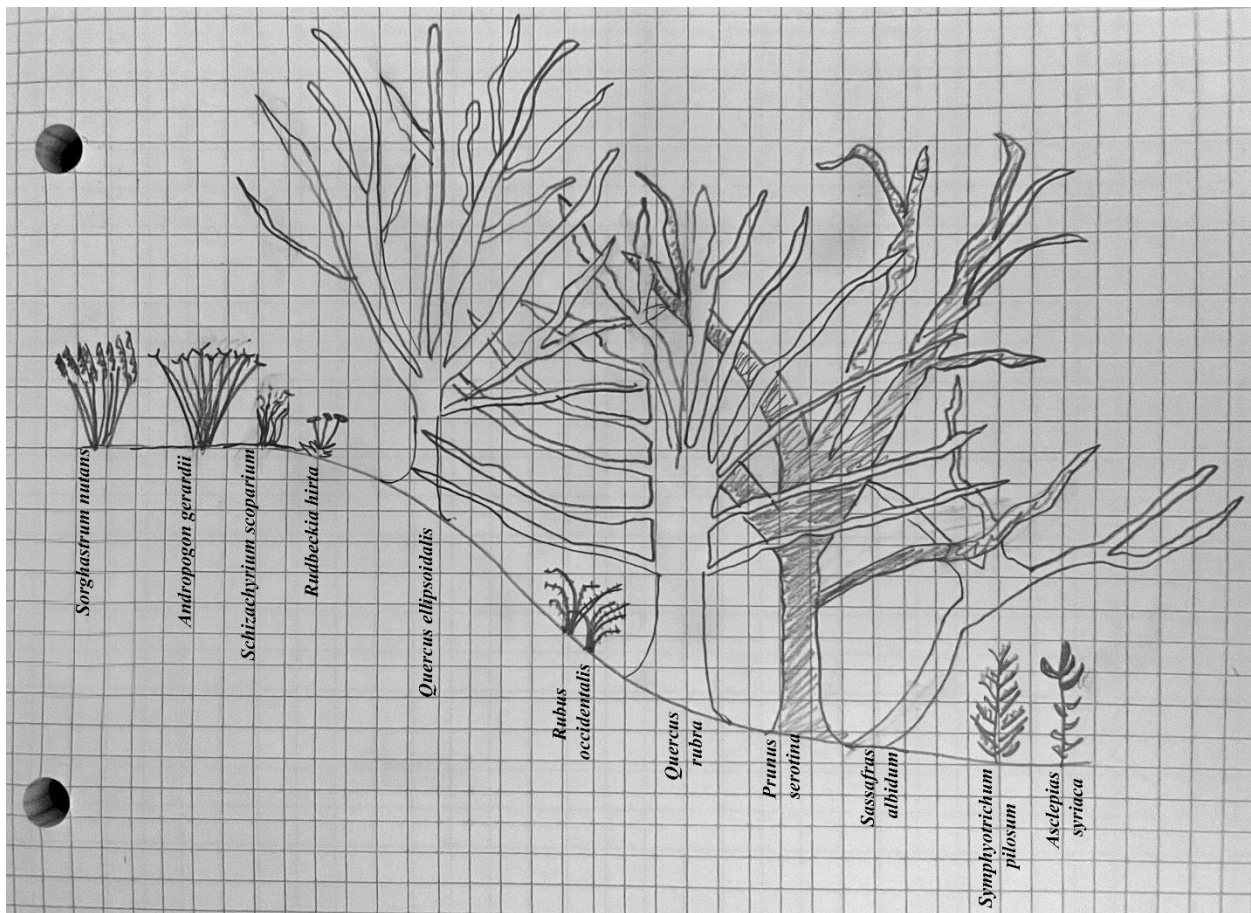
Management recommendations parallel the goals of the restoration projects envisioned by the Michigan Audubon Society. Several patches of the upland portion of the preserve that were historically oak openings have been partially restored to mesic prairie, and large, solitary oaks punctuate the landscape. It is imperative that the woody invasive shrubs which are encroaching on the site be controlled, either with brush hogging treatments, prescribed burns, stump cutting with herbicide application, or a mixture of the three.

The Great Marsh and its associated wetland complex are now unique in Michigan, and management activities should focus on the long-term preservation of the site. Key to the resilience of this ecosystem is the protection of groundwater recharge areas and the maintenance of the buffer of natural communities that encircles the wetlands. Like the oak savanna uplands, plant diversity in this section of the preserve can be encouraged with the reintroduction of fire. This would remove much of the dense aboveground debris that has collected throughout the years, allowing light to penetrate to the ground level so that seeds from the seed bank can germinate. Additionally, efforts to cull the large deer population in the preserve would lower rates of herbivory and provide a window for native plants to establish once again. Wetland losses in the United States have been severe due to drainage and agriculture, with particularly severe reductions throughout the Midwest, endowing additional

significance to this site. In the two centuries since European settlement, these “farm belt” states have lost over 36 million acres of wetlands, or one third of the total wetland area in the United States (Dahl, 1990). Without sufficient undisturbed wetland sites that lack pollution the migratory and reproductive capabilities of numerous avian species will be affected.

Any management plan implemented by the Michigan Audubon Society will also require a monitoring program to observe temporal changes in the landscape relative to restoration treatments. Maintaining a robust network of volunteers will be crucial in this endeavor, as there is no staff at the preserve to organize activities. Citizen science applications such as iNaturalist and eBird, which are steadily gaining in popularity as technology improves, can enable volunteers to record data in the field and could encourage participation. Strengthening a volunteer network at the preserve will also improve the ecological literacy of those who participate, renewing their relationship with nature in novel ways and creating new opportunities for the community members to meet and socialize. Shared experience and meaning making lead to contemplation and personal discovery, and volunteers who participate in ecological restoration projects are likely to see value in a healthy landscape (Clewel & Aronson 2007).

Drawing



Discussion

The Bernard W. Baker Sanctuary is a dynamic ecosystem containing of several historic natural communities. The lowland sites are primarily comprised of a matrix of submergent and emergent marsh, wet meadow, prairie fen, and rich tamarack swamp. They had been subject to annual fire treatments for millennia up until about seventy years ago. The historic oak savanna upland was destroyed in the nineteenth century and replaced with farmland. It has been partially restored throughout the past three decades and now provides ecosystem services to support a diverse population of insects and other wildlife. Floral data collected from throughout this portion of the preserve was utilized to calculate an FQI score of 24.8, indicating that there is significant potential for this site to evolve into high quality mesic prairie if additional restoration efforts are undertaken. Woody invasive shrubs are a major concern and should be prioritized for removal from both this section and the wetland complex as well. Fire treatments should be reinstated throughout the preserve, which will encourage the proliferation of native species whose seeds either require heat or sunlight to germinate. This will also promote the establishment and longevity of fire-adapted species such as oak, which are in danger of becoming extirpated from the landscape if management activities are permanently ceased, while also diminishing the dominance of fire-sensitive invasives. Additionally, native seeds could be collected from nearby sites and broadcast in the prairie following burn treatments. This is one of many restoration-related activities that could be accomplished with a healthy volunteer presence on the land.

Deer herbivory is a constant pressure on the system, and it is important that the Michigan Audubon Society consult with professionals to create a plan to control their population. The preserve is a haven for wildlife, and all management decisions should be focused on to creating and preserving safe, clean habitat for nesting and migrating avian species. Additionally, efforts should be undertaken to work with local governments and businesses to reduce the light pollution nearby, as that can affect the migratory patterns of birds.

The Baker Sanctuary is situated within a highly anthropogenically-developed landscape and has a complicated land use history, yet it remains as one of the few remaining habitats of its kind in Michigan. Big Marsh Lake provides a migratory stop-over for dozens of avian species and is a vital nesting habitat for Sandhill Cranes. The restored mesic prairie and oak-hickory forests are important for countless additional species and are also rare in the state. With appropriate management this site will continue to improve ecologically as well as provide a location for nearby residents to develop an appreciation for the natural communities that occupy their landscape.

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